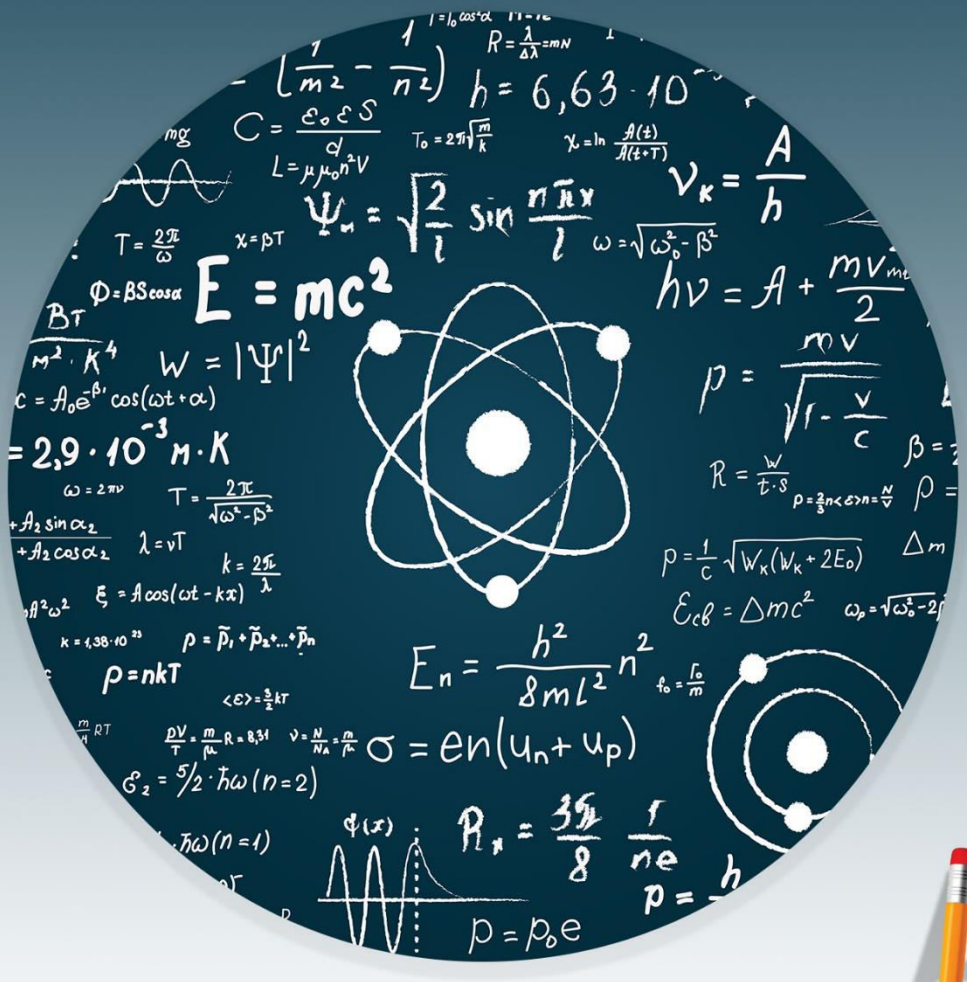
PHYSICS



WORKSHEET-1

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-1

Topics:- Coulomb's Law, Electric Field Strength, Electric Potential & Potential Gradient, Electric and Gravitational Force, Capacitors & Energy Stored in Capacitor

USE THIS SPACE FOR SCRATCH WORK

Q.1 For a capacitor the charge per unit volt is called:

A) Charge density
C) Capacitance
B) Charge per unit volume
D) None of these

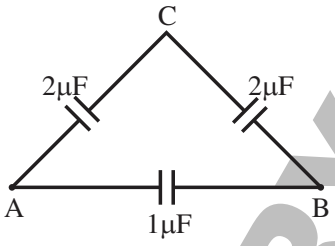
Q.2 Farad is unit of:

A) Charge
C) Current
B) Potential
D) Capacitance

Q.3 A capacitor is a perfect insulator for:

A) A.C
C) Both "A" and "B"
B) Pure D.C
D) Pulsating D.C

Q.4 What is the effective capacitance between A and B?



A) 2 μF
C) 1.0 μF
B) 1.5 μF
D) 0.5 μF

Q.5 The Coulomb's law is:

$$\vec{F} = \frac{1}{4\pi\varepsilon_\circ}\frac{q_1 q_2}{r^2}\hat{r}$$

The units of "$\varepsilon_\circ$" are:

A) $N\ m^{-2}\ C^{-2}$
C) $N^{-1}\ m^{-2}\ C^{2}$
B) $N\ m^{-2}\ C^{2}$
D) None of these

Q.6 A $50\ \mu F$ capacitor has a potential difference of 8 volts across it, The charge on the capacitor will be:

A) $4\times10^{-4}\ C$
C) $4\times10^{4}\ C$
B) $4\times10^{-3}\ C$
D) $4 \times 10^{3}\ C$

Q.7 Three capacitors of capacitance $3\ \mu F$ each are connected in parallel the equivalent capacitance will be:

A) $9\ \mu F$
C) $27\ \mu F$

B) $\frac{1}{3}\ \mu F$ D) $2\ \mu F$

Q.8 If $6\ \mu F$, $4\ \mu F$ and $2\ \mu F$ capacitors are connected is series the equivalent capacitance is given by:

A) $\frac{12}{11}\ \mu F$ C) $\frac{6}{11}\ \mu F$

B) $\frac{11}{12}\ \mu F$ D) $\frac{11}{6}\ \mu F$

Q.9 The study of charges at rest under the action of electric forces is called:

A) Electromagnetics C) Electricity

B) Electrostatics D) None of these

Q.10 The existence of an object is primarily because of:

A) Magnetic force C) Gravitational force

B) Electric force D) Nuclear force

Q.11 Which one is sure test for the presence of charge on a body?

A) Attraction C) Both A and B

B) Repulsion D) None of these

Q.12 Coulomb's force:

A) Obeys inverse square law

B) Depends on magnitudes of charges

C) Depends on medium between charges

D) All of these

Q.13 A charge q is divided into two parts 'q_1 *and* $(q-q_1)$'. What is the ratio $\frac{q}{q_1}$ so that force between the two parts placed at a given distance is maximum?

A) 1:1 C) 1:2

B) 2:1 D) 1:4

Q.14 The ratio of the force between two charges in vacuum to that the force between two same charges when a medium is placed between them is:

A) ε_r:1 C) $\varepsilon_\circ$:1

B) 1:ε_r D) 1: $\varepsilon_\circ$

Q.15 The ratio of electric force to electric field strength gives the units of:

USE THIS SPACE FOR SCRATCH WORK

A) Current C) Time

B) Charge D) None of these

Q.16 The work done in carrying a unit positive charge from one point to other in electric field keeping the charge in equilibrium is called:

A) Electric potential energy

B) Electric potential difference

C) Electric field strength

D) None of these

Q.17 An ECG records _____ between points on human skin.

A) Current C) Voltage

B) Charge D) Electric field

Q.18 Which statement is true for two oppositely charged metal plates?

A) Electric field is constant between plates

B) Potential difference is constant between plates

C) Electric potential is zero at mid-point of plates

D) All of these

Q.19 If a charge of 5 C is moved against an electric field of 10 N C^{-1} through a distance of 5 m, the P.E gained by charge is:

A) 25 J C) 2 J

B) 200 J D) 250 J

Q.20 Two point charges each of magnitude "q" and opposite sign are separated by distance "2d". Which one of following statement is true?

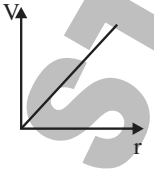
A) Electric Potential at midpoint of charges is zero

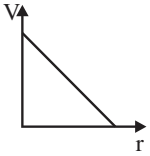
B) Electric field at midpoint of charges is not zero

C) Potential difference (due to electric potentials of both charges) at midpoint is not zero

D) All of these

Q.21 The graph which correctly describes the relation between electric potential "V" at a point due to point charge and distance "r" from point charge is:

A) 

C) 

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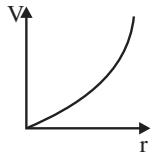
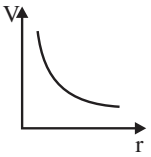
B) 

D) 

Q.22 If the magnitude of a point charge is doubled and distance of a point from point charge is halved, then electric potential and electric field at that point becomes:

A) Two times each

B) Two times & four times

C) Four times & Eight times

D) None of these

Q.23 A particle carrying a charge of 10e falls through a potential difference of 5 V, the energy gained by it is:

A) 50 eV

B) 5 eV

C) 3.2×10^{-18}J

D) Both A and C

Q.24 If a positive charge is brought near the positive plate of a capacitor, its P.E will:

A) Increase

B) Decrease

C) Remain same

D) None of these

Q.25 If a charge of +10 C is stored on either the plate of a parallel plate capacitor of capacitance 5 μF. Then energy stored in the capacitor in mega Joules is:

A) 10

B) 15

C) 20

D) 5

Q.26 The coulomb's force between two charges "q_1=2 μC" and "q_2" is 2 N. The distance between them is 3 m, what is the charge q_2?

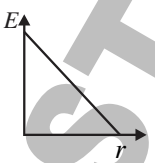
A) 1×10^{0} C

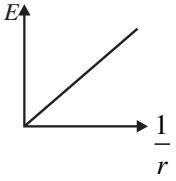
B) 1×10^{-3} C

C) 2×10^{2} C

D) 4×10^{-2} C

Q.27 While moving from positive plate of a charged capacitor towards its negative plate, the electric field "E" varies with distance covered "r" as:

A) 

C) 

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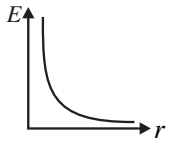
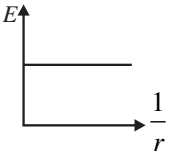
B) 

D) 

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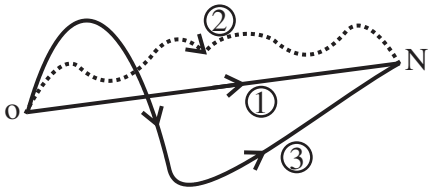
Q.28 In the region of an electric field a charge is moved from "O" to "N" via three different paths W_1, W_2 and W_2 denote the work done along three paths. Then:



A) $W_1<W_2<W_3$ C) $W_1=W_2>W_3$

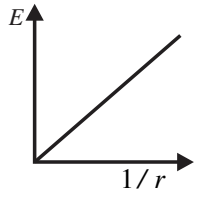
B) $W_1>W_2>W_3$ D) $W_1=W_2=W_3$

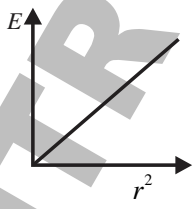
Q.29 The electric field strength between two oppositely charged parallel plates is E. If the distance between the plates is halved and potential difference is doubled, then the electric field strength becomes:

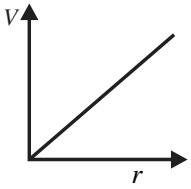
A) E C) 4E

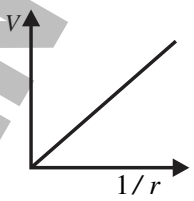
B) 2E D) 8E

Q.30 Which of the following is correct graph for a point charge?

A) 

C) 

B) 

D) 

Q.31 Five identical capacitors connected in series have an equivalent capacitance of 4 µF. If all of them are now connected in parallel across a 400 V source, the total energy stored in them will be:

A) 2 J C) 6 J

B) 4 J D) 8 J

Q.32 How three capacitors of 2 µF each be connected to have an equivalent capacitance of 3 µF?

A) All the capacitors should be connected in series

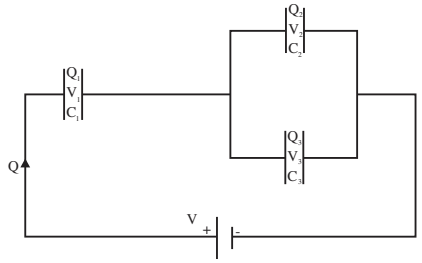
B) All the capacitors should be connected in parallel

C) Two capacitors in series and one is parallel across their series combination

D) Two capacitors in parallel and one is in series with their parallel combination

Q.33 In the diagram below are shown three capacitors C_1, C_2, C_3 joined to a battery. With symbols having their usual meanings, the correct conditions will be:

USE THIS SPACE FOR SCRATCH WORK



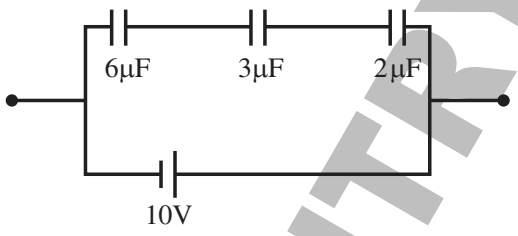
A) $Q_1=Q_2=Q_3$ and $V_1=V_2=V_3=V$

B) $Q_1=Q_2+Q_3$ and $V=V_1+V_2+V_2$

C) $Q_1=Q_2+Q_3$ and $V=V_1+V_2$

D) $Q_2=Q_3$ and $V_2=V_3$

Q.34 In figure below, the charge on 3 μF capacitor is:



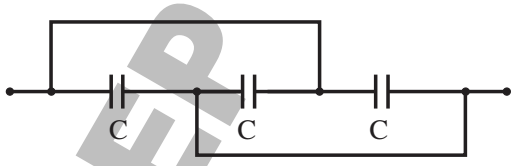
A) 3 μC

B) 5 μC

C) 10 μC

D) Zero

Q.35 What is the equivalent capacitance of the combination shown:



A) 3C

B) C

C) $\frac{C}{2}$

D) $\frac{C}{3}$

Q.36 Which of the following is similarity between electric and

gravitational force?

A) Both are Conservative forces

B) Both are long range forces

C) Both obey inverse square law

D) All of these

ANSWER KEY (Worksheet-1)							
1	C	11	B	21	D	31	D
2	D	12	D	22	C	32	C
3	B	13	B	23	A	33	C
4	A	14	A	24	A	34	C
5	C	15	B	25	A	35	A
6	A	16	B	26	B	36	D
7	A	17	C	27	D		
8	A	18	D	28	D		
9	B	19	D	29	C		
10	B	20	D	30	D		

SOLUTIONS

Unit – 9 (WS-1)

Q.1 Answer is "C"

Solution:- $Q = CV \Rightarrow C = \frac{Q}{V}$

$$1 \text{ farad} = \frac{1 \text{ coulomb}}{1 \text{ volt}}$$

Q.2 Answer is "D"

Solution:- Capacitance of capacitor has the unit "Farad" which is defined as:

$$1 \text{ farad} = \frac{1 \text{ coulomb}}{1 \text{ volt}}$$

Q.3 Answer is "B"

Solution:- Capacitor has infinite reactance for pure D.C. i.e $X_c = \frac{1}{2\pi fC}$

As $f_{D.C} = 0, \text{so} \Rightarrow X_c = \infty$

Q.4 Answer is "A"

Solution:-

The equivalent capacitance between A and B is:

$$C_{AB} = \left(\frac{2\times 2}{2+2}\right) + 1 = 2\ \mu F$$

Q.5 Answer is "C"

Solution:- The units of "$\varepsilon_\circ$" are reciprocal of the units of "k".

Q.6 Answer is "A"

Solution:- $Q = CV$

Q.7 Answer is "A"

Solution:- $C_e = nC$

Q.8 Answer is "A"

Solution:- $\frac{1}{C_e} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

Q.9 Answer is "B"

Solution:- "The study of charges at rest under the action of the electric force is named as electrostatics".

Q.10 Answer is "B"

Solution:- Matter is composed of atoms and existence of atom is primarily due to electric forces present in it.

Q.11 Answer is "B"

Solution:- If a test charge is brought near an object (about which we are going to find whether it is charged or not) and test charge is attracted towards it, this leads to two possibilities:

i. That object is oppositely charged

ii. That object is neutral but because of Electrostatic Induction it shows attraction for test charge.

Hence, attraction is not a sure test to find whether an object is charged or not.

Q.12 Answer is "D"

Solution:- Coulomb's law is given as

$$F = \frac{1}{4\pi\varepsilon_\circ\varepsilon_r}\frac{q_1 q_2}{r_2}$$

$$F \propto q_1 q_2 \ , \ F \propto \frac{1}{r^2} \ , \ F \propto \frac{1}{\varepsilon_r}$$

Q.13 Answer is "B"

Solution:- If the charge q is divided into equal parts, the product of these parts and electric force between them will be maximum. i.e $\Rightarrow q_1 = q - q_1$

Q.14 Answer is "A"

Solution:- The Coulomb's force in case of vacuum and medium is given as:

$$F_{vac} = \frac{1}{4\pi\varepsilon_\circ}\frac{q_1 q_2}{r^2}; F_{med} = \frac{1}{4\pi\varepsilon_\circ\varepsilon_r}\frac{q_1 q_2}{r^2}$$

Taking ratio

$$\frac{F_{vac}}{F_{med}} = \varepsilon_r$$

Q.15 Answer is "B"

Solution:- Electric field strength is defined as:

$$E = \frac{F}{q} \Rightarrow \frac{F}{E} = q = \text{coulomb}$$

Q.16 Answer is "B"

Solution:- Electric potential difference is defined as:

$$\Delta V = \frac{W_{AB}}{q_\circ}$$

Q.17 Answer is "C"

Solution:- ECG records electric voltage and display it on graph.

Q.18 Answer is "D"

Solution:- Between two oppositely charged metal plates:

i. $E = -\frac{\Delta V}{\Delta r} = \text{constant}$

ii. $\Delta V = -E\Delta r = \text{constant}$

iii. $V_{mid} = V_+ + V_- = \frac{kq}{r} - \frac{kq}{r} = 0$

Q.19 Answer is "D"

Solution:- $\Delta V = \frac{\Delta U}{q}$ …… (i)

Also $\Delta V = E\Delta r$ …… (ii)

Compare (i) and (ii) and solve for P.E.

Q.20 Answer is "D"

Solution:-

i. $V_{mid} = V_+ + V_- = \left(\frac{kq}{d}\right) + \left(\frac{k(-q)}{d}\right) = 0$

ii. $\vec{E}_{mid} = \vec{E}_+ + \vec{E}_- \neq 0$

iii. $\Delta V = V_+ - V_- = \left(\frac{kq}{d}\right) - \left(\frac{k(-q)}{d}\right) \neq 0$

Q.21 Answer is "D"

Solution:- $V \propto \frac{1}{r}$

Q.22 Answer is "C"

Solution:- $E = \frac{kq}{r^2}, V = \frac{kq}{r}$

Q.23 Answer is "A"

Solution:- K.E = QΔV

Q.24 Answer is "A"

Solution:- If a charge is moved against the coulomb force, then P.E increases and vice versa.

Q.25 Answer is "A"

Solution:- Energy stored is given as:

$$E = \frac{1}{2}\frac{Q^2}{C}$$

Q.26 Answer is "B"

Solution:- Use Coulomb's law;

$$F = k\frac{q_1 q_2}{r_2} \Rightarrow q_2 = \frac{Fr^2}{kq_1}$$

Put the values and solve for q_2.

Q.27 Answer is "D"

Solution:- Electric field between capacitor plates is constant at every point. So, graph of electric field strength will be a horizontal straight line whether it is plotted against "r" or "1/r".

Q.28 Answer is "D"

Solution:- Electric field just like gravitational field is conservative so, work done is independent of path followed.

Q.29 Answer is "C"

Solution:- Electric field strength is given as

$$E = \frac{\Delta V}{\Delta r}$$

If $\Delta V' = 2\Delta V$ and $\Delta r' = \frac{1}{2}\Delta r$ then

$$E' = \frac{2\Delta V}{\frac{1}{2}\Delta r} = 4\frac{\Delta V}{\Delta r}$$

$$E' = 4E$$

Q.30 Answer is "D"

Solution:- $V = \frac{kq}{r} \Rightarrow V \propto \frac{1}{r}$

Q.31 Answer is "D"

Solution:- Series Equivalent

$$C_{s,e} = \frac{C}{n} = \frac{C}{5} = 4\ \mu F$$

$$C = 20\ \mu F$$

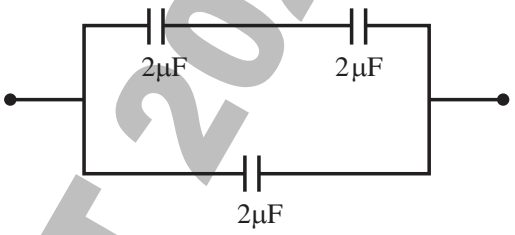
Now if these five capacitors each of capacitance 20 μF are connected in parallel across 400 V source, then

$$C_{p,e} = nC = 5C = 100\ \mu F$$

$$Energy\ stored = \frac{1}{2}C_{p,e}V^2$$

Q.32 Answer is "C"

Solution:-



$$C_e = \left(\frac{2\times 2}{2+2}\right) + 2 = 3\ \mu F$$

Q.33 Answer is "C"

Solution:- In series charge is same and in parallel combination the voltage is same.

Q.34 Answer is "C"

Solution:- In series combination;

i. $Q_{6\mu F} = Q_{3\mu F} = Q_{2\mu F} = C_e V$

ii. $\frac{1}{C_e} = \frac{1}{6} + \frac{1}{3} + \frac{1}{2}$

Find C_e from (ii) and put in (i) to find Q.

Q.35 Answer is "A"

Solution:- All capacitors are in parallel, so their parallel equivalent is given as:

$$C_e = nC = 3C$$

Q.36 Answer is "D"

Solution:- Read properties of electric and gravitational forces.

STEP

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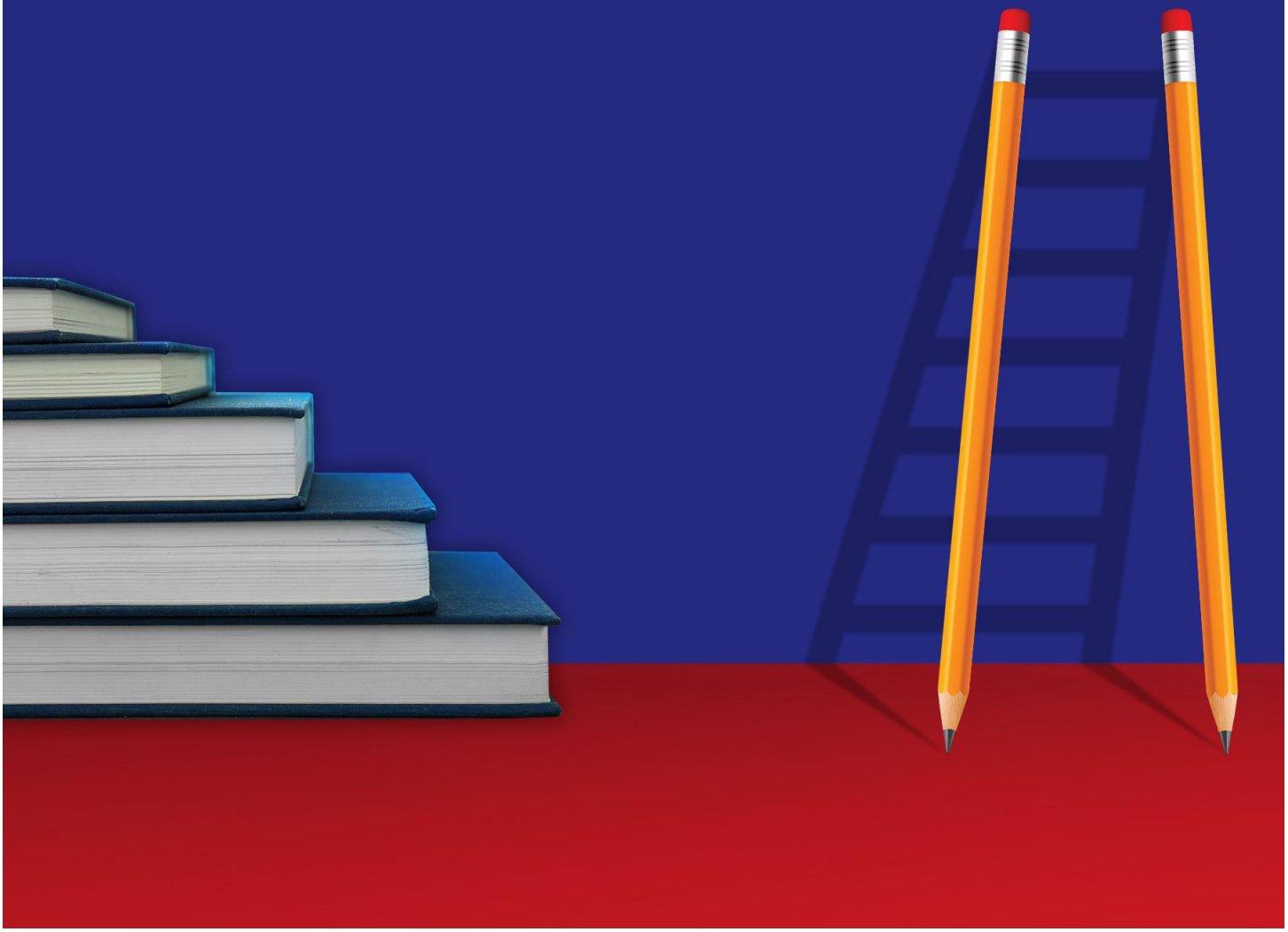

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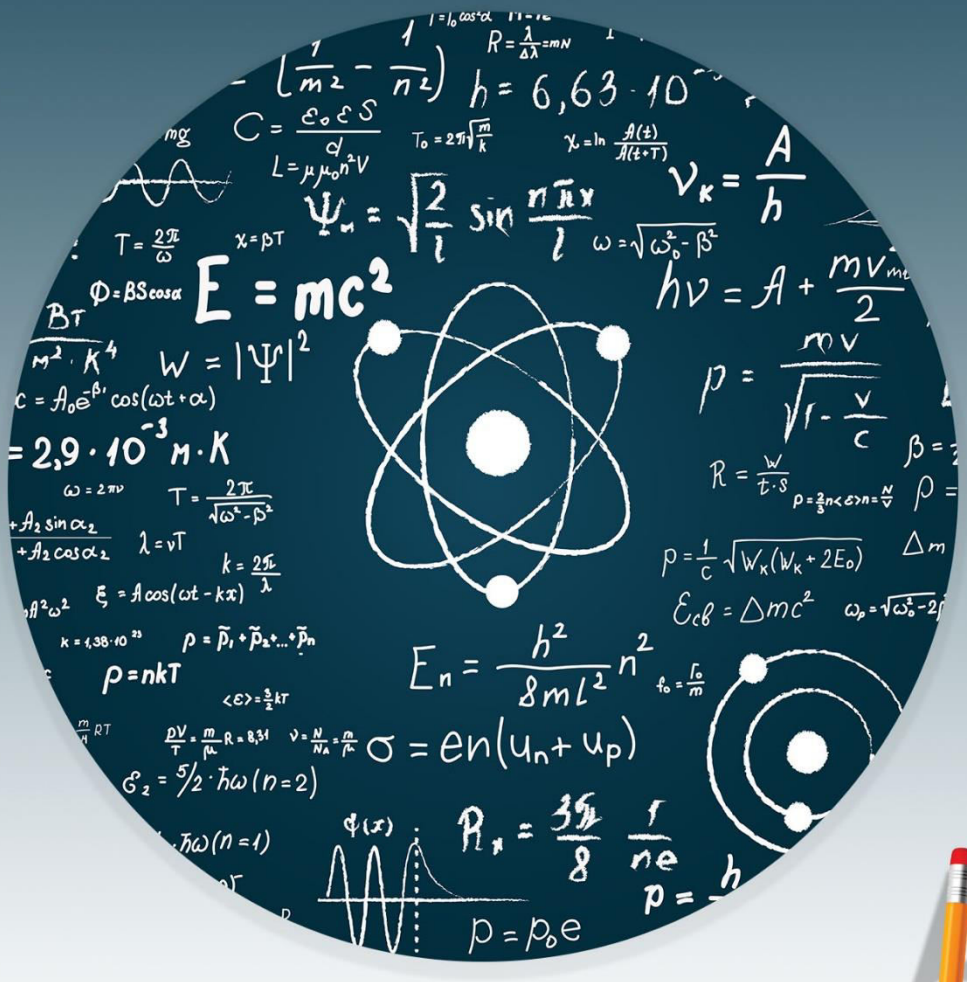


WORKSHEET-2

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-02

Topics:- Current, Ohm's Law, Combination of Resistors, Resistivity, Potential Difference & e.m.f, Power Dissipation, Kirchhoff's Rules, Potentiometer

USE THIS SPACE FOR SCRATCH WORK

Q.1 The graphical representation of ohm's law is:

A) Hyperbola C) Parabola

B) Ellipse D) Straight Line

Q.2 ohm is defined as:

A) volt / ampere C) ampere / volt

B) volt / coulomb D) joule / coulomb

Q.3 The resistance of a meter cube of the substance is called:

A) Resistivity C) Permittivity

B) Conductivity D) None of these

Q.4 The S.I unit of resistivity is:

A) ohm-m C) ohm-m^3

B) ohm-m^2 D) ohm-cm

Q.5 When the resistances are connected in series the equivalent resistance is equal to?

A) Sum of the reciprocal of the individual resistances

B) Sum of individual resistances

C) Product of the individual resistances

D) Can't be predicted

Q.6 The potential difference across resistances in series combination is:

A) Always same C) May be same or different

B) Always different D) None of these

Q.7 Three resistances 500 ohm, 350 ohm and 500 ohm are connected in series the equivalent resistance will be:

A) 1300 Ω C) 650 Ω

B) 1350 Ω D) 1400 Ω

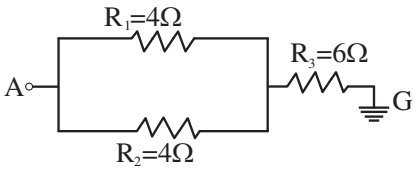
Q.8 The resistance of a 60 watt bulb in a 120 volt line is:

A) 240 Ω C) 60 Ω

B) 220 Ω D) 200 Ω

USE THIS SPACE FOR SCRATCH WORK

Q.9 In the circuit shown



If voltage applied at A is 20 V then what would be the resultant current passing through R_3.

A) 4 A C) 2.5 A

B) 6 A D) 10 A

Q.10 If a battery of 9 V is connected across 2.0 Ω resistance, then what would be the resultant current?

A) 4.0 A C) 3.5 A

B) 4.5 A D) 5.0 A

Q.11 How many different resistances are possible with two equal resistors?

A) 2 C) 4

B) 3 D) 5

Q.12 Internal resistance of the cell is caused due to the:

A) Static charges C) Electrolyte

B) Electrodes D) None of these

Q.13 A voltmeter directly connected across a battery in a circuit where current is flowing, will measure:

A) Emf

B) Terminal potential difference

C) Internal resistance

D) None of these

Q.14 Value of current for ideal short circuit is:

A) Zero C) Both are possible

B) Infinity D) Non-zero but finite

Q.15 Value of current is _____ for open circuit.

A) Zero C) Either A or B

B) Infinity D) Non-zero but finite

Q.16 For close circuit (with load applied across battery), the emf E of battery is related with terminal potential difference V_t as:

A) $E > V_t$ C) $E = V_t$

B) $E < V_t$ D) All of these

USE THIS SPACE FOR SCRATCH WORK

Q.17 **Kirchhoff's 1st rule is in accordance with law of conservation of:**

A) Energy C) Mass

B) Momentum D) Charge

Q.18 **When the battery is being charged, then emf E and terminal Potential difference V_t are related as:**

A) $E > V_t$ C) $E = V_t$

B) $E < V_t$ D) Any of these

Q.19 **The potential difference between the terminals of a battery in open circuit is 2.2 V. When it is connected across a resistance of 5 Ω, the potential falls to 1.8 V. The current drawn from battery is:**

A) 0.46 A C) 0.26 A

B) 0.54 A D) 0.36 A

Q.20 **Referring to Q .19, the internal resistance of battery is:**

A) 3.1 Ω C) 1.1 Ω

B) 2.1 Ω D) 0.51 Ω

Q.21 **In the rules for finding the potential changes, if a resistor is traversed in the direction of current, the change in potential is:**

A) Zero C) Positive

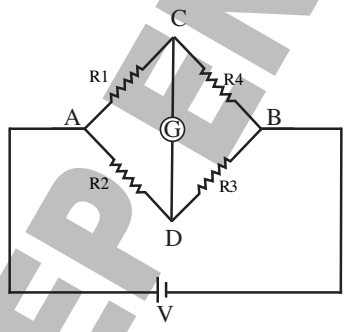
B) Negative D) Any of these

Q.22 **Kirchhoff's 2nd rule is based on:**

A) Energy conservation C) Charge conservation

B) Mass conservation D) Momentum conservation

Q.23 **In the bridge shown below:**



The final expression of balanced bridge is:

A) $\frac{R_1}{R_2} = \frac{R_3}{R_4}$ C) $\frac{R_2}{R_4} = \frac{R_1}{R_3}$

B) $\frac{R_1}{R_3} = \frac{R_4}{R_2}$ D) $\frac{R_1}{R_4} = \frac{R_2}{R_3}$

USE THIS SPACE FOR SCRATCH WORK

Q.24 **In the bridge circuit shown in Q.23, if $R_1=R$, $R_2=R$, $R_3=2R$ and $R_4=2R$, then the effective Resistance between A and B is:**

A) $\frac{5R}{2}$ C) $\frac{3R}{2}$

B) $\frac{7R}{2}$ D) $\frac{4R}{3}$

Q.25 **Referring to the values of resistances in Q.24, the effective resistance between C and D is:**

A) $\frac{5R}{2}$ C) $\frac{3R}{2}$

B) $\frac{7R}{2}$ D) $\frac{4R}{3}$

Q.26 **Referring to the Q.24, the net current through Galvanometer is:**

A) Zero C) Half of maximum

B) Maximum D) Can't be predicted

Q.27 **Wheatstone bridge is based on Kirchhoff _____.**

A) 1^{st} C) 3^{rd}

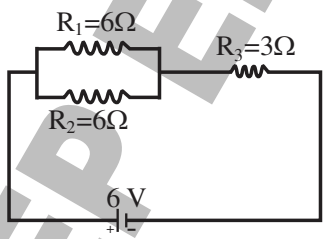
B) 2^{nd} D) 4^{th}

Q.28 **A charge of 90 C passes through a wire in 1 hour and 15 minutes. What is the current in the wire?**

A) 1 mA C) 20 mA

B) 5 mA D) 10 mA

Q.29 **Find the equivalent resistance of the circuit:**



A) 3 Ω C) 6 Ω

B) 12 Ω D) 4 Ω

Q.30 **Referring to Q.29, the total current drawn from source is:**

A) 0.5 A C) 1 A

B) 2 A D) 0.25 A

USE THIS SPACE FOR SCRATCH WORK

Q.31 **Referring to Q.29, the current passing through R_1 is:**

A) 0.5 A C) 1 A

B) 2 A D) 0.25 A

Q.32 **Referring to Q.29, the current passing through R_2 is::**

A) 0.5 A C) 1 A

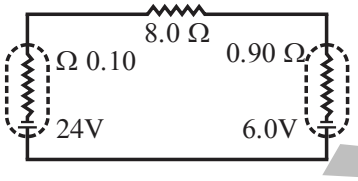
B) 2 A D) 0.25 A

Q.33 **Referring to Q.29, the current passing through R_3 is:**

A) 0.5 A C) 1 A

B) 2 A D) 0.25 A

Q.34 **Calculate terminal potential difference of 24 V cell in circuit:**



A) 24.2 V C) 24 V

B) 23.8 V D) 22.6 V

Q.35 **Referring to Q.34, Calculate terminal potential difference of 6 V cell in circuit:**

A) 4.2 V C) 7.8 V

B) 5.5 V D) 6 V

Q.36 **2×10^6 electrons pass through a conductor in 1 ms. Find electric current flowing through conductor:**

A) 32×10^{-9} A C) 3.2×10^{-10} A

B) 32×10^{-10} A D) 0.32×10^{-10} A

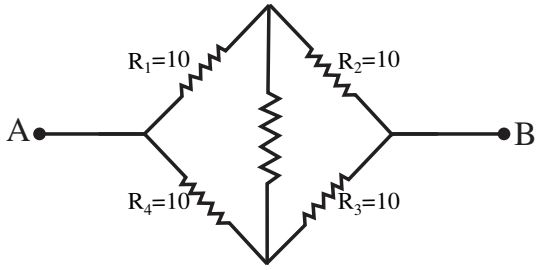
Q.37 **A carbon resistor is connected to a battery of 50 V and 2 A current is passing through it. If voltage is increases to 75 V, the current will become:**

A) 3 A C) 4.5 A

B) 1.5 A D) 6 A

USE THIS SPACE FOR SCRATCH WORK

Q.38 If the resistance of each resistor is 10 ohm in the following figure, then what will be the effective resistance between points 'A' and 'B':



A) 40 ohm
C) 30 ohm
B) 50 ohm
D) 10 ohm

Q.39 The ratio of effective resistances of two identical resistors, first connected in series then in parallel is:

A) 1:2
C) 4:1
B) 2:1
D) 1:4

Q.40 A wire carrying electronic current is:

A) Negatively charged
C) Electrically neutral
B) Positively charged
D) Any of these

Q.41 To compare two emfs in potentiometer, we use:

A) $\frac{E_1}{E_2} = \frac{\ell_2}{\ell_1}$
C) $\frac{E_1}{E_2} = \frac{r_2}{r_1}$
B) $\frac{E_1}{E_2} = \frac{\ell_1}{\ell_2}$
D) $\frac{E_1}{E_2} = \frac{\ell_1 \ell_2}{\ell_1 + \ell_2}$

ANSWER KEY (Worksheet-02)									
1	D	11	B	21	B	31	A	41	B
2	A	12	C	22	A	32	A		
3	A	13	B	23	D	33	C		
4	A	14	B	24	C	34	B		
5	B	15	A	25	D	35	C		
6	C	16	A	26	A	36	C		
7	B	17	D	27	B	37	A		
8	A	18	B	28	C	38	D		
9	C	19	D	29	C	39	C		
10	B	20	C	30	C	40	C		

SOLUTIONS

Unit – 9 (WS-02)

Q.1 Answer is "D"

Solution:- Graph of ohm's law is between "V" and "I". Since $V \propto I$, so, graph is straight line inclined with "V-axis".

Q.2 Answer is "A"

Solution:- By ohm's law:

$$R = \frac{V}{I}$$

$$1 \text{ ohm} = \frac{1 \text{ volt}}{1 \text{ ampere}}$$

Q.3 Answer is "A"

Solution:- Resistivity of material of wire is defined as:

$$\rho = \frac{RA}{L} \quad \rho = \frac{R\left(1\ m^2\right)}{\left(1\ m\right)}$$

Q.4 Answer is "A"

Solution:- By formula

$$\rho = \frac{RA}{L} = \frac{\Omega\ m^2}{m} = \Omega\ m$$

Q.5 Answer is "B"

Solution:- $R_e=R_1+R_2+R_3+. . . . .$

Q.6 Answer is "C"

Solution:- If resistances are same then potential is also same, otherwise it is different.

Q.7 Answer is "B"

Solution:- $R_e=R_1+ R_2+ R_3$

Q.8 Answer is "A"

Solution:- Use relation:- $P = \frac{V^2}{R}$

Q.9 Answer is "C"

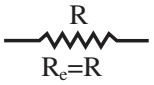
Solution:- $I = \frac{V}{R_e}$

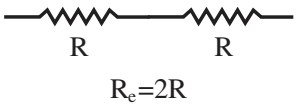
Q.10 Answer is "B"

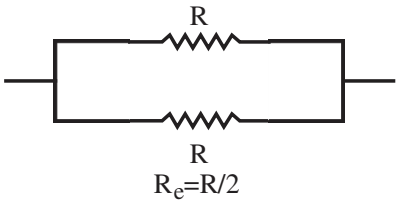
Solution:- $I = \frac{V}{R}$

Q.11 Answer is "B"

Solution:- By two resistors of equal value, following different resistances can be obtained:

i. 

ii. 

iii. 

Q.12 Answer is "C"

Solution:- Internal resistance is the hindrance which charge carriers feel while passing through electrolyte inside the battery.

Q.13 Answer is "B"

Solution:- When current is flowing through circuit, the voltmeter measures terminal potential difference. When current is not flowing, voltmeter reads emf.

Q.14 Answer is "B"

Solution:- For short circuit

$R = 0 \Rightarrow I=\infty$

Q.15 Answer is "A"

Solution:- For open circuit

$I=0 \Rightarrow R=\infty$

Q.16 Answer is "A"

Solution:- When battery is being discharged: $E = V_t + Ir$

Q.17 Answer is "D"

Solution:- Kirchhoff's first rule is another statement of law of conservation of charge.

Q.18 Answer is "B"

Solution:- When battery is being charged then

$E = V_t - Ir$

Q.19 Answer is "D"

Solution:- $V_t = IR \Rightarrow I = \frac{V_t}{R} = \frac{1.8}{5}$

Q.20 Answer is "C"

Solution:- $E = V_t + Ir$

Q.21 Answer is "B"

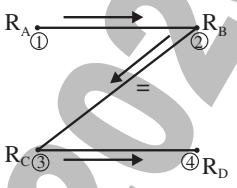
Solution:- Read rules for finding potential changes at the end of 2nd Kirchhoff's rules.

Q.22 Answer is "A"

Solution:- Kirchhoff's 2nd rule is based on law of conservation of energy.

Q.23 Answer is "D"

Solution:- Trick:



$\frac{R_A}{R_B} = \frac{R_C}{R_D}$

Q.24 Answer is "C"

Solution:- Ignore Galvanometer while finding Equivalent resistance.

Q.25 Answer is "D"

Solution:- Ignore Galvanometer while finding Equivalent resistance.

Q.26 Answer is "A"

Solution:- For balanced Bridge; $I_g=0$

Q.27 Answer is "B"

Solution:-

Principle of Wheat stone Bridge.

Q.28 Answer is "C"

Solution:- $I = \frac{Q}{t}$

Q.29 Answer is "C"

Solution:- $R_e = (R_1 \parallel R_2) + R_3$

Q.30 Answer is "C"

Solution:- $V = I R_e$

Q.31 Answer is "A"

Solution:- $I_1 = \left(\frac{R_2}{R_1 + R_2} \right) I$

Q.32 Answer is "A"

Solution:- $I_2 = \left(\frac{R_1}{R_1 + R_2}\right) I$

Q.33 Answer is "C"

Solution:- $I_3 = I_1 + I_2$

Q.34 Answer is "B"

Solution:-

Step-I

Find net current through circuit

$$I = I_{net} = \frac{V_{net}}{R_e} = \frac{24-6}{0.1+8+0.9} = 2 \text{ A}$$

Step-II

$$E = V_t + Ir$$

$$V_t = E - I_{net} r$$

$$V_t = 24 - (2)(0.1) = 23.8 \text{ V}$$

Q.35 Answer is "C"

Solution:-

Step-I

Finding net current through circuit

$$I = I_{net} = \frac{V_{net}}{R_e} = \frac{24-6}{0.1+8+0.9} = 2 \text{ A}$$

Step-II

When two batteries of different voltages are connected such that their high potential terminals or low potential terminals are combined, then smaller battery gets charged & for smaller battery;

$$E = V_t - Ir$$

$$V_t = E + Ir$$

$$V_t = 6 + (2)(0.9)$$

$$V_t = 7.8 \text{ V}$$

Q.36 Answer is "C"

Solution:-

Use:

$$I = \frac{Q}{t} = \frac{ne}{t}$$

Q.37 Answer is "A"

Solution:-

Initially

$$V = IR$$

$$R = \frac{V}{I} = \frac{50}{2} = 25\ \Omega$$

After increasing voltage

$$I' = \frac{V'}{R} = \frac{75}{25} = 3 \text{ A}$$

Q.38 Answer is "D"

Solution:-

$$R_{AB} = (10+10) \| (10+10)$$

Q.39 Answer is "C"

Solution:-

$$R_s = nR$$

$$R_P = \frac{R}{n}$$

Taking ratio

$$\frac{R_s}{R_P} = \frac{nR}{\frac{R}{n}} = n^2$$

Q.40 Answer is "C"

Solution:-

Any current carrying object is electrically neutral.

Q.41 Answer is "B"

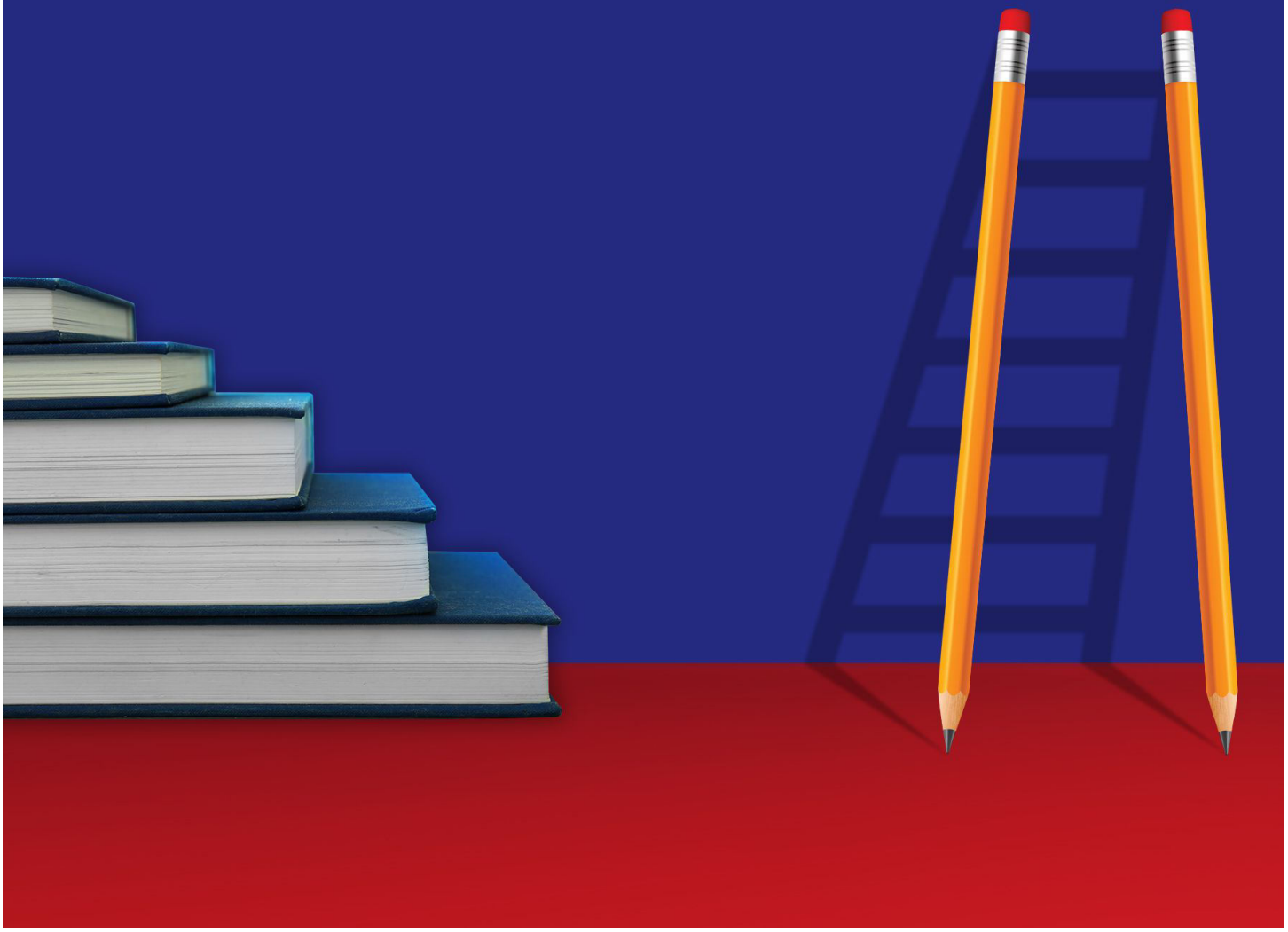
Solution:-

To compare two emf we use:

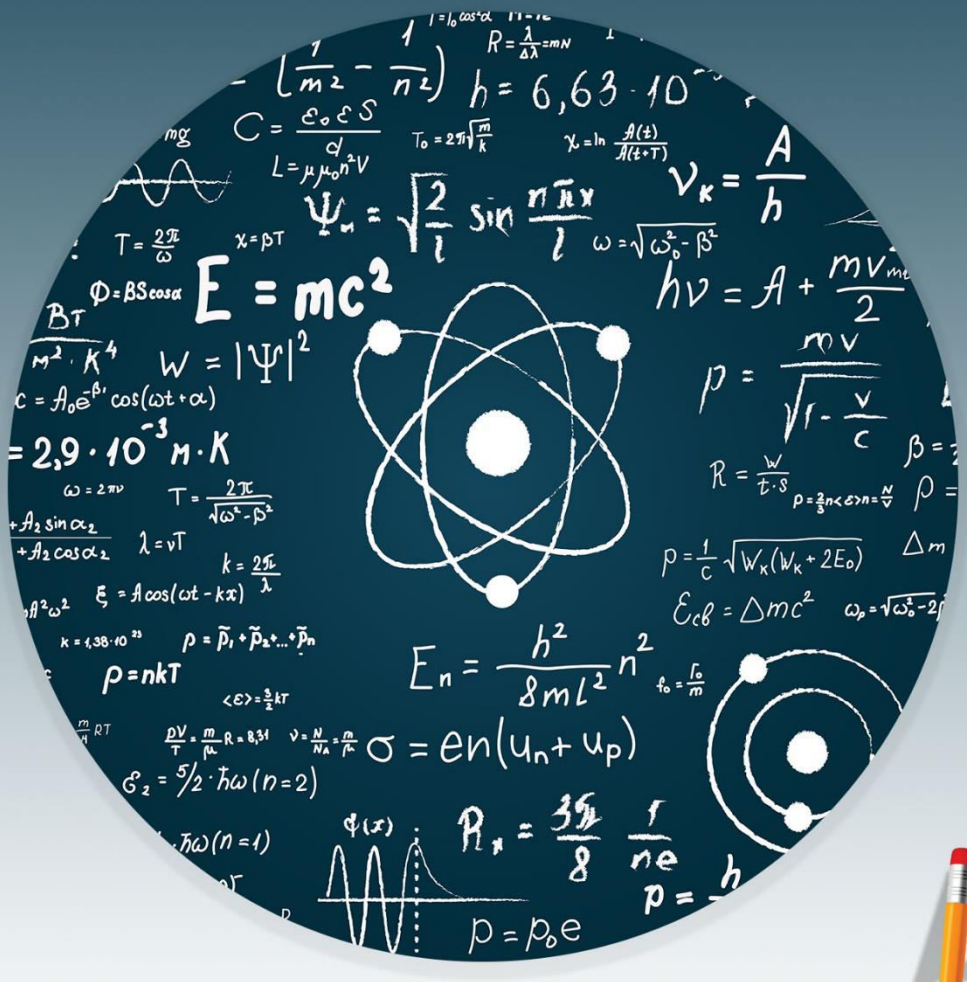
$$\frac{E_1}{E_2} = \frac{\ell_1}{\ell_2}$$

STEP

A PROGRAM BY PUNJAB GROUP



PHYSICS



WORKSHEET-3

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-03

Topics:- Magnetic Field Due to Current Carrying Straight Wire & Solenoid, Force on a Moving Charge in Magnetic Field & e/m of Electron

USE THIS SPACE FOR SCRATCH WORK

Q.1 Two parallel beams of positrons moving in the same direction will:

A) Repel each other
B) Will not interact with each other
C) Attract each other
D) First attract then repel each other

Q.2 The value of permeability of free space in S.I unit is:

A) $4\pi \times 10^{7} Wb\, A^{-1}\, m^{-1}$
B) $4\pi \times 10^{-7} Wb\, A^{-1}\, m^{-1}$
C) $4\pi \times 10^{-10} Wb\, A^{-1}\, m^{-1}$
D) $4\pi \times 10^{10}\ Wb\, A^{-1}\, m^{-1}$

Q.3 The magnetic field along the axis of solenoid with N turns carrying a current I is given by:

A) $B = \mu_o nI$
B) $B = \mu_o NI$
C) $B = \dfrac{\mu_o n}{I}$
D) $B = \dfrac{I}{\mu_o N}$

Q.4 In case of solenoid if it is cut into equal parts then "n" becomes:

A) Half
B) Remains same
C) Double
D) Quadruple

Q.5 Generalized form of Ampere's law is given by:

A) $\sum_{r=1}^{n}\left(\vec{B}.\overrightarrow{\Delta l}\right)_r = I$
B) $\sum_{r=1}^{n}\left(\vec{B}.\overrightarrow{\Delta l}\right)_r = \mu_o I$
C) $B = \mu_o nI$
D) $B = \mu_o \dfrac{N}{L} I$

Q.6 The magnetic induction at a distance r from an infinitely long straight wire, carrying current I, is given by:

A) $\dfrac{\mu_\circ 2I}{4\pi r}$
B) $\dfrac{\mu_\circ r}{4\pi 2I}$
C) $\dfrac{4\pi 2I}{\mu_\circ r}$
D) $\dfrac{4\pi r}{\mu_\circ 2I}$

Q.7 If we double all the parameters of force acting on current carrying conductor placed inside uniform magnetic field keeping the conductor perpendicular to field, then magnetic force becomes:

A) Remains same
B) Double
C) Eight times
D) Four times

USE THIS SPACE FOR SCRATCH WORK

Q.8 **A current carrying solenoid is squeezed to half of it's length keeping number of turns same and current constant, How would it changes the magnetic field in it?**

A) Remains same
C) Becomes half
B) Becomes double
D) Becomes four times

Q.9 **According to Amperes Law if current is increased the value of magnetic field will be:**

A) Increased
C) Remain same
B) Decreased
D) May increase or decrease

Q.10 **A magnetic field is applied on an electron at rest then it will:**

A) Start moving
C) Remain at rest
B) Start rotating
D) Start accelerating

Q.11 **A charge particle is projected perpendicular into a region of $\vec{B}$ such that before entering it's $K.E = 6\ eV$, what will be true about it?**

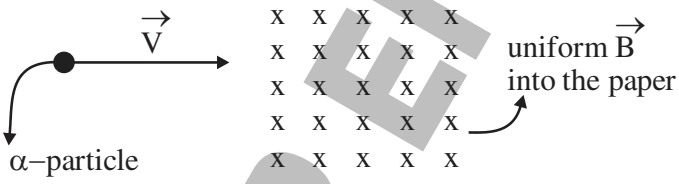
A) It will be in angular dynamic equilibrium

B) It will be continuously accelerated yet it's K.E will remain same

C) It will move along a circular path with no torque

D) All of these

Q.12 **An α-particle is projected in a region of magnetic field as shown in the following figure. What will be the direction of torque in it?**



A) Clock-wise
C) Along axis of rotation
B) Anti-clock wise
D) It has no torque

Q.13 **An electron is injected into a uniform magnetic field with components of velocity parallel to and normal to the field direction. The path of the electron is a:**

A) Helix
C) Parabola
B) Circle
D) Straight line

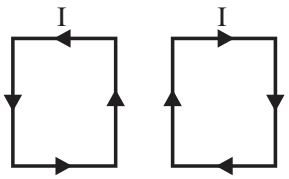
USE THIS SPACE FOR SCRATCH WORK

Q.14 **Particle enters a region where a uniform electric field E and a uniform magnetic field B exist. If E and B are perpendicular to each other and also perpendicular to the velocity v of the particle, then particle will move un-deviated if v=_____.**

A) $\frac{B}{E}$ C) $\frac{E}{B}$

B) EB D) $\frac{E^2}{B}$

Q.15 **Two rectangular loops lying in same plane carrying currents of same value situated near each other as shown in the figure will:**



A) Attract each other

B) Repel each other

C) Remain stationary

D) Start rotating

Q.16 **A beam of β particles is projected in the magnetic field as shown in the figure. The β particles:**

A) Will deflect in the upward direction

B) Will deflect in the downward direction

C) Suffer no deflection

D) Will deflect out of paper

Q.17 **When a charge is moving with uniform speed it produces?**

A) Constant electric field C) Varying electric field

B) Constant magnetic field D) Varying magnetic field

Q.18 **The geometry of magnetic field lines produced around the current carrying conductor depend upon:**

A) Length of conductor C) Shape of conductor

B) Area of conductor D) All of these

Q.19 **Magnetic field $\vec{B}$ due to finite length current carrying solenoid at the corners of solenoid is:**

A) $B = \mu_\circ nI$ C) $B = \frac{1}{2}\mu_\circ nI$

B) $B = 2\mu_\circ nI$ D) $B = 4\mu_\circ nI$

USE THIS SPACE FOR SCRATCH WORK

Q.20 If two current carrying wires are placed parallel to each other and direction of current is same in both conductors, then magnetic field at mid-point between the conductors is _____.

A) Zero

B) Twice than individual conductor

C) Half than individual conductor

D) Quarter than individual conductor

Q.21 The magnetic field at a distance r from a long wire carrying current I is 0.5 T. Then the magnetic field at a distance 2r is:

A) 0.5 T C) 2.0 T

B) 0.25 T D) 1.0 T

Q.22 What is true regarding magnetic force & magnetic intensity:

A) If electron's movement is parallel to magnetic field it will rotate clockwise

B) If electron's movement is parallel to magnetic field it will rotate anti clockwise

C) If electron enters perpendicular to field force would be parallel to plane

D) If electron enters perpendicular to field force will be maximum

Q.23 If electron passes through axis of solenoid then electromagnetic force on electron will be:

A) Towards the outward C) Towards the inward

B) Parallel to its motion D) No force acts on it

Q.24 A proton and an ∝-particle, moving with same kinetic energy, enter a uniform magnetic field normally. The radii of their circular paths will be in the ratio:

A) 1:1 C) 2:1

B) 1:2 D) 4:1

Q.25 What current should pass through a solenoid that is 0.5 m long with 10,000 turns of copper wire so that it will have a magnetic field of 0.4 T?

A) 16 A C) 10 A

B) 25 A D) 14.5 A

USE THIS SPACE FOR SCRATCH WORK

Q.26 A velocity selector has a magnetic field of 0.3 T. If a perpendicular electric field of 10,000 V m^{-1} is applied, what will be the speed of the particle that will pass through the selector?

A) 3.7×10^{5} m s^{-1} C) 2.3×10^{4} m s^{-1}

B) 3.3×10^{4} m s^{-1} D) 4.6×10^{5} m s^{-1}

Q.27 A straight wire of length 0.5 m and carrying a current of 1.2 A is placed in a uniform magnetic field of 4 T. The magnetic field is perpendicular to the length of the wire. The force on the wire is:

A) 2.4 N C) 1.2 N

B) 3.0 N D) 2.0 N

Q.28 The magnetic field lines in the middle of a solenoid are:

A) Circles C) Spiral

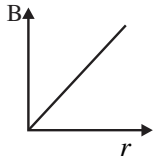
B) Parallel to axis D) Perpendicular to axis

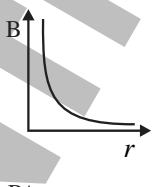
Q.29 If some current is passed in a spring, then the spring:

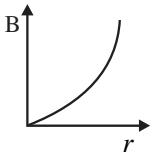
A) Gets expanded C) Oscillates

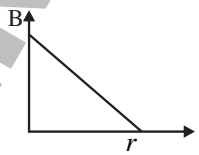
B) Gets compressed D) Remains unchanged

Q.30 Which of the following graph correctly represents the variation of magnetic flux density (B) with distance (r) for a straight wire carrying an electric current?

A) 

C) 

B) 

D) 

ANSWER KEY (Worksheet-03)					
1	C	11	D	21	B
2	B	12	D	22	D
3	A	13	A	23	D
4	B	14	C	24	A
5	B	15	A	25	A
6	A	16	A	26	B
7	C	17	B	27	A
8	B	18	C	28	B
9	A	19	C	29	B
10	C	20	A	30	C

SOLUTIONS

Unit – 9 (WS-03)

Q.1 Answer is "C"

Solution:- Two beam of positrons moving in the same direction will attract each other because of dominating magnetic force which is attractive.

Note:

These beams can repel each other due to the repulsive electric force which becomes dominant at low velocities of moving particles. If not mentioned anything about velocities, then simply choose the attractive force between similar charges moving parallel.

Q.2 Answer is "B"

Solution:- Permeability of free space is given as:

$\mu_\circ = 4\pi \times 10^{-7}\ Wb\ A^{-1}\ m^{-1}$

Q.3 Answer is "A"

Solution:- Magnetic field inside the solenoid is: $B = \mu_\circ nI = \mu_\circ \frac{N}{\ell} I$

Q.4 Answer is "B"

Solution:- $n = \frac{N}{L} = remain\ same$

Q.5 Answer is "B"

Solution:-

$$\sum_{r=1}^{N}\left(\vec{B}.\Delta\vec{\ell}\right) = \mu_\circ \begin{pmatrix}\text{Current Enclosed by}\\ \text{Amperian Path}\end{pmatrix}$$

Q.6 Answer is "A"

Solution:- Ampere's law for straight wire is:

$$B = \frac{\mu_\circ I}{2\pi r} = \frac{\mu_\circ 2I}{4\pi r}$$

Q.7 Answer is "C"

Solution:- $F = ILB\sin\theta$

Q.8 Answer is "B"

Solution:- Magnetic field inside solenoid is given as:

$$B = \mu_\circ nI = \frac{\mu_\circ NI}{\ell}$$

Q.9 Answer is "A"

Solution:- According to Ampere's law $B \propto I$

Q.10 Answer is "C"

Solution:- When electron is at rest, v=0 then, $F = e\text{vB}\sin\theta = 0$

Q.11 Answer is "D"

Solution:- W=ΔK.E; as no work is done so K.E remains same. Also in angular dynamic equilibrium, "ω" = constant and α = 0 so τ = Iα, there will be no torque.

Q.12 Answer is "D"

Solution:- The magnetic force on α-particle is given as $\vec{F} = q\left(\vec{v}\times\vec{B}\right)$

The direction of force by right hand rule turns out to be upward when α-particle enters in magnetic field. So, this force deflects the path in anticlockwise direction.

Q.13 Answer is "A"

Solution:-

i. If $\theta = 90°$ between $\vec{v}$ and $\vec{B}$, then path is circular.

ii. If $\theta = 0°/180°$, then path is straight line.

iii. If θ is other than $0°, 90°, 180°$, then path is helical.

Q.14 Answer is "C"

Solution:- Use $F_B = F_E$, $qvB = qE$, $v = \frac{E}{B}$

Q.15 Answer is "A"

Solution:- The sides of rectangular loops closer to each other are carrying current in same direction, so they will attract each other.

Q.16 Answer is "A"

Solution:- "β" has "-ve" charge so opposite deflection.

Q.17 Answer is "B"

Solution:- A charge moving with uniform speed produces magnetic field which is of constant value at any certain point around it.

Note:-

If Question is asked that a charge moving with uniform speed possesses / exhibits, then its answer would have been both electric and magnetic fields.

Q.18 Answer is "C"

Solution:- Geometry of magnetic field lines depend on shape of conductor only.

Q.19 Answer is "C"

Solution:- At corners field is half as compared to field at centre.

Q.20 Answer is "A"

Solution:- At mid points, M.F by both conductors cancel each other.

Q.21 Answer is "B"

Solution:- For straight wire;

$$B = \frac{\mu_\circ I}{2\pi r} \Rightarrow B \propto \frac{1}{r}$$

Q.22 Answer is "D"

Solution:- When a charge particle enter into magnetic field region perpendicularly, then;

$$F = qvB\sin 90° = qvB = \max$$

Q.23 Answer is "D"

Solution:- In this case, the velocity of electron is either parallel (θ = 0°) or antiparallel (θ = 180°) to magnetic field, hence

$$F = qvB\sin\theta = 0$$

So, electron will continue its straight line motion.

Q.24 Answer is "A"

Solution:-

$$q\not{v}B = \frac{mv^{\not{2}}}{r}$$

$$qB = \frac{mv}{r}$$

$$r = \frac{mv}{qB} = \frac{p}{qB} = \frac{\sqrt{2mK.E}}{qB}$$

So,

$$\frac{r_P}{r_\alpha} = \sqrt{\frac{m_p}{m_\alpha}} \times \frac{q_\alpha}{q_P}$$

Put the value of $m_\alpha = 4m_p$ and $q_\alpha = 4q_p$ solve.

Q.25 Answer is "A"

Solution:- Use $B = \frac{\mu_\circ NI}{\ell}$

Q.26 Answer is "B"

Solution:- $v = \frac{E}{B}$

Q.27 Answer is "A"

Solution:- As $\theta = 90°$ So $F = ILB$

Q.28 Answer is "B"

Solution:- Field lines inside solenoid are along its axis.

Q.29 Answer is "B"

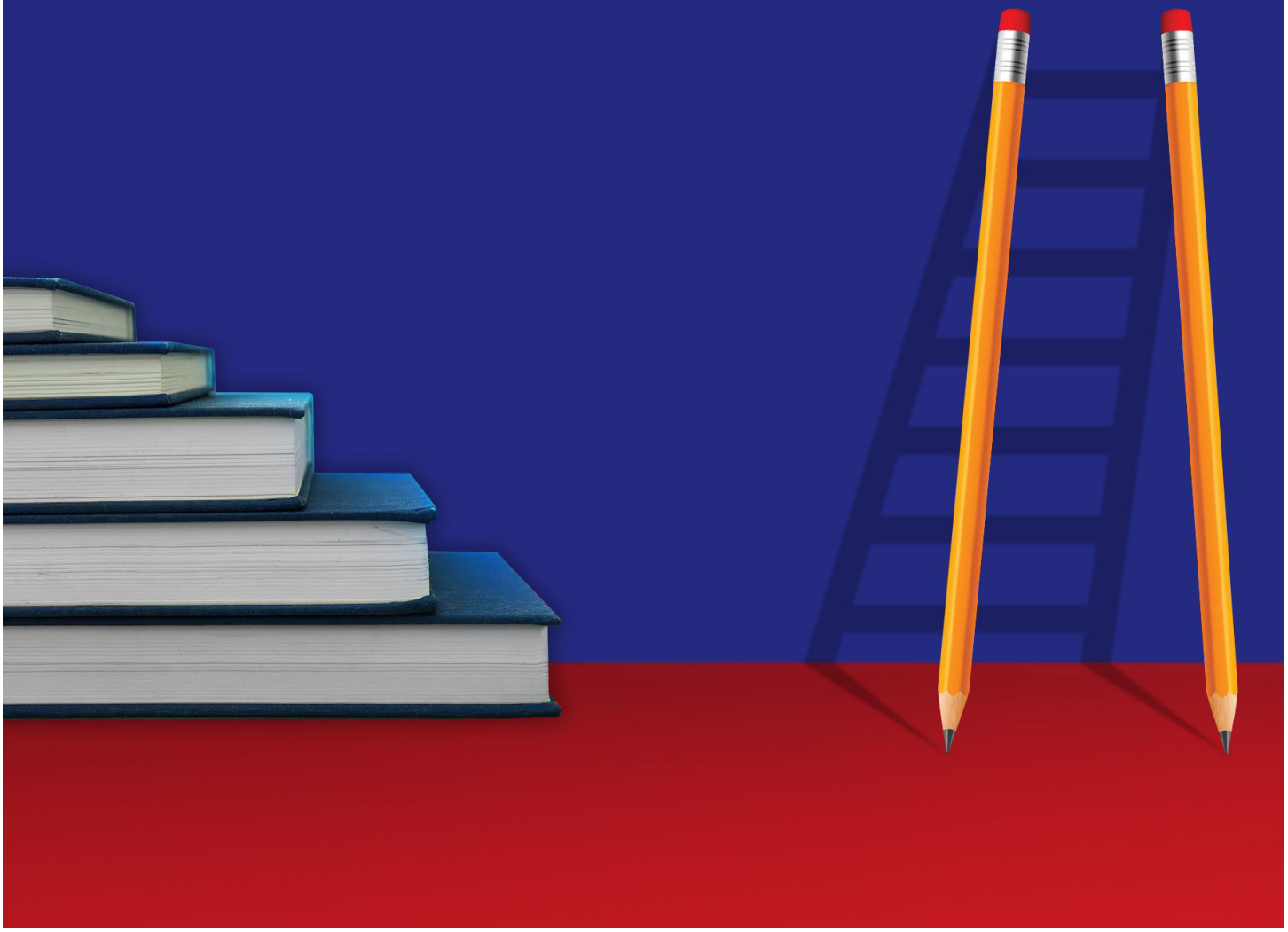
Solution:- Adjacent loops of spring carry current in same direction and get attracted, hence spring gets compressed.

Q.30 Answer is "C"

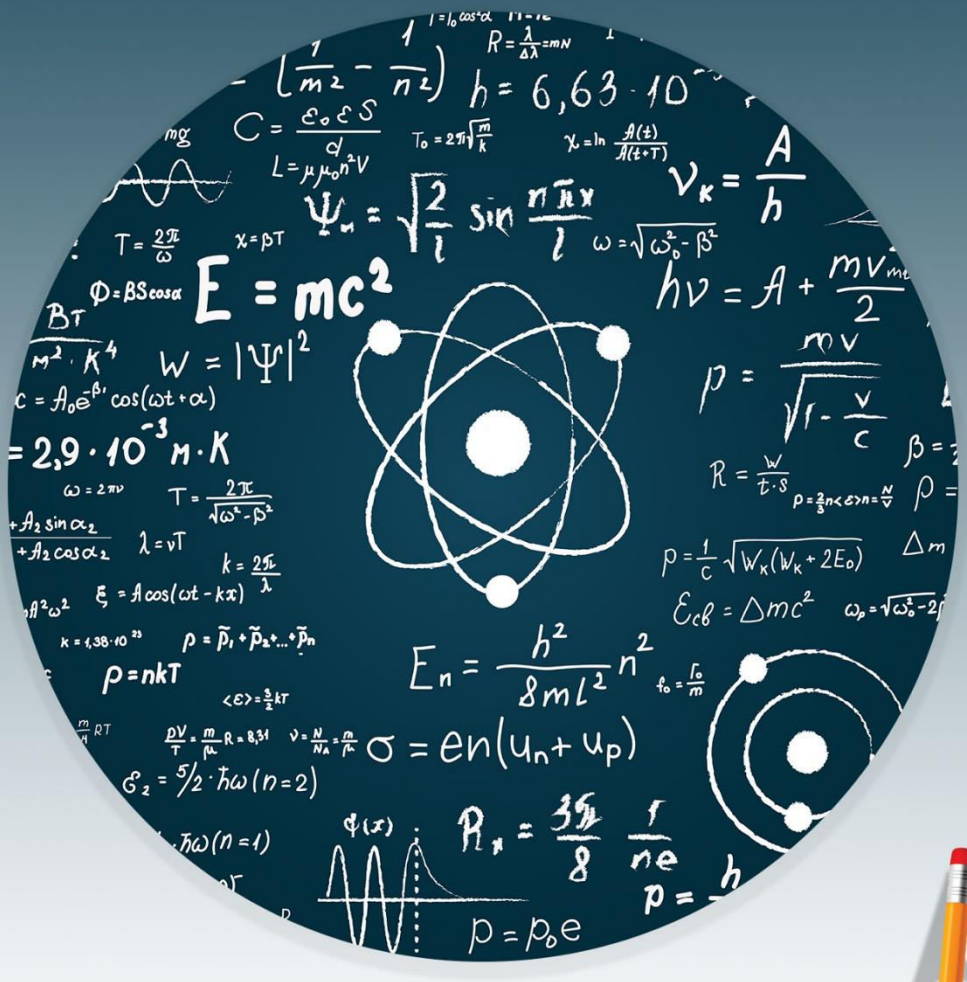
Solution:- $B = \dfrac{\mu_\circ I}{2\pi r} \quad \Rightarrow \quad B \propto \dfrac{1}{r}$

STEP

A PROGRAM BY PUNJAB GROUP



PHYSICS



WORKSHEET-4

STEP

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Worksheet-4

Topics:- Magnetic Flux, Faraday's Law, Lenz's Law, Transformer, Alternating Current, Peak and RMS Value of AC

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Q.1 A metallic rod falls under gravity in such a way that it's two ends points in the direction of east and west, then:

A) No e.m.f is induced at all

B) An e.m.f is induced in it as it cuts earth's magnetic field

C) Two e.m.f's of equal but opposite directions are generated giving no net e.m.f induced

D) Gravitational field opposes it's downward motion

Q.2 A bar magnet of magnetic field 2 T is made to move towards a coil having a galvanometer with a speed of 4 m s^{-1} such that galvanometer shows a deflection "θ_1". Now if the same bar magnet is made to move away from same coil with same speed and galvanometer shows deflection "θ_2" then what is true?

A) $\theta_1=\theta_2$ and both deflections are in same direction

B) $\theta_1<\theta_2$ and both deflections are in same direction

C) $\theta_1>\theta_2$ and both deflections are is opposite directions

D) $\theta_1=\theta_2$ but both deflections are in opposite direction

Q.3 With reference to the Q.2 if only $\vec{B}$ is doubled and bar is only made to move towards coil with a speed of 4 m s^{-1} then:

A) Induced e.m.f becomes half

B) Induced e.m.f remains same

C) Induced e.m.f is doubled

D) None of these

Q.4 With reference to the Q.2 if both $\vec{B}$ and speed of bar magnet are doubled then:

A) Induced e.m.f becomes quadrupled

B) Induced e.m.f remains same

C) Induced e.m.f is doubled

D) None of these

Q.5 With reference to Q.2 if only number of turns of coil are doubled then:

A) Induced e.m.f becomes half

B) Induced e.m.f remains same

C) Induced e.m.f is doubled

D) None of these

USE THIS SPACE FOR SCRATCH WORK

Q.6 The relation for motional e.m.f is written as:

A) $\varepsilon = -vBL\cos\theta$ C) $\varepsilon = +vBL\sin\theta$

B) $\varepsilon = -vBL\sin\theta$ D) $\varepsilon = -vBL\tan\theta$

Q.7 If a conductor is moved across a $\vec{B}$ such that θ=90° then induced e.m.f:

A) Is a maximum C) $\varepsilon = -vBL$

B) Is zero D) Both "A" and "C"

Q.8 At what angle when a rod is moved in a uniform $\vec{B}$ such that induced e.m.f becomes half of it's maximum?

A) 30° C) 60°

B) 45° D) 90°

Q.9 According to Lenz's law the direction of induced current is such that it:

A) Decreases flux if it is increasing

B) Opposes the cause which produces it

C) Increases flux if it is decreasing

D) All of these

Q.10 The value of induced e.m.f in a coil mainly depends upon:

A) Increase in flux

B) Decrease in flux

C) Both "A" & "B"

D) Rate of change of magnetic flux

Q.11 If we take away north-pole of a bar magnet from a coil then the end of coil facing north-pole act as:

A) A north pole C) May be north or south

B) A south pole D) No pole will be induced

Q.12 Which of the following is true about dependence upon resistance of the coil in which e.m.f is generated?

A) Only induced current depends upon resistance of coil

B) Only e.m.f depends upon resistance of coil

C) Both e.m.f and induced current depends upon resistance of coil

D) Can't be predicted

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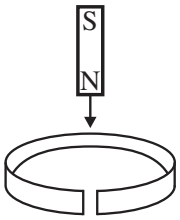
Q.13 A bar magnet as shown in figure is allowed to fall down into a coil having a cut. What is true?



A) e.m.f will be induced only

B) Neither e.m.f nor current will be induced

C) Both e.m.f and current will be induced

D) None of these

Q.14 Considering the statement of Q.13 what is true about the acceleration of bar magnet while coming down?

A) $a=g$ C) $a>g$

B) $a<g$ D) $a=0$

Q.15 Considering the figure of Q.13 if the coil is complete and does not have cut in it then:

A) Only e.m.f will be induced

B) Only current will be induced

C) Both e.m.f and current will be induced in it

D) Nothing will be induced

Q.16 Considering the statement of Q.15 what is true about the acceleration produced in the bar magnet while falling downwards?

A) $a=g$ C) $a<g$

B) $a>g$ D) $a=0$

Q.17 Under which of the following conditions even when both area of coil and $\vec{B}$ in the region are continuously changing yet there is no e.m.f induced?

A) If $A \propto \frac{1}{B}$

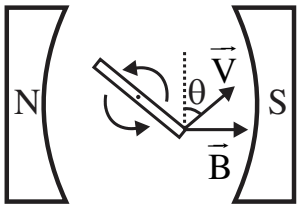
B) If flux remains zero

C) If coil is placed parallel to $\vec{B}$

D) All of these

USE THIS SPACE FOR SCRATCH WORK

Q.18 **Consider the figure in which an upper view for a rotating coil is shown placed in the uniform magnetic field. For which value of "θ" the induced e.m.f will be a maximum?**



A) 90° C) 60°

B) 30° D) 0°

Q.19 **The ratio of the number of turns in primary and secondary coils of a transformer is 1:20. The ratio of the currents in the primary and secondary coils will be:**

A) 1:20 C) 1:400

B) 20:1 D) 400:1

Q.20 **The relation for e.m.f produced by an A.C generator is:**

A) $\varepsilon = \varepsilon_{\circ} \sin\theta$ C) Both "A" and "B"

B) $\varepsilon = N\omega AB\sin\theta$ D) None of these

Q.21 **The maximum e.m.f induced by an A.C generator which has only one turn is:**

A) $N\omega AB$ C) ωAB

B) NAB D) None of these

Q.22 **A step-up transformer is the one which:**

A) Increases voltage level C) Keeps power level same

B) Decreases current level D) All of these

Q.23 **In a step-up transformer the turns ratio is found to be 2:1; such a transformer will:**

A) Increase current level C) Both "A" & "B"

B) Decrease voltage level D) Decrease current level

Q.24 **A transformer steps down 100 volt to 10 volt to operate a device with an impedance of 2 ohm. Then the current drawn from the mains by the primary of the transformer is:**

A) 50 A C) 0.5 A

B) 5 A D) 0.05 A

Q.25 **An ideal step down transformer is connected to main supply of 240 V. It is desired to operate a 12 V, 30 W lamp. What is the current in the primary?**

A) 0.125 A C) 0.5 A

B) 0.25 A D) 0.75 A

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Q.26 Referring to Q.25, what is the transformation ratio:

A) 10 C) 20

B) $\frac{1}{20}$ D) $\frac{1}{10}$

Q.27 Magnetic flux passing through a surface area will be half of maximum value when:

A) $\vec{A}$ makes 60° with $\vec{B}$ C) $\vec{A}$ makes 45° with $\vec{B}$

B) $\vec{A}$ makes 30° with $\vec{B}$ D) $\vec{A}$ makes 0° with $\vec{B}$

Q.28 Magnetic flux passing through a surface area will be $\frac{1}{\sqrt{2}}$ times the maximum flux if plane area makes _____ angle with magnetic field.

A) 30° C) 60°

B) 45° D) 75°

Q.29 The basic difference between A.C and D.C is:

A) Direction reversal by A.C

B) Changing magnitude by A.C

C) Both A and B

D) None of these

Q.30 An A.C current is given by I=100 sin100πt. It will achieve value of 50 A after _____second.

A) $\frac{1}{600}$ C) $\frac{1}{300}$

B) $\frac{1}{1800}$ D) $\frac{1}{900}$

Q.31 A bulb is connected with A.C supply. The intensity of light from the bulb:

A) Changes continuously

B) Decreases and becomes zero

C) Increases and reaches to its maximum

D) Remains constant

Q.32 Two A.Cs are represented by $I_1 = 100 sin 100\pi t$ and $I_2 = 100 sin 200\pi t$, the relation between the frequencies of these A.Cs is:

A) $f_1 = f_2$ C) $f_2 = 2f_1$

B) $f_1 = 2f_2$ D) $f_1 = 10f_2$

Q.33 The time taken by A.C to reach half of maximum value is _____ while initial phase of A.C is 90°.

A) $\frac{T}{8}$ C) $\frac{T}{12}$

B) $\frac{T}{6}$ D) $\frac{T}{4}$

Q.34 How many times A.C achieves zero value in one cycle:

A) Once C) Thrice

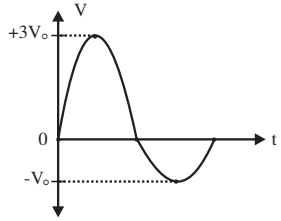
B) Twice D) Four times

Q.35 The rms value of A.C in 1st half is:

A) Zero C) $\frac{I_\circ}{\sqrt{2}}$

B) $\frac{I_\circ}{2}$ D) $\frac{2I_\circ}{\sqrt{2}}$

Q.36 In the following waveform, the peak to peak value is:



A) $+2V_\circ$ C) $+1V_\circ$

B) $+3V_\circ$ D) $+4V_\circ$

Q.37 Referring to questions # 36, the rms value will be:

A) $\frac{V_\circ}{\sqrt{2}}$ C) $\sqrt{\frac{3}{2}}V_\circ$

B) $\sqrt{\frac{2}{5}}V_\circ$ D) $\sqrt{\frac{5}{2}}V_\circ$

Q.38 The rate of heat production in a resistor due to an alternating current of rms value 10A is same as that due to a direct current of:

A) 10 A C) $10\sqrt{3}\ A$

B) $10\sqrt{2}\ A$ D) 5 A

Q.39 The voltage of domestic A.C is 220 volt what does this represent:

A) Mean voltage B) Peak voltage

C) Root mean voltage D) Root mean square voltage

Q.40 Mostly voltmeters read _____ value of A.C voltage:

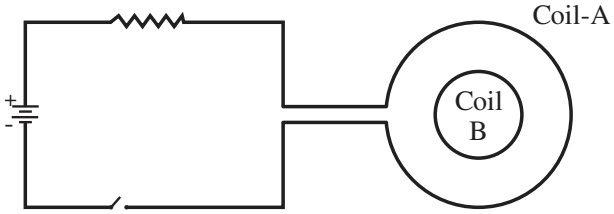
A) Mean voltage B) Peak voltage

C) Root mean voltage D) Root mean square voltage

Q.41 In the figure shown, what is the direction of induced

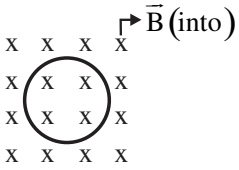
USE THIS SPACE FOR SCRATCH WORK

current in the coil B at the moment when the switch is closed?



A) Clockwise
B) Anticlockwise
C) No current is induced
D) Induced current changes its direction form clockwise to anticlockwise

Q.42 A loop of wire is placed in a perpendicular magnetic field. Suddenly, the magnitude of magnetic field begins to increase, what is the direction of the induced current in the loop?



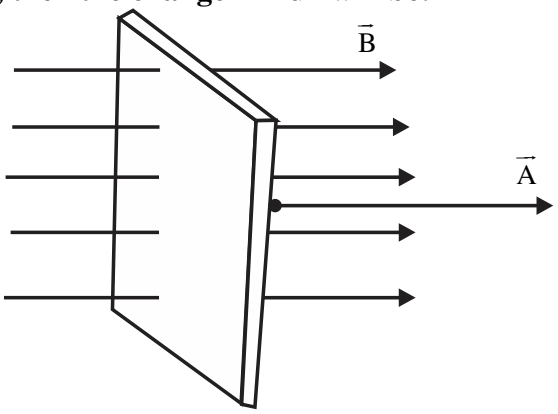
A) Clockwise
B) Anticlockwise
C) No current is induced
D) Out of the page

Q.43 In the figure shown, the magnet is moved towards the coil with a speed v. The induced emf in coil is "ε". Now if the magnet and coil recede away from one another each moving with speed v. The induced emf in the coil is:

A) ε
B) 2ε
C) $\frac{\varepsilon}{2}$
D) 4ε

Q.44 The coil of area "A" is kept perpendicular in a magnetic field $\vec{B}$ as shown in following figure. If coil is rotated by

180° such that its axis of rotation is perpendicular to field, then the change in flux will be:

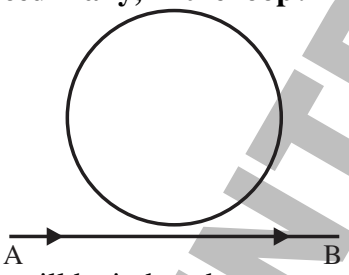


A) BA C) Zero
B) -2BA D) 4BA

Q.45 The north pole of a long horizontal bar magnet is being brought closer to a vertical conducting coil along the perpendicular direction. The direction of the induced current in the conducting coil will be:

A) Horizontal C) Vertical
B) Clockwise **D) Anticlockwise**

Q.46 An electron starts moving along the line AB, which lies in the same plane as a circular loop of conducting wire as shown in the diagram. What will be the direction of current induced if any, in the loop?



A) No current will be induced
B) The current will be clockwise
C) The current will be anticlockwise
D) The current will change direction as the electron pass by

Q.47 The coil of area A is kept parallel in a magnetic field B. If coil is rotated by 90° such that its axis is perpendicular to magnetic field, the change in flux will be:

A) BA C) Zero
B) 2BA D) 4BA

Q.48 A 50 turns circular coil has a radius of 3 cm. It is kept in a magnetic field acting normal to the area of the coil. The magnetic field B is increased from 0.10 T to 0.35 T in 2 ms. The average induced emf in the coil is:

A) 1.77 V C) 177 V
B) 17.7 V D) 0.177 V

Q.49 There is an aerial 1 m long in a car. It is moving from east to west with a velocity 100 km h^{-1}. If the horizontal component of earth's magnetic field is 0.18×10^{-4} T, then induced emf is:

A) 0.50 mV C) 0.75 mV

B) 0.25 mV D) 1 mV

Q.50 In a step-up transformer, the turns ratio is 1:10. A resistance of 200 ohm connected across the secondary is drawing a current of 0.5 A. What is the primary voltage and current?

A) 50 V, 1 A C) 25 V, 4 A

B) 10 V, 5 A D) 20 V, 2 A

ANSWER KEY (Worksheet-04)									
1	B	11	B	21	C	31	A	41	B
2	D	12	A	22	D	32	C	42	B
3	C	13	A	23	D	33	B	43	B
4	A	14	A	24	C	34	B	44	B
5	C	15	C	25	A	35	C	45	D
6	B	16	C	26	B	36	D	46	C
7	D	17	D	27	A	37	D	47	A
8	A	18	D	28	B	38	A	48	B
9	D	19	B	29	A	39	D	49	A
10	D	20	C	30	A	40	D	50	B

SOLUTIONS

Unit – 8 (WS-04)

Q.1 Answer is "B"

Solution:- Since the metallic rod is moving in earth's magnetic field, so motional e.m.f will be produced.

Q.2 Answer is "D"

Solution:- The induced current will flow opposite in both cases as the direction of motion of bar is opposite in both cases. Also, the magnitude of current will be same as the speed of conductor with which it is moving is same.

Q.3 Answer is "C"

Solution:- $\varepsilon = -vBL\sin\theta \quad \Rightarrow \quad \varepsilon \propto B$

Q.4 Answer is "A"

Solution:- $\varepsilon = -vBL\sin\theta$

Q.5 Answer is "C"

Solution:- $\varepsilon = -N\frac{\Delta\phi}{\Delta t}$

Q.6 Answer is "B"

Solution:- Motional e.m.f in a conductor is given as

$\varepsilon = -vBL\sin\theta$

Q.7 Answer is "D"

Solution:- $\varepsilon = -vBL\sin\theta$

Q.8 Answer is "A"

Solution:- Put $\varepsilon = -\frac{vBL}{2}$ and find "θ".

Q.9 Answer is "D"

Solution:- Lenz's law

Q.10 Answer is "D"

Solution:- E.m.f is caused by change in flux. The rate of change of flux determines its value.

Q.11 Answer is "B"

Solution:- Induced current opposes the cause which produces it.

Q.12 Answer is "A"

Solution:- First short question of Ch:15.

$\varepsilon = -N\frac{\Delta\phi}{\Delta t} = \text{constant}$ and $I = \frac{\varepsilon}{R}$

$\Rightarrow I \propto \frac{1}{R}$

Q.13 Answer is "A"

Solution:- As $I = \frac{\varepsilon}{R}$ and for ring with a cut it acts as open circuit whose R=infinite.

Q.14 Answer is "A"

Solution:- As no current is induced so this coil will not become a magnet and hence can't oppose the motion of falling bar magnet which will only fall with a = g.

Q.15 Answer is "C"

Solution:- Current flows only is close path.

Q.16 Answer is "C"

Solution:- As now current can be generated so coil will become magnet and will oppose motion of falling magnet.

Q.17 Answer is "D"

Solution:- In all cases; $\Delta\phi = 0 \Rightarrow \varepsilon = 0$

Q.18 Answer is "D"

Solution:- E.m.f induced in one side of coil is given as;

$\varepsilon = -vBL\sin\alpha$

Where α is angle between $\vec{v}$ and $\vec{B}$. In the given figure α can be expressed as:

$\alpha = 90° - \theta$

If $\theta = 0°$, $\alpha = 90°$

$\sin 90° = 1 = \max$

So e.m.f will be maximum when $\theta = 0°$.

Q.19 Answer is "B"

Solution:- $\frac{I_P}{I_s} = \frac{N_s}{N_P} = \frac{1}{\frac{N_P}{N_s}} = \frac{1}{\frac{1}{20}} = \frac{20}{1}$

Q.20 Answer is "C"

Solution:- E.m.f produced by generator is given as:

$\varepsilon = N\omega AB\sin\theta$

Where $N\omega AB = \varepsilon_\circ = \text{maximum emf}$

So, $\varepsilon = \varepsilon_\circ \sin\theta$

Q.21 Answer is "C"

Solution:- $\varepsilon = N\omega AB\sin\theta$ For maximum e.m.f in one turn coil, put; N =1 , θ = 90°

Q.22 Answer is "D"

Solution:- An ideal step-up transformer:

i. Increases voltage level

ii. Decreases current level

iii. Keeps P_{in}=P_{out}

Q.23 Answer is "D"

Solution:- A step-up transformer increases voltage level & decreases current level.

Q.24 Answer is "C"

Solution:-

Step-I

$$I_s = \frac{V_s}{Z}$$

Step-II

$$\frac{I_P}{I_s} = \frac{V_s}{V_P}$$

Q.25 Answer is "A"

Solution:- P_{in}=P_{out}

$V_P I_P$=30 W

Q.26 Answer is "B"

Solution:- $\frac{N_s}{N_P} = \frac{V_s}{V_P}$

Q.27 Answer is "A"

Solution:- $\phi = BA\cos\theta$

Put $\phi = \frac{BA}{2}$ and solve

Q.28 Answer is "B"

Solution:-

i. $\phi = \frac{1}{\sqrt{2}}\phi_{max}$

$$BA\cos\theta = \frac{1}{\sqrt{2}}BA$$

Solve for θ.

ii. To find angle between plane area and magnetic field use

$$\alpha = 90° - \theta$$

Q.29 Answer is "A"

Solution:- Basic difference between A.C and D.C is direction reversal, otherwise magnitude can change for both A.C and D.C.

Q.30 Answer is "A"

Solution:- $I = 100\sin 100\pi t$

$50 = 100\sin 100\pi t$ solve it

Q.31 Answer is "A"

Solution:- Intensity $\propto I_{ins}$

Q.32 Answer is "C"

Solution:- Compare I_1 and I_2

Q.33 Answer is "B"

Solution:-

$Since\ \phi = 90°, so\ I = I_\circ \cos\left(\frac{2\pi}{T}\right)t$, put

$I = \frac{I_\circ}{2}$ & solve it.

Q.34 Answer is "B"

Solution:- In one cycle of A.C, it achieves zero value twice i.e at 0° and at 180°.

Q.35 Answer is "C"

Solution:- $I_{rms} = \frac{I_\circ}{\sqrt{2}}$

Q.36 Answer is "D"

Solution:- V_{PP} = sum of +ve & -ve peaks without signs

Q.37 Answer is "D"

Solution:- rms value = $\sqrt{\frac{0 + 9V_\circ^2 + 0 + V_\circ^2}{4}}$

Q.38 Answer is "A"

Solution:- $I_{rms} \rightarrow effective\ value\ of\ A.C$

i-e it produces same heating effect as produced by equal D.C current.

Q.39 Answer is "D"

Solution:- Usually the value specified of A.C is rms values unless specified that it is peak value.

Q.40 Answer is "D"

Solution:- Mostly voltmeter and ammeters read rms value of alternating voltage and current.

Q.41 Answer is "B"

Solution:-
When switch is closed, the current in coil-A increases from zero to maximum, so its magnetic flux also increases from zero to maximum, this flux is linked with coil-B. Since the field of coil-A is into the page so to oppose this cause (increasing flux) the field of induced current in coil-B must be out of the page. Hence current in coil B must be in anti-clockwise direction.

Q.42 Answer is "B"

Solution:-
To oppose the cause i.e increasing flux, the field of coil must be out of page (opposite to increasing field). So, the current in coil will be anticlockwise.

Q.43 Answer is "B"

Solution:-
The relative speed between coil and magnet becomes "2v" so emf induced will also be doubled.

Q.44 Answer is "B"

Solution:-
$\phi_i = BA\cos0° = BA$
$\phi_f = BA\cos180° = -BA$
$\Delta\phi = \phi_f - \phi_i$
$\Delta\phi = -BA-BA$
$\Delta\phi = -2BA$

Q.45 Answer is "D"

Solution:-
Simply follow the statement of Lenz's law.

Q.46 Answer is "C"

Solution:-
Simple follow the statement of Lenz's Law keeping in mind that the magnetic field linked with the coil is because of electronic current i.e the direction of magnetic field will be opposite to that obtained by right hand rule.

Q.47 Answer is "A"

Solution:-
$\phi_i = BA\cos90° = 0$
$\phi_f = BA\cos0° = BA$
$\Delta\phi = \phi_f - \phi_i$
$\Delta\phi = BA-0$
$\Delta\phi = BA$

Q.48 Answer is "B"

Solution:-

$\Delta\phi = NA(B_2 - B_1) = 50\times\frac{22}{7}\left(3\times10^{-2}\right)^2$

$\Delta\phi = 353\times10^{-4}$ Wb
Now

$$\varepsilon = \frac{NA\left(B_2 - B_1\right)}{\Delta t}$$
$$\varepsilon = \frac{353\times10^{-4}}{2\times10^{-3}}$$
$$\varepsilon = 17.7V$$

Q.49 Answer is "A"

Solution:-
Magnitude of emf is
$\varepsilon = vBL\sin90°$
$\varepsilon = \frac{100\times1000}{3600}\times0.18\times10^{-4}\times1$
$\varepsilon = 0.5\ mV$

Q.50 Answer is "B"

Solution:-

i- $V_s = I_sR$

ii- $\frac{V_P}{V_S} = \frac{N_P}{N_S} = \frac{1}{10}$

iii- $\frac{I_P}{I_S} = \frac{N_S}{N_P}$

STEP

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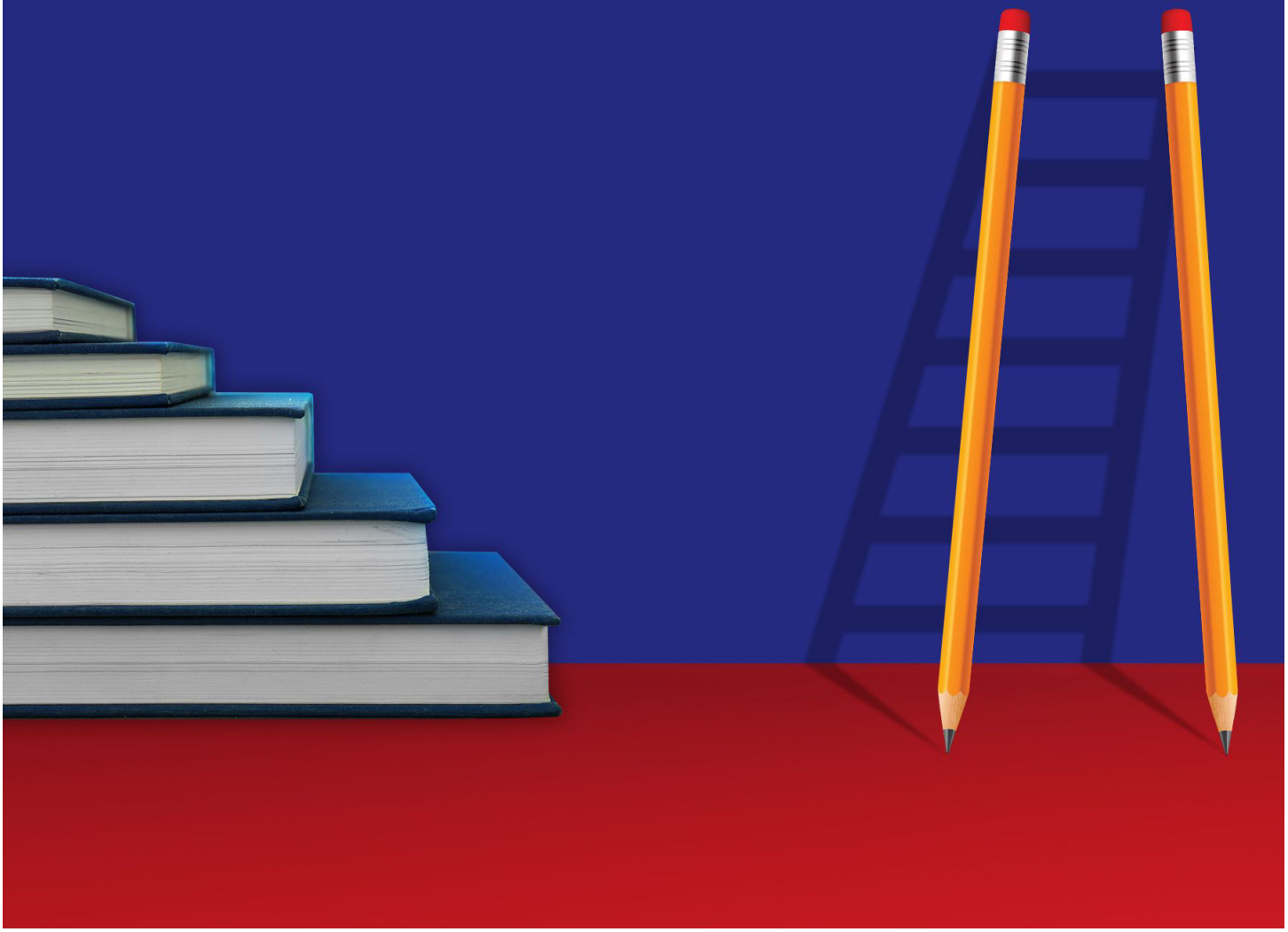
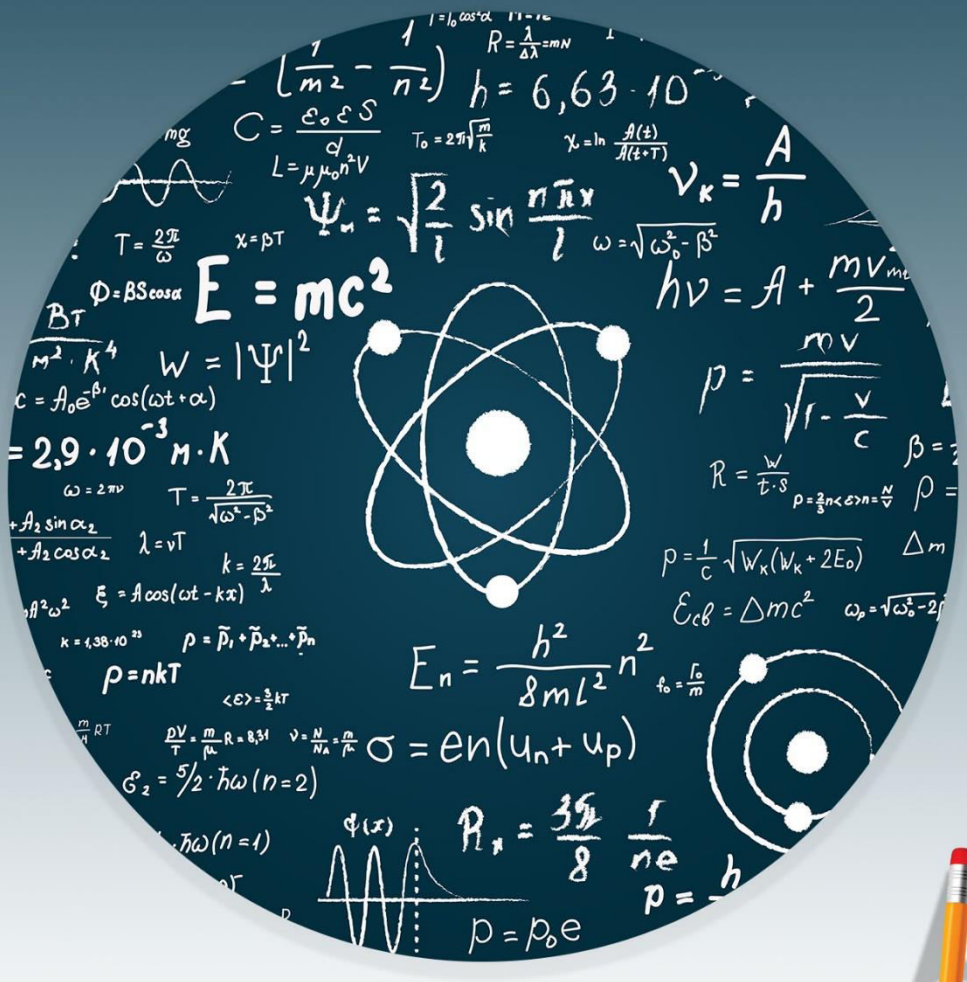


PHYSICS



WORKSHEET-5

STEP

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Worksheet-5

Topics:- Half and Full Wave Rectification, Operational Amplifier and its Characteristics

USE THIS SPACE FOR SCRATCH WORK

Q.1 A P-N junction diode is said to be forward biased when:

A) No potential difference is applied across P and N regions

B) A potential difference is applied across P and N regions making P region positive and N region negative

C) A potential difference is applied across P and N regions making P region negative and N region positive

D) A magnetic field is applied in the region of junction

Q.2 When a P-N junction is forward biased then width of depletion region.

A) Increases C) Remains unchanged

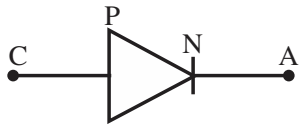
B) Decreases D) is variable

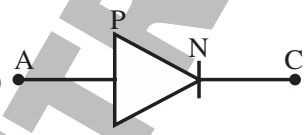
Q.3 Circuit used to convert pulsating D.C into pure D.C is called:

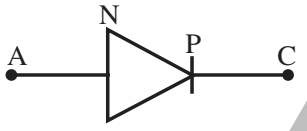
A) Rectifier C) Filter

B) Inverter D) Converter

Q.4 If "A" stands for anode and "C" stands for cathode, then which of following is a correct labeled symbolic diagram of a rectifier.

A) 

C) 

B) 

D) None of these

Q.5 When a diode is reverse biased, then its resistance is of the order of?

A) ohms C) mega ohms

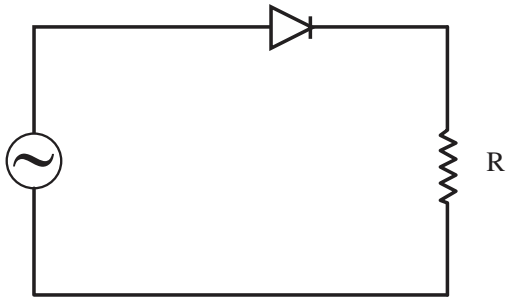
B) kilo ohms D) micro ohms

Q.6 The time period of output ripple of a full wave rectifier is 40 ms, what will be the input A.C frequency of this rectifier circuit?

A) 100 Hz C) 25 Hz

B) 50 Hz D) 12.5 Hz

Q.7 The potential drop across the diode in the following circuit during the conduction mode of diode is:

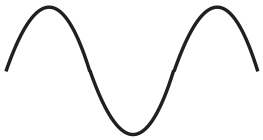


A)

B)

C)

D)



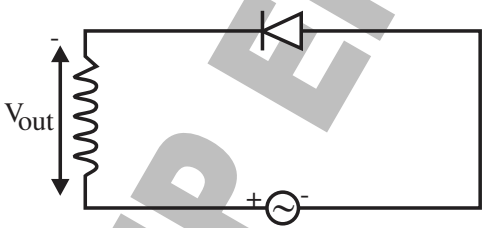
Q.8 Which of following is not true about half wave rectifier?

A) Output ripple has same time period as that of A.C input
B) It produces pure D.C at output
C) Diode conducts only for one half of A.C
D) During reverse Biased mode of rectifier, the output is zero

Q.9 The similar feature of half wave rectifier and full wave rectifier for same input A.C source is:

A) Both produces output ripples of same frequency
B) Both uses only forward biased mode of diode
C) Both uses a pair of diodes for operation
D) Both produces pulsating D.C output

Q.10 What can be the output of following half wave rectifier?



A)

B)

C)

D)

Q.11 For identical external resistors, which of the following will have more value of output voltage, when input

USE THIS SPACE FOR SCRATCH WORK

voltage is same;

A) Non-inverting Op-Amp C) Both have same output

B) Inverting Op-Amp D) None of these

Q.12 The number of input terminals of an ordinary op-amp are:

A) Two C) Four

B) Three D) Eight

Q.13 The magnitude of "Open loop gain" of an amplifier is of the order of:

A) $10^5\ \Omega$ C) 10^5 V

B) 10^5 A D) 10^5

Q.14 An op-amp can be used as a:

A) Inverting and non-inverting amplifier

B) Comparator

C) Night switch

D) All of the above

Q.15 The Closed loop Gain "G" of the non-inverting amplifier can be expressed by:

A) $G = \frac{-R_2}{R_1}$ C) $G = \frac{R_2}{R_1}$

B) $G = 1 + \frac{R_2}{R_1}$ D) $G = 1 - \frac{R_1}{R_2}$

Q.16 An op-amp will act as an inverting amplifier when the input signal is not connected to:

A) Non-inverting terminal C) Non-Inverting output

B) Inverting terminal D) Inverting output

Q.17 An op-amp will not act as a non-inverting amplifier when input signal is connected to the

A) Non-inverting input C) Non-Inverting output

B) Inverting input D) Inverting out put

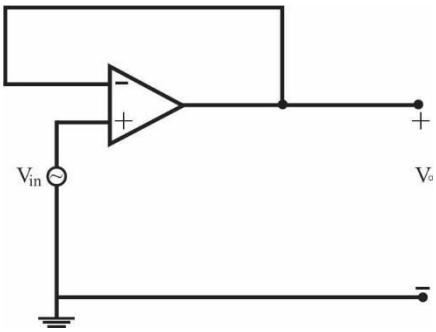
Q.18 The gain of an inverting amplifier having external resistance R_1=50 kΩ and R_2=200 kΩ respectively will be

A) 4 C) -20

B) 20 D) -4

Q.19 What is gain of Op-Amp shown in figure:

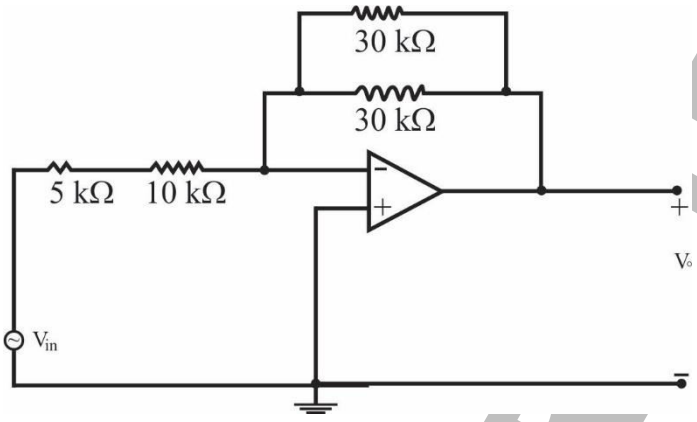
USE THIS SPACE FOR SCRATCH WORK



A) 0 C) ∞

B) 10^5 D) 1

Q.20 What is gain of Op-Amp shown in figure:

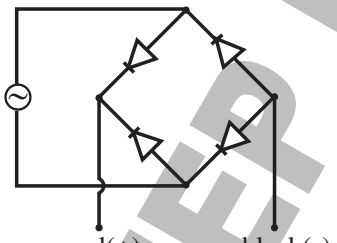


A) -3 C) -5

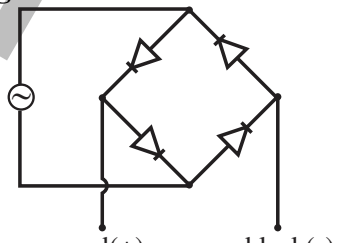
B) -2 D) None of these

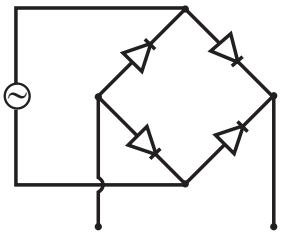
Q.21 Some students were given following instructions.
"Design a circuit to give a full wave rectifier output from an A.C supply. The positive output must be connected to a red terminal and negative output to a black terminal."
Which circuit satisfies the design instructions?

A)



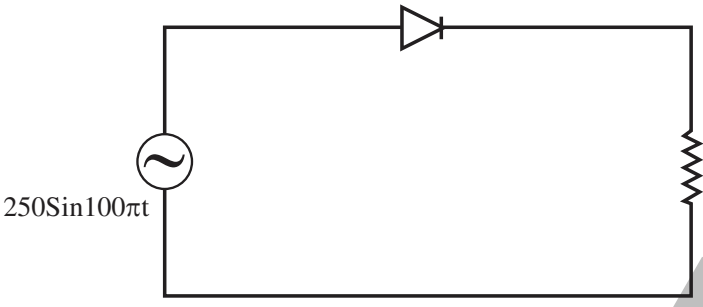
C)





B) D) None of these

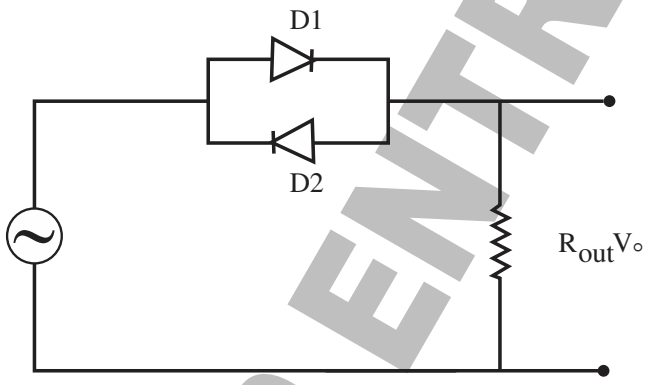
Q.22 The rms current flowing through the following circuit will be (where diode has negligible forward biased resistance):



A) $\frac{5}{2}A$ **C)** $\frac{5}{4}A$

B) $\frac{5}{3}A$ D) $\frac{5}{6}A$

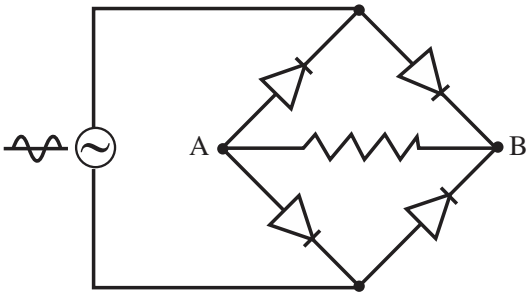
Q.23 If the diode D_1 is taken off from the circuit, the output across resistor will become?



A) Half wave rectified C) Zero

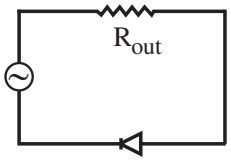
B) Full wave rectified D) A.C

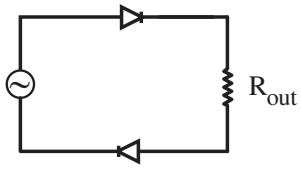
Q.24 The direction of current through the resistor in the circuit shown during negative half of A.C will be:

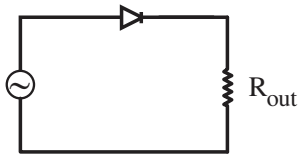


A) From A to B
B) From B to A
C) No current flows during negative half
D) Both A and B are possible

Q.25 If the source frequency is same in all cases, for which circuit out of the following the ripple frequency is more?

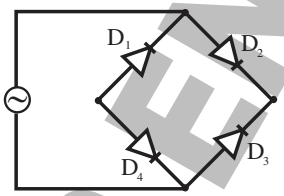
A)


B)


C)


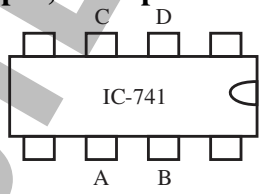
D) Ripple frequency will be same in all cases

Q.26 What change can be made to convert the following bridge into half wave rectifier?



A) Replace D_1 by a resistor C) Replace D_3 by a resistor
B) Replace D_2 by a resistor **D) All of these**

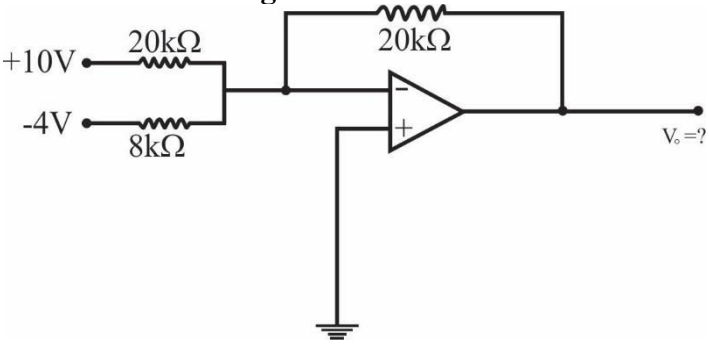
Q.27 An operational amplifier is shown in the diagram, to get an inverted output, the input must be applied at:



A) A C) C

B) B **D) D**

Q.28 The current through 8kΩ in the circuit shown is:



A) Zero C) +0.75A

B) -0.5mA D) None of these

ANSWER KEY (Worksheet-05)					
1	B	11	A	21	A
2	B	12	A	22	C
3	C	13	D	23	A
4	C	14	D	24	B
5	C	15	B	25	D
6	D	16	A	26	D
7	C	17	B	27	D
8	B	18	D	28	B
9	D	19	D		
10	A	20	D		

SOLUTIONS

Unit – 8 (WS-05)

Q.1 Answer is "B"

Solution:- A diode is said to be in forward biased mode if its P-side is connected with high potential and N-side is connected with low potential.

Q.2 Answer is "B"

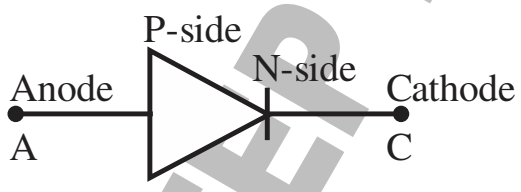
Solution:- During forward biased mode the resistance and width of potential barrier drops.

Q.3 Answer is "C"

Solution:- RC-filter is used to produce pure D.C by pulsating D.C.

Q.4 Answer is "C"

Solution:- Correct labeled diagram of rectifier is



Q.5 Answer is "C"

Solution:- Forward biased resistance is of the order of few ohms while reverse biased resistance is of the order of mega ohms.

Q.6 Answer is "D"

Solution:-

Step-I

For full-wave rectifier:

$$T_{A.C} = 2T_{ripple} = 80\ ms$$

Step-II

$$f_{A.C} = \frac{1}{T_{A.C}} = \frac{1}{80\times10^{-3}} = 12.5\ \text{Hz}$$

Q.7 Answer is "C"

Solution:- During forward biased mode the potential drop across is negligible.

Q.8 Answer is "B"

Solution:- Half wave rectifier have pulsating D.C at output.

Q.9 Answer is "D"

Solution:- Both rectifiers produces pulsating D.C at output.

Q.10 Answer is "A"

Solution:- This rectifier will conduct for negative half of A.C

Q.11 Answer is "A"

Solution:- For identical resistors

$$G_{non-inverting} = 1 + \frac{R_2}{R_1} = 1 + G_{inverting}$$

$$\therefore G_{inverting} = \frac{-R_2}{R_1}$$

-ve sign just shows

180° shift in output

Q.12 Answer is "A"

Solution:- Op-Amp has two input terminals and one output terminal.

Q.13 Answer is "D"

Solution:- Open loop gain is of the order of 10^5.

Q.14 Answer is "D"

Solution:- Op-Amp can be used for all mentioned operations

Q.15 Answer is "B"

Solution:- For non-inverting amplifier

$$G = 1 + \frac{R_2}{R_1}$$

Q.16 Answer is "A"

Solution:- Op-Amp acts as inverting amplifier when input is connected to inverting terminal.

Q.17 Answer is "B"

Solution:- Op-Amp acts as non-inverting amplifier when input is connected to non-inverting terminal.

Q.18 Answer is "D"

Solution:- $G = -\frac{R_2}{R_1}$

Q.19 Answer is "D"

Solution:- $G = 1 + \frac{R_2}{R_1}$

Q.20 Answer is "D"

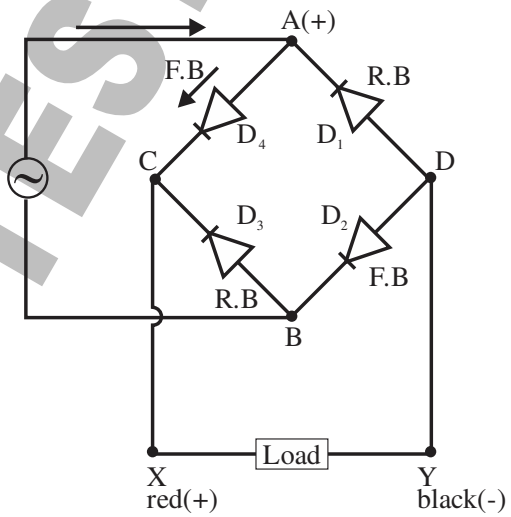
Solution:- $G = -\frac{R_2}{R_1}$

Q.21 Answer is "A"

Solution:-

Checking for option "A" during (0-T/2)

During this half D_2 and D_4 will be forward biased. When direction of current is traced, it is from X $\rightarrow$ Y on output side. Since conventional current flow from high to low potential, so X will be at +ve potential w.r.t Y. As labeled "X" is made red terminal so this satisfies the design conditions. Similarly check for negative half, same result will come, so "A" option is correct.



Q.22 Answer is "C"

Solution:-

Finding $I_\circ$

$$I_\circ = \frac{\varepsilon_\circ}{R} = \frac{250}{100} = \frac{5}{2}\ A$$

Finding I_{rms}

For half wave rectifier;

$$I_{rms} = \frac{I_\circ}{2} = \frac{\frac{5}{2}}{2} = \frac{5}{4}\ A$$

Q.23 Answer is "A"

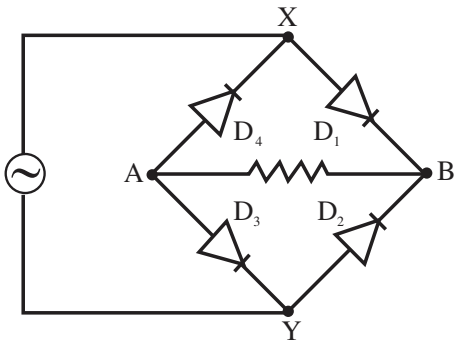
Solution:-

Taking D_1 off will result only one diode in circuit, so it will behave as half wave rectifier.

Q.24 Answer is "B"

Solution:-

During negative half, X will become -ve and Y will become +ve. Consequently, D_1 and D_3 will become reverse biased and D_2 & D_4 will become forward biased. The conventional current will flow from Y toward B and then from B towards A.



Q.25 Answer is "D"

Solution:-

All the given circuits are of half wave rectification, so ripple frequency will be same for all.

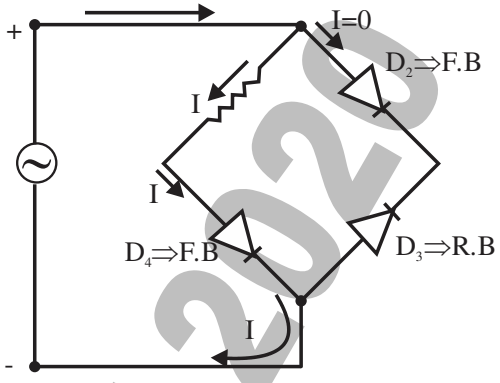
Q.26 Answer is "D"

Solution:-

When anyone out of four diodes is replaced by resistor, the circuit behaves as half wave rectifier. For example, if D_1 is replaced by resistor the circuit for both halves of A.C will be:

For +ve half

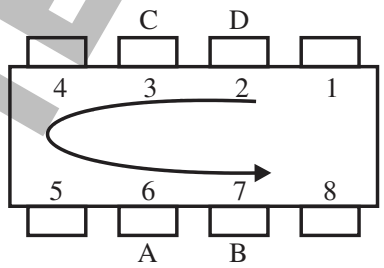
A positive pulse will be output across resistor during this half. Check for negative half, current won't flow as it will not find any close path.



Q.27 Answer is "D"

Solution:-

Op-Amp numbering is done from capsule side in anti-clockwise direction as following:



Pin "2" (D) & "3" (C) represent inverting and non-inverting inputs terminals.

- Pin "6" (A) represents output terminal.
- Pin "4" & "7" represent $\pm V_{cc}$.
- Pin "1" & "5" represent offset null terminals.
- Pin "8" represents NC terminal (not connected).

Q.28 Answer is "B"

Solution:-

By ohm's Law

$$I = \frac{\Delta V}{R} = \frac{-4 - V_-}{8k\Omega} \qquad (\because V_- \approx V_+ = 0)$$

$$I = \frac{-4-0}{8k\Omega} = -0.5mA$$

STEP

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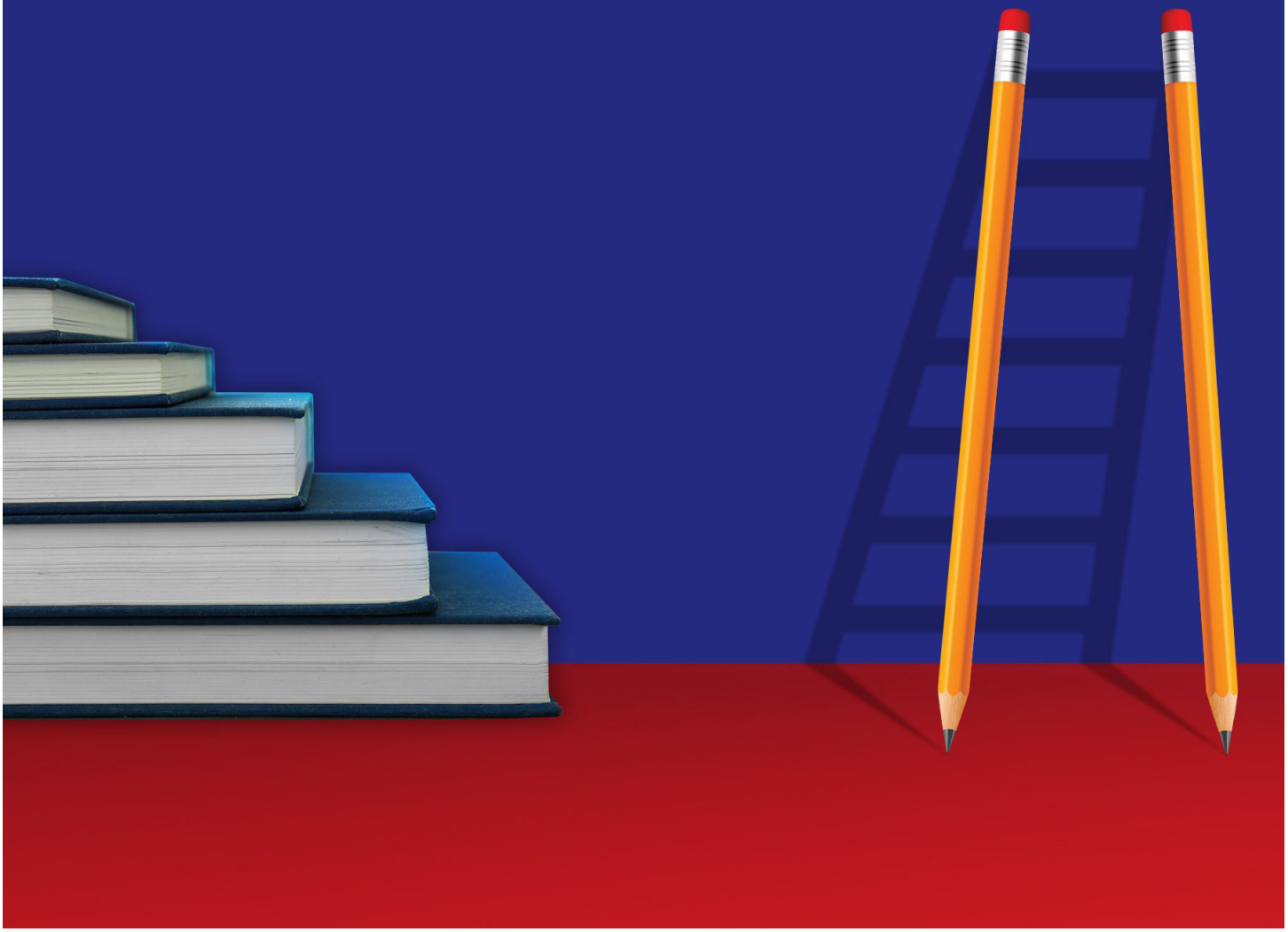
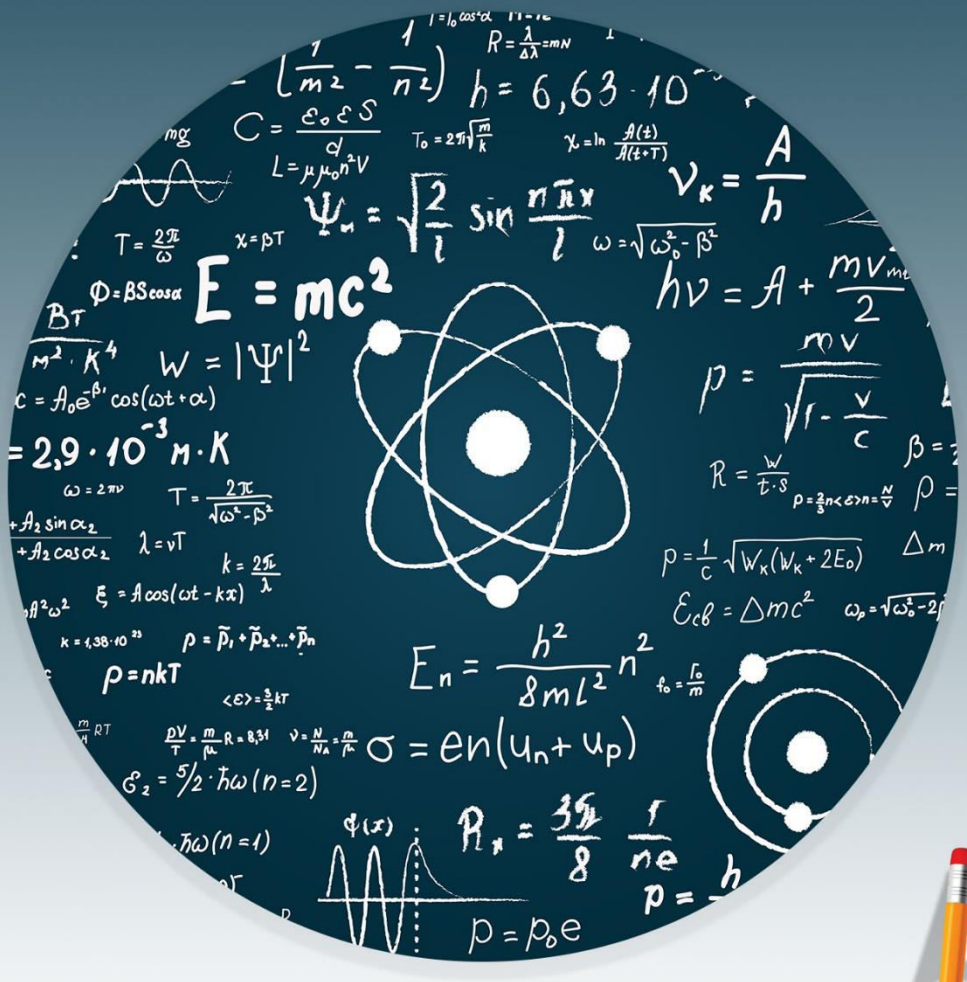


PHYSICS



WORKSHEET-6

STEP

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Worksheet-06

Topics:- Stress strain & Young's Modulus, Hook's Law, Elastic & Plastic deformation, Strain energy, Energy Band Theory

USE THIS SPACE FOR SCRATCH WORK

Q.1 The amount of strain energy stored in deformed stretched wire is equal to:

A) $\frac{1}{2}\left[\frac{EAl_1^2}{L}\right]$ C) $\frac{1}{2}\left[\frac{EAl_1}{2}\right]$

B) $\frac{1}{2}\left[EAl_1\right]^3$ D) $\left[\frac{EAl_1}{2}\right]$

Q.2 Glass and high carbon steel are examples of:

A) Hard substances C) Brittle substances

B) Ductile substances D) None of these

Q.3 Substance which break just after the elastic limit is reached, are called:

A) Brittle substances C) Soft substances

B) Hard substances D) Ductile substances

Q.4 Two bars A and B of circular cross-sectional area and of same volume made of same material are subjected to tension. If the diameter of A is half that of B and if force applied to both rods is the same, the ratio of extension of A to that of B will be:

A) 16 C) 4

B) 8 D) 2

Q.5 The substances which undergo plastic deformation until they break are called:

A) Soft substances C) Brittle substances

B) Ductile substances D) Hard substances

Q.6 The value of stress beyond which the body is permanently deformed is called:

A) Yield stress C) Plastic stress

B) Minimum stress D) None of these

Q.7 If stress is increased beyond the elastic limit of the material, it becomes permanently changed this behavior is called:

A) Plasticity C) Yield strength

B) Elasticity D) Rigidity

Q.8 Stress is directly proportional to strain within the elastic limit is:

A) Newton's law C) Hook's law

B) Lenz's law D) Faraday's law

Q.9 S.I unit of modulus of elasticity is/are:

A) Pascal C) Ampere

B) Newton D) Volt

Q.10 Temporary deformation is called:

A) Elastic deformation C) Yield strength

B) Plastic deformation D) Soft deformation

Q.11 Beyond ultimate tensile stress the stress at which material breaks is called:

A) Fracture stress C) Volumetric stress

B) Tensile stress D) Rigidity

Q.12 The units of elastic limit are of:

A) Energy density C) Both "A" and "B"

B) Young's modulus D) No units

Q.13 The area under stress-strain graph provides _____ stored in deformed object:

A) Energy C) Modulus of rigidity

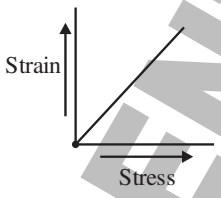
B) Energy density D) Energy intensity

Q.14 The modulus of elasticity depends upon:

A) Nature of material C) Both "A" and "B"

B) Temperature D) Area of cross section

Q.15 The slope of the following graph provides:



A) Modulus of elasticity C) Hardness

B) Compressibility D) Ductility

Q.16 The units of proportional limit are:

A) $N\ m^{-2}$ C) Both "A" and "B"

B) Pascal D) No units

Q.17 What is the relation between stress σ and modulus of elasticity (Y) if length of a wire under stress is doubled?

A) $\sigma > Y$ C) $\sigma = Y$

B) $\sigma < Y$ D) None of these

USE THIS SPACE FOR SCRATCH WORK

Q.18 The stress has same units as that of:

A) Pressure C) Bulk modulus

B) Energy density D) All of these

Q.19 A wire of radius "r", breaking force F_B and breaking stress (σ_B) is stretched such that its radius becomes half, the new breaking force and stress will be:

A) F_B, σ_B C) $\frac{F_B}{2}, \frac{\sigma_B}{2}$

B) $\frac{F_B}{4}, \sigma_B$ D) None of these

Q.20 A wire breaks if a load of "W" is suspended with it. Now if it is cut into two equal parts these parts will break if a load of _____ is suspended.

A) $\frac{W}{2}$ C) $\frac{W}{4}$

B) W D) $\frac{W}{3}$

Q.21 The breaking stress depends on:

A) Material of wire

B) Area of cross section of wire

C) Length of wire

D) Diameter of wire

Q.22 Compressive stress is given by:

A) $\frac{F}{\ell}$ C) $\frac{F}{V}$

B) FA D) $\frac{F}{A}$

Q.23 The breaking force of a wire depends on:

A) Material of wire

B) Area of cross section of wire

C) Change is length of wire when stress is applied

D) All of these

Q.24 The ratio of tensile stress to volume stress has units same as that of:

A) Area C) Volume

B) Length D) Referactive index

Q.25 A wire is stretched so that its length becomes double of initial length. The strain produced is:

USE THIS SPACE FOR SCRATCH WORK

A) 2 C) 1

B) $\frac{1}{2}$ D) 4

Q.26 A load "W" is suspended with a wire causes an extension of "$\Delta\ell$" in the length of wire. Now if the wire is cut into two equal parts & same load is suspended with each part, the extension caused in each part will be:

A) $\Delta\ell$ C) $\frac{\Delta\ell}{2}$

B) $2\Delta\ell$ C) $\frac{\Delta\ell}{4}$

Q.27 If a stress changes the shape of a crystal by 45°, the strain occurred will be :

A) $\frac{1}{\sqrt{2}}$ C) $\sqrt{2}$

B) 1 D) $\frac{1}{2}$

Q.28 If the temperature of a copper wire is increased, its modulus of elasticity _____.

A) Increases C) Decreases

B) Remains same D) Becomes infinity

Q.29 The ratio of compressive stress to compressive strain is called _____.

A) Young's Modulus C) Bulk Modulus

B) Shear Modulus D) Modulus of rigidity

Q.30 The extension occurred in a wire depends on (For same applied force):

A) Initial length of wire

B) Area of cross section of wire

C) Material of wire

D) All of these

Q.31 To cause greater extension a wire should be:

A) Thin and short C) Thick and long

B) Thin and long D) Thick and short

Q.32 Young's Modulus is also named as:

A) Modulus of rigidity C) Bulk modulus

B) Shear modulus D) Tensile modulus

USE THIS SPACE FOR SCRATCH WORK

Q.33 The reciprocal of bulk modulus is called:

A) Stiffness C) Hardness

B) Toughness D) Compressibility

Q.34 Shear modulus and Young's modulus for water are:

A) Undefined C) Zero

B) $2.2\times10^{9}\ Nm^{-2}$ D) None of these

Q.35 Modulus of rigidity is another name for:

A) Young's modulus C) Bulk modulus

B) Shear modulus D) None of these

Q.36 Modulus of elasticity for a perfect elastic/rigid body is:

A) Zero C) Very large

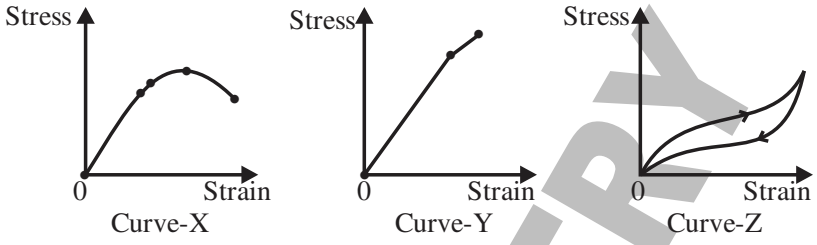
B) Very small D) Infinite

Q.37 Which of following is more elastic?

A) Rubber C) Glass

B) Steel D) Lead

Q.38 Three stress-strain graph are shown as:



Curve X, Y & Z represent which substance respectively?

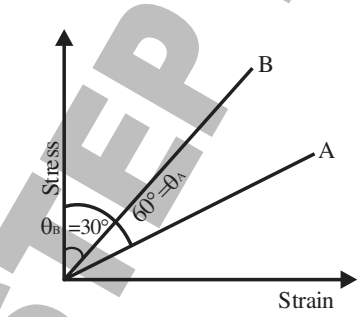
A) Brittle, ductile, rubber

B) Rubber, brittle, ductile

C) Ductile, brittle, rubber

D) None of these

Q.39 The stress-strain graphs for two wires of A and B are shown as:



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$\frac{Y_A}{Y_B}$ =_____?

A) 1:3 C) 3:1

B) $\sqrt{3}$:1 D) 1: $\sqrt{3}$

Q.40 The slope of graph between strain and stress taking strain on y-axis and stress on x-axis represents?

A) Elastic modulus

B) Energy density

C) Tensile stress

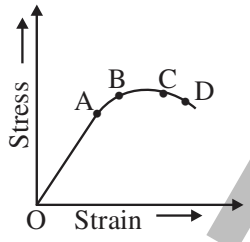
D) Reciprocal of elastic modulus

Q.41 In a tensile test a wire is stretched such that its radius becomes half of present value when the load suspended is doubled If the initial value of Young's Modulus is "Y", then new value of Modulus will be:

A) 2Y C) $\frac{Y}{2}$

B) 4Y D) Y

Q.42 In the following curve for a ductile substance the plasticity behavior is from:



A) O to A C) O to B

B) O to C D) B to C

Q.43 Referring to graph shown in Question 42, Hook's law is obeyed from:

A) O to A C) O to B

B) O to C D) B to C

Q.44 Referring to graph shown in Question 42, the elasticity region is from:

A) O to A C) O to B

B) O to C D) B to C

Q.45 A stress of 200 x 10^5 Pa is applied on a 2 m long rod through a mass of 5000 Kg. If the linear strain of the rod is 10^{-4} m, the Young's modulus Y is:

A) 1.5 x 10^{-4} Pa C) 1.5 x 10^4 Pa

B) 2 x 10^5 Pa D) 200 x 10^9 Pa

Q.46 An iron cube of length 1 m is acted upon by a tangential

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force of 10^5 N due to which the upper face the cube is displaced by 0.02 cm w.r.t the bottom face. Then the shearing stress of the cube will be:

A) 0.02 Pa
C) 10^5 Pa
B) 0.02 x 10^5 Pa
D) 3 x 10^5 Pa

Q.47 Referring to data in Question 46, what will be the shearing strain?

A) 0.02
C) 10^5
B) 0.02 x 10^{-2}
D) 2 x 10^5

Q.48 A certain force increases the length of a wire by 1 mm which of the following is required to increase the length by 2 mm:

A) 2F
C) 4F
B) 8F
D) 16F

Q.49 Steel has greater modulus of elasticity than rubber thus for larger strain in rubber it requires stress:

A) Less as compared to steel
B) Larger as compared to steel
C) Equal as compared to steel
D) Very high as compared to steel

Q.50 A steel wire 12 mm in diameter is stretched by a force of 36π N, the tensile stress will be:

A) 2 MPa
C) 1 MPa
B) 0.5 μPa
D) None of these

Q.51 A steel wire is loaded by 2 Kg, if the radius of the wire is halved uniformly, then length becomes:

A) Double
C) Half
B) Four times
D) Remains same

Q.52 There are two wires A and B of same material and same length while the diameter of wire B is 2 times the diameter of wire A. Then ratio of the extensions produced in the wires by applying the same force will be

A) 1:1
C) 2:1
B) 3:1
D) None of these

Q.53 Two wires of the same material and radius but having lengths in the ratio 1:2 are stretched with the same force. The ratio of the work done in the two cases will be:

A) 1:1
C) 1:2
B) 1:4
D) None of these

Q.54 Which of following option contain only Brittle substances?

A) Cast iron, ice, high carbon steel
B) Platinium, mild steel, glass
C) Lead, ice, glass
D) None of these

USE THIS SPACE FOR SCRATCH WORK

Q.55 If stress is applied on a body then ratio of change in volume to original volume will be:

A) Polymeric strain C) Volumetric strain

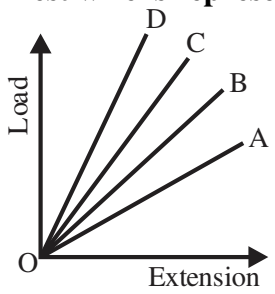
B) Parallel strain D) Tensile strain

Q.56 Following four wires of length L and radius r are made from same material. Which of the following has largest elongation when same tension is applied?

A) L=50 cm, r=0.25 mm C) L=60cm, r=0.1 mm

B) L=50 cm, r=0.5 mm D) L=60cm, r=1 mm

Q.57 The load versus elongation graph for some material is shown. The thinnest wire is represented by:



A) OB C) OD

B) OA D) OC

Q.58 A rubber cord 10m long is suspended vertically. How much stress is applied on it due to its own weight while density of rubber is 1500 kgm^{-3} and $Y = 5\times10^{8}\ Nm^{-2}$?

A) 1500 Nm^{-2} **C) 150000 Nm^{-2}**

B) 15000 Nm^{-2} D) 30000 Nm^{-2}

Q.59 The Young's Modulus of steel is twice that of brass. Two wires of same length and of same area of cross section, one of steel and other of brass are suspended from same roof. We want the lower ends of the wires to be at the same level, then the weight added to the steel and brass wires must be in the ratio of:

A) 1:2 C) 4:1

B) 2:1 D) 1:1

Q.60 A metal rod of Young's Modulus 2×10^{10} Nm^{-2} undergoes an elastic strain of 0.06%. The energy per unit volume stored in Jm^{-3} is:

A) 3600 C) 1800

B) 7200 D) 900

Q.61 The electrical properties of solids are successfully explained by _____ which is based on _____.

A) Conventional free electron theory, Bohr model

B) Classical theory, Rutherford model

C) Energy band theory, Rutherford model

D) Energy band theory, wave mechanical model

Q.62 The electrical conductivities of semiconductors ranges from:

A) 10^{7} to 10^{9} $(\Omega\ m)^{-1}$ C) 10^{-6} to 10^{-2} $(\Omega\ m)^{-1}$

B) 10^{-20} to 10^{-10} $(\Omega\ m)^{-1}$ D) 10^{-6} to 10^{-4} $(\Omega\ m)^{-1}$

Q.63 Which one is not similarity between conductors and semiconductors?

A) Both have partially fill conduction band

B) Both have partially fill valence band

C) Both can conduct current

D) Both become insulator at zero kelvin

Q.64 The majority charge carriers in n-type substance are:

A) Electrons C) Positive charges

B) Holes D) All of these

Q.65 The minority charge carriers in p-type substance are:

A) Electrons C) Positive charges

B) Holes D) All of these

ANSWER KEY (Worksheet-06)							
1	A	21	A	41	D	61	D
2	C	22	D	42	D	62	D
3	A	23	D	43	A	63	D
4	A	24	D	44	C	64	A
5	B	25	C	45	D	65	A
6	A	26	C	46	C		
7	A	27	B	47	B		
8	C	28	C	48	A		
9	A	29	A	49	A		
10	A	30	D	50	C		
11	A	31	B	51	B		
12	C	32	D	52	D		
13	B	33	D	53	C		
14	C	34	C	54	A		
15	B	35	B	55	C		
16	C	36	D	56	C		
17	C	37	B	57	B		
18	D	38	C	58	C		
19	B	39	A	59	B		
20	B	40	D	60	A		

SOLUTIONS

Unit – 7 (WS-06)

Q.1 Answer is "A"

Solution:- Strain Energy $= \frac{1}{2}\left[\frac{EA\ell_1^2}{L}\right]$

Here;

$\ell_1 = \Delta\ell$ and L = Initial Length

A = area of cross section

E = Elastic Modulus

Q.2 Answer is "C"

Solution:- The examples of Brittle Substances are; Glass, high carbon steel, cast iron, ice, various ceramics etc.

The examples of ductile substances are; Lead, Copper, Aluminium, Platinium, wrought iron mild steel etc.

Q.3 Answer is "A"

Solution:- "The substances which break just after the elastic limit is reached are called brittle substances."

Q.4 Answer is "A"

Solution:-.

$V_1=V_2, F_1=F_2, Y_1=Y_2$

Extension is given as:

$$\Delta\ell = \frac{F\ell}{YA} = \frac{F(\ell A)}{YA^2} = \frac{FV}{YA^2}$$

Since

F, V and Y is same, so;

$$\frac{\Delta\ell_1}{\Delta\ell_2} = \frac{A_2^2}{A_1^2} = \frac{d_2^4}{d_1^4}$$

Put $d_1 = \frac{d_2}{2}$ and solve.

Q.5 Answer is "B"

Solution:- "The substances which undergo plastic deformation until they break are called ductile substances."

Q.6 Answer is "A"

Solution:- "The value of stress beyond which a body is permanently deformed is called yield stress."

Q.7 Answer is "A"

Solution:- "The permanent deformation of substances is called plasticity."

Q.8 Answer is "C"

Solution:- Hook's Law states:

"Within the elastic limits (upto proportional limits) of a substance, the stress applied is directly proportional to strain produced in that substance."

Q.9 Answer is "A"

Solution:-

Modulus of Elasticity = $\frac{stress}{strain} = \frac{N}{m^2}$

Modulus of elasticity = Pascal

Q.10 Answer is "A"

Solution:- Temporary deformation is called elastic deformation, while permanent deformation is called plastic deformation.

Q.11 Answer is "A"

Solution:- "Breaking stress/Fracture stress is the stress at which the structure of material breaks."

Q.12 Answer is "C"

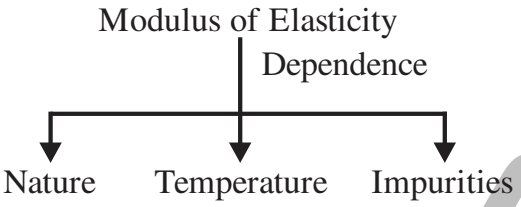
Solution:- Elastic limit is basically stress, so it has units of stress, which are same as that of elastic modulus & energy density.

Q.13 Answer is "B"

Solution:- Area under stress strain curve gives energy density while area under force elongation graph gives energy.

Q.14 Answer is "C"

Solution:-



Q.15 Answer is "B"

Solution:-

$$Slope = \frac{\Delta y}{\Delta x} = \frac{\Delta strain}{\Delta stress} = compressibility$$

Q.16 Answer is "C"

Solution:- Proportional limit is basically stress, so it has units of stress.

Q.17 Answer is "C"

Solution:- Doubling the length makes strain=1, So,

$$Y = \frac{\sigma}{strain} = \sigma$$

Q.18 Answer is "D"

Solution:- The unit of stress, pressure, elastic modulus and energy density are same i.e Nm^{-2} or Pascal.

Q.19 Answer is "B"

Solution:- Breaking force of a wire is given as

$F_B = \sigma_B A = \sigma_B \left(\pi r^2\right)$ this breaking force depends on:

i. Breaking stress σ_B (which further depends on the nature of material of wire, σ_B does not depend on dimensions of wire.)

ii. Area of cross section (which further depend on radius of wire)

Since the radius of wire is halved, so area of cross section of wire and its breaking force becomes $\frac{1}{4}$ times while breaking stress remains same as material of wire is not changed.

Q.20 Answer is "B"

Solution:- Breaking Force/Load depends on:

i. Breaking stress (which further depend on material of wire)

ii. Area of cross section (which further depend on radius of wire)

By cutting the wire, neither area of cross section changes nor breaking stress changes, so breaking load remains same.

Q.21 Answer is "A"

Solution:- Breaking stress is the property of material of wire, so it only depend on the material of wire and not the dimensions of wire.

Q.22 Answer is "D"

Solution:- All the types of stress have same formula i.e $\frac{F}{A}$

Q.23 Answer is "D"

Solution:- Breaking force of a wire is given as:

$F_B = \sigma_B A = \sigma_B \left(\pi r^2\right)$

It depends on:

i. Breaking stress (which further depends on material of wire)

ii. Area of cross section (which further depend of radius of wire, also if wire is stretched then because of change in length of wire both its radius and area change and hence it will change breaking force as well).

Q.24 Answer is "D"

Solution:-

$$\frac{\text{Tensile stress}}{\text{Volume stress}} = \frac{\left(\frac{F}{A}\right)}{\left(\frac{F}{A}\right)} = unitless$$

Q.25 Answer is "C"

Solution:- $Strain = \frac{\Delta\ell}{\ell} = \frac{2\ell - \ell}{\ell} = 1$

Q.26 Answer is "C"

Solution:- $\Delta\ell \propto \ell$

Q.27 Answer is "B"

Solution:- $Shear\ strain = \tan\theta$

Q.28 Answer is "C"

Solution:-

$$Modulus\ of\ Elasticity \propto \frac{1}{temperature}$$

Q.29 Answer is "A"

Solution

$$\text{Tensile/Young's Modulus} = \frac{\text{Tensile (compressive)Stress}}{\text{Tensile (compressive) Strain}}$$

Q.30 Answer is "D"

Solution:- $\Delta\ell = \frac{FL}{YA}$

Q.31 Answer is "B"

Solution:- $\Delta\ell = \frac{FL}{YA}$ and $\Delta\ell \propto \mathrm{L}$, $\Delta\ell \propto \frac{1}{\mathrm{A}}$

Q.32 Answer is "D"

Solution:-

- Modulus of rigidity is another name of shear modulus.
- Tensile modulus is another name of Young's Modulus.

Q.33 Answer is "D"

Solution:- Compressibility is defined as:

$$\text{Compressibility} = \frac{1}{\text{Bulk Modulus}}$$

Q.34 Answer is "C"

Solution:- For fluids both Y=0 and G=0

Q.35 Answer is "B"

Solution:-

- Modulus of rigidity is another name of shear modulus
- Tensile modulus is another name of Young's Modulus

Q.36 Answer is "D"

Solution:- For ideal rigid body

$\Delta\ell$ =0; ΔV=0; $\Delta\theta$ =0 So, Y=G=K= ∞

Q.37 Answer is "B"

Solution:- Among the given options, rubber is least elastic while steel is most elastic.

Q.38 Answer is "C"

Solution:- Curve–X represents ductile substance as it contains plastic region, Curve-Y represents Brittle substance as it contains only elastic region and Curve–Z represents the loading & unloading of rubber.

Q.39 Answer is "A"

Solution:- Slope of stress-strain graph

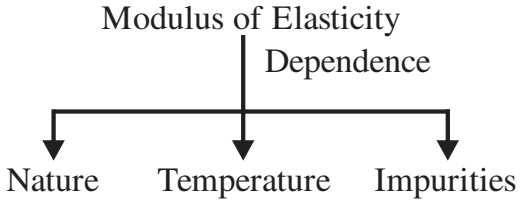
$$\frac{\Delta stress}{\Delta strain} = tan\theta = Y$$

Q.40 Answer is "D"

Solution:- Slope $= \frac{\Delta y}{\Delta x} = \frac{\Delta strain}{\Delta stress}$

Q.41 Answer is "D"

Solution:-



Q.42 Answer is "D"

Solution:-

- From O→A the region is proportional limit region
- From O→B the region is elastic limit region
- From B→C the region is plasticity region

Q.43 Answer is "A"

Solution:-

- From O→A the region is proportional limit region
- From O→B the region is elastic limit region
- From B→C the region is plasticity region

Q.44 Answer is "C"

Solution:-

- From O→A the region is proportional limit region
- From O→B the region is elastic limit region
- From B→C the region is plasticity region

Q.45 Answer is "D"

Solution:- $Y = \frac{stress}{strain}$

Q.46 Answer is "C"

Solution:- $\sigma = \frac{F}{A} = \frac{F}{\ell^2}$

Q.47 Answer is "B"

Solution:- $\gamma = \frac{\Delta a}{a} = \frac{\Delta a}{\ell}$

Q.48 Answer is "A"

Solution:-

By Hook's law

$F \propto x$

Q.49 Answer is "A"

Solution:- Elastic Modulus $= \frac{Stress}{Strain}$

Thus for larger value of strain in less elastic material rubber, the stress will be smaller.

Q.50 Answer is "C"

Solution:- $\sigma = \frac{F}{A} = \frac{F}{\pi r^2}$

Q.51 Answer is "B"

Solution:- If radius is halved, area becomes $\frac{1}{4}$ times, so to keep volume constant length becomes four times.

Q.52 Answer is "D"

Solution:- $\Delta\ell = \frac{F \times L}{A \times Y} \Rightarrow$

For same materials & same loads;

$$\frac{\Delta\ell_A}{\Delta\ell_B} = \frac{L_A A_B}{A_A L_B}$$

Q.53 Answer is "C"

Solution:- $W = \frac{1}{2} F \times \Delta\ell \Rightarrow$

For two wires of same materials and same stretching force;

$$\frac{W_1}{W_2}=\frac{\Delta\ell_1}{\Delta\ell_2}$$

Q.54 Answer is "A"

Solution:- The examples Brittle Substances are; Glass, high carbon steel, cast iron, ice, various ceramics etc.

The examples of Ductile substances are; Lead, Copper, Aluminium, Platinium, wrought iron mild steel etc.

Q.55 Answer is "C"

Solution:- Volumetric strain = $\frac{\Delta V}{V}$

Q.56 Answer is "C"

Solution:-

Elongation in a wire is given as:

$$\Delta\ell=\frac{F\ell}{YA}=\frac{F\ell}{Y\left(\pi r^2\right)}$$

$$\Delta\ell\propto\frac{\ell}{r^2}$$

Since "$\frac{\ell}{r^2}$" is maximum for option "C", so elongation will be maximum for this wire.

Q.57 Answer is "B"

Solution:-.

Slope of this graph is given as:

Slope = $\frac{\Delta F}{\Delta\ell}$ ---------(i)

As extension in a wire is given as:

$$\Delta\ell=\frac{F\ell}{YA}$$

$$\frac{F}{\Delta\ell}=\frac{YA}{\ell}$$

From equation (i)

Slope = $\frac{\Delta F}{\Delta\ell}=\frac{YA}{\ell}$

Slope $\propto$ A

Since slope for graph "A is minimum, so wire – A (given in option B) is thinnest.

Q.58 Answer is "C"

Solution:-.

Stress is given as:

$$\sigma=\frac{F}{A}=\frac{mg}{A}=\frac{\rho Vg}{A}=\frac{\rho\left(A\ell\right)g}{A}$$

$$\sigma=\rho\ell g=1500\times10\times10=150{,}000\ N\,m^{-2}$$

Q.59 Answer is "B"

Solution:-.

The extension is given as:

$$\Delta\ell=\frac{F\ell}{YA}$$

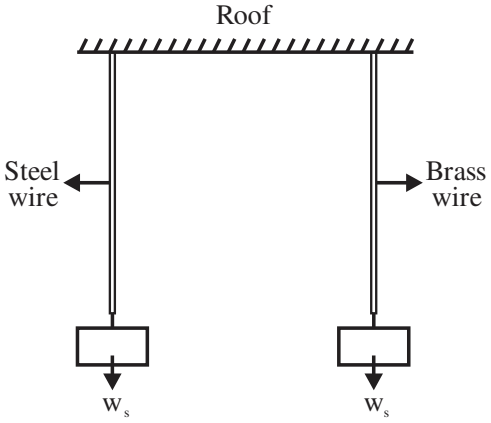
Separating the load/force

$$F=\frac{\Delta\ell\,YA}{\ell}$$

Applying this formula for both wires;

$$\frac{F_S}{F_B}=\frac{\left(\frac{\Delta\ell\,YA}{\ell}\right)_S}{\left(\frac{\Delta\ell\,YA}{\ell}\right)_B}$$

$$\frac{F_S}{F_B}=\frac{Y_S}{Y_B}=\frac{2Y_B}{Y_B}=\frac{2}{1}$$



$\left(\therefore \Delta\ell_s=\Delta\ell_B, A_s=A_B, \ell_s=\ell_B\right)$

Q.60 Answer is "A"

Solution:-.

(energy per unit volume) $=\frac{1}{2}\sigma\varepsilon=\frac{1}{2}Y\varepsilon^2$

$$= \frac{1}{2} \times 2 \times 10^{10} \times \left(\frac{0.06}{100} \right)^2$$

$$= 10^{10} \times 36 \times 10^{-8}$$

(energy per unit volume) $= 3600\ J\ m^{-3}$

Q.61 Answer is "D"

Solution:- Energy band theory explains the electrical properties of solids and it is based on wave-mechanical model.

Q.62 Answer is "D"

Solution:- For Semiconductors: Conductivity ranges from 10^{-6} to 10^{-4} $(\Omega\ m)^{-1}$.

Q.63 Answer is "D"

Solution:- Conductors don't become insulator at zero kelvin rather they become super conductors.

Q.64 Answer is "A"

Solution:- In N-type Semiconductors, the majority carriers are electrons.

Q.65 Answer is "A"

Solution:- Electrons are minority carriers in P-type semiconductor.

STEP

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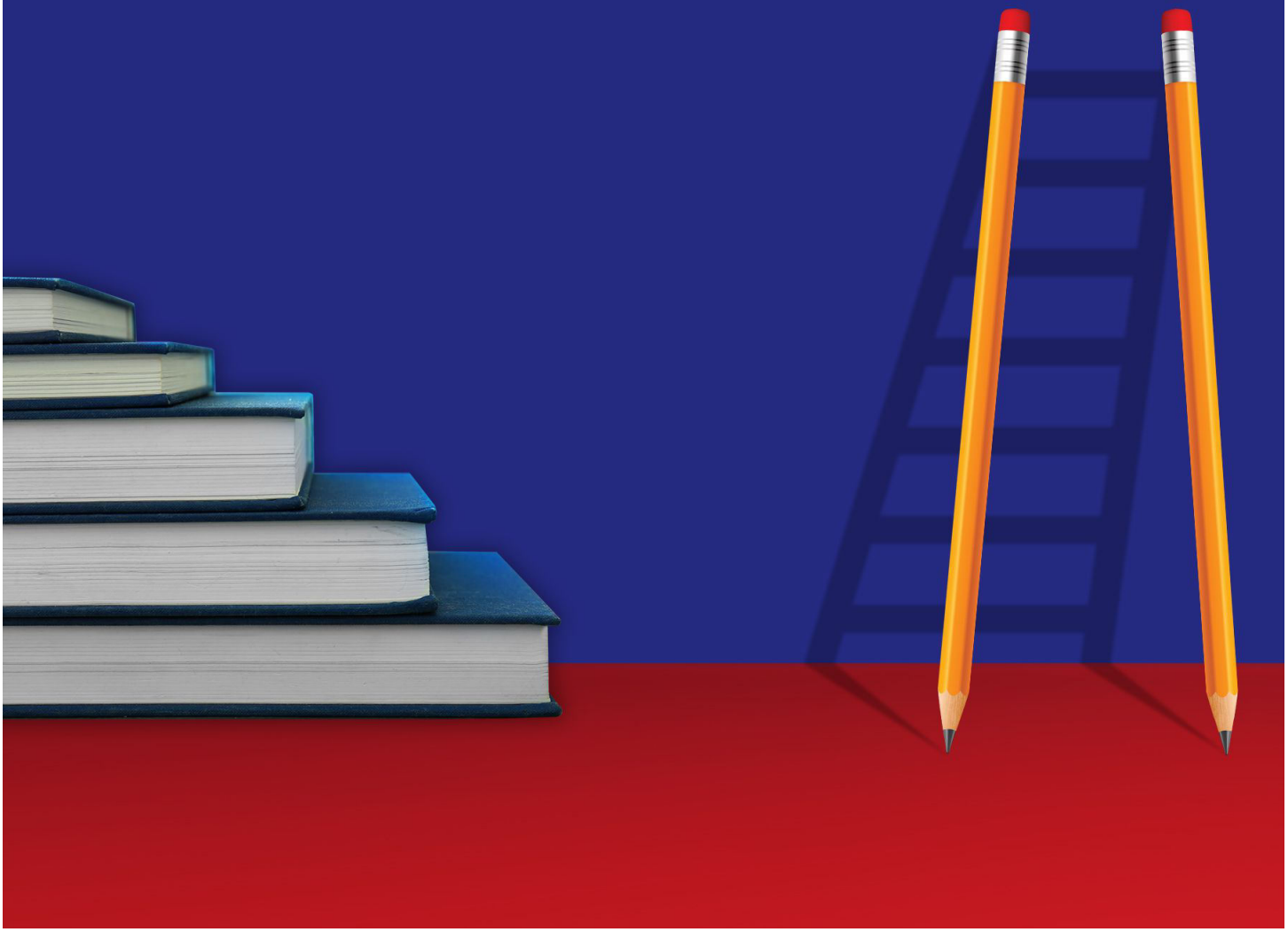
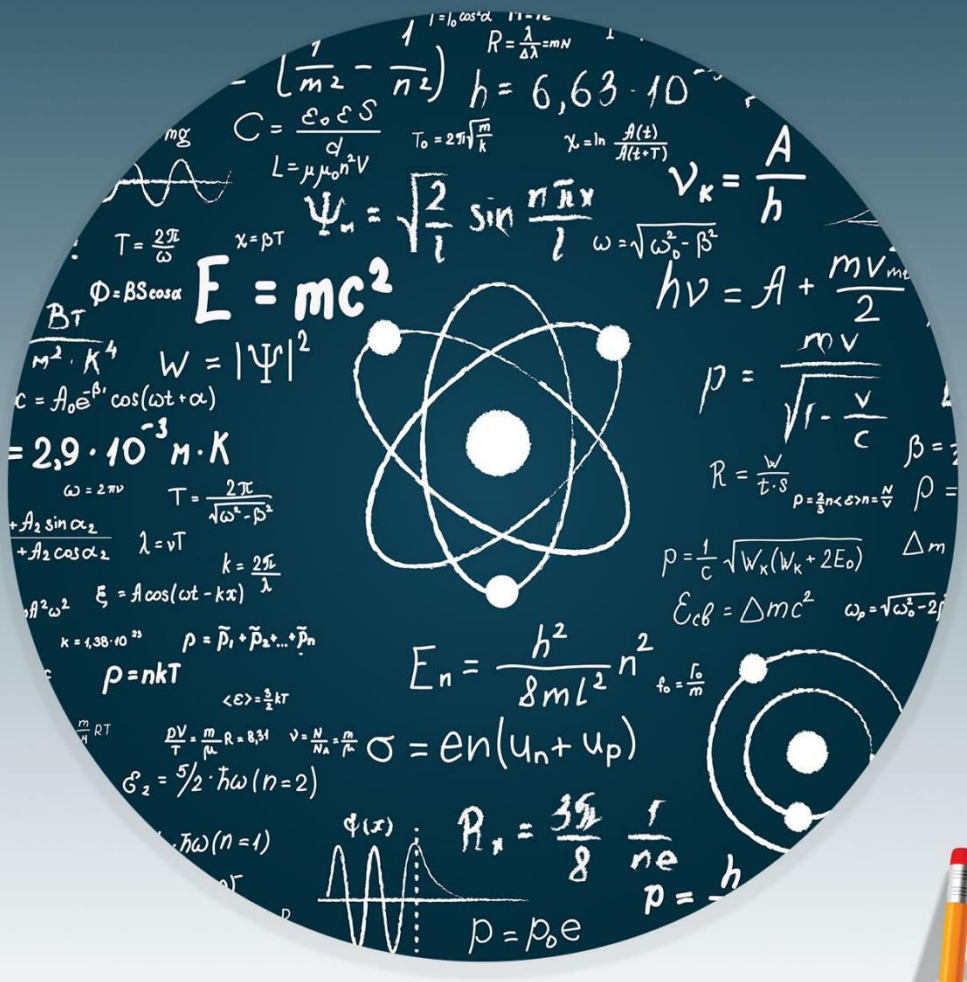


PHYSICS



WORKSHEET-7

STEP

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Worksheet-07

Topics:- Energy of Photon, Photoelectric Effect, de-Broglie Wave Particle Duality

USE THIS SPACE FOR SCRATCH WORK

Q.1 Which of the following light has highest momentum?

A) Blue C) Yellow

B) Violet D) Red

Q.2 If energy of a photon A is twice the energy of photon B, then ratio of their momenta $\frac{p_A}{p_B} =$

A) 2 C) 4

B) $\frac{1}{2}$ D) $\frac{1}{4}$

Q.3 Which of the following properties, the photon does not possess:

A) Rest mass C) Momentum

B) Energy D) Frequency

Q.4 The energy of a photon of frequency f is given by E= hf, where h is Plank's constant. The momentum of a photon of wavelength λ is $p = \frac{h}{\lambda}$. Then we may conclude that velocity of light is equal to:

A) $\left(\frac{E}{p}\right)^{1/2}$ C) Ep

B) $\left(\frac{E}{p}\right)$ D) $\left(\frac{E}{p}\right)^2$

Q.5 If the value of h is 6.6×10^{-34} J s, the energy of a quantum of frequency 10^{15} Hz will be:

A) 6.6×10^{-19} J C) 6.6×10^{-49} J

B) 6.6×10^{-12} J D) 6.6×10^{-41} J

Q.6 If stopping potential is 3 volts. The maximum K.E of photoelectron is:

A) 1.6×10^{-19} J C) 4.8×10^{-19} J

B) 3.2×10^{-19} J D) 6.4×10^{-19} J

Q.7 $K.E_{max}$ of photoelectrons depends upon.

A) Intensity of light C) Energy of light

B) Frequency of light D) Both B and C

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Q.8 **If work function for a surface is $\frac{h}{2}$ then photoelectric threshold frequency is (where h is plank's constant)**

A) 1 Hz C) 1.5 Hz

B) 0.5 Hz D) 2 Hz

Q.9 **Which cathode material emits photoelectrons for white light?**

A) Potassium cathode

B) Cesium coated oxidized silver cathode

C) Both A and B

D) Aluminum cathode

Q.10 **A brighter light as compared to a dimmer light of same colour will eject:**

A) More number of electrons C) Electrons of greater K.E

B) Less number of electrons D) Electrons of lesser K.E

Q.11 **The mass of moving photon is:**

A) $\frac{h}{\lambda c}$ C) Zero

B) $\frac{hc}{\lambda}$ D) $\frac{hf}{\lambda}$

Q.12 **Which of the following equation represent Einstein's equation of photoelectric effect K.E $_{max}$=?**

A) hf C) hf_o

B) $h(f+f_o)$ D) $h(f-f_o)$

Q.13 **On increasing the frequency of incident light in photoelectric effect:**

A) Photoelectric current decrease

B) Photoelectric current increases

C) Stopping potential increases

D) Stopping potential decreases

Q.14 **If a photon of energy 5.2 eV strikes a metal surface of work function 4 eV, then maximum K.E. of photoelectrons is.**

A) 9.2 eV C) 4.2 eV

B) 1.5 eV D) 1.2 eV

Q.15 **The slope of the graph between $K.E_{max}$ of photoelectrons and frequency of incident light gives units of:**

A) h C) $\frac{e}{h}$

B) $\frac{h}{e}$ D) he

Q.16 **When light of wavelength 100 nm falls on a metal, photoelectrons are ejected. If another light of 200 nm is sufficient for photoemission from another metal, then ratio of work function of two metals is:**

A) 1:2 C) 2:1

B) 4:1 D) 1:4

Q.17 **A source of light is placed at a distance of 10 cm from photocell and stopping potential is V_o if source is now placed at 20 cm then stopping potential will become:**

A) $\frac{V_o}{2}$ C) $\frac{V_o}{4}$

B) $2V_o$ D) V_o

Q.18 **Which one shows wave nature of particles:**

A) Photoelectric effect

B) Compton effect

C) Pair production

D) Davisson and Germer experiment

Q.19 **When a ball is thrown upwards, then its de-Broglie's wavelength will be minimum?**

A) At the point of projection

B) At maximum height

C) At the point midway between the initial and final points

D) Both A and B

Q.20 **If an electron, neutron and a proton have the same de-Broglie wavelength then which particle will have the greatest speed?**

A) Electron C) Neutron

B) Alpha particle D) Proton

Q.21 **If K.E of electron is doubled in Davison Germer experiment then its de-Broglie's wavelength is:**

A) Doubled C) Increased by four times

B) Halved D) None of these

USE THIS SPACE FOR SCRATCH WORK

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Q.22 **If a proton and an alpha particle are accelerated by same voltage, then the ratio of wavelengths associated with them is:**

A) 4:1 C) $2\sqrt{2}:1$

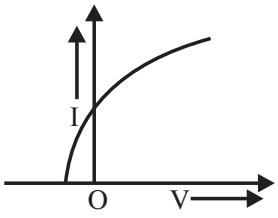
B) 2:1 D) 8:1

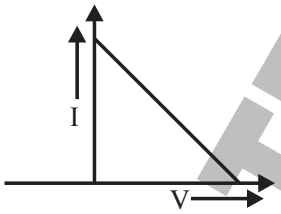
Q.23 **A bullet of mass 40 g and flying with speed 165 m s^{-1} will have a de-Broglie wavelength of:**

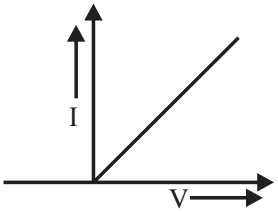
A) 1×10^{-34} m C) 3.3×10^{-34} m

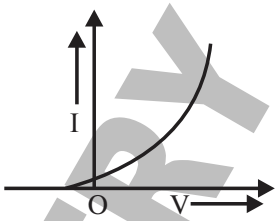
B) 2.4×10^{-34} m D) 6.6×10^{-34} m

Q.24 **The current-voltage (I-V) curve for a photo-cell is best represented by:**

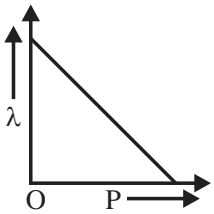
A) 

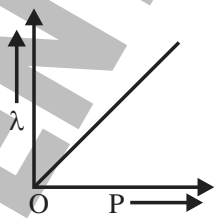
C) 

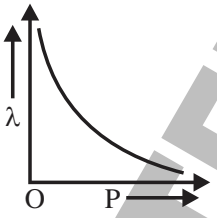
B) 

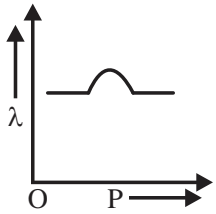
D) 

Q.25 **The de-Broglie wavelength (λ) associated with a moving material particle varies with its momentum p as:**

A) 

C) 

B) 

D) 

ANSWER KEY (Worksheet-07)					
1	B	11	A	21	D
2	A	12	D	22	C
3	A	13	C	23	A
4	B	14	D	24	A
5	A	15	A	25	B
6	C	16	C		
7	D	17	D		
8	B	18	D		
9	A	19	A		
10	A	20	A		

SOLUTIONS

Unit – 10 (WS-07)

Q.1 **Answer is "B"**

Solution:- $p = \frac{h}{\lambda}$

Q.2 **Answer is "A"**

Solution:- $E = mc^2 = pc$

Q.3 **Answer is "A"**

Solution:- The rest mass of photon is zero.

Q.4 **Answer is "B"**

Solution:- $E = mc^2 = pc$

Q.5 **Answer is "A"**

Solution:- $E = hf$

Q.6 **Answer is "C"**

Solution:- K.E = Ve

Q.7 **Answer is "D"**

Solution:- $K.E \propto E_{photon} \propto f$

Q.8 **Answer is "B"**

Solution:- $\phi = hf_{\circ}$

Q.9 **Answer is "A"**

Solution:-

- Sodium or Potassium cathode emits electrons for visible light.
- Cesium coated oxidized silver emits electrons for infrared light.

Q.10 **Answer is "A"**

Solution:- Intensity $\propto$ no. of electrons

Q.11 **Answer is "A"**

Solution:- Mass of a moving photon:

$$E = mc^2 = \frac{hc}{\lambda}$$

$$m = \frac{h}{\lambda c}$$

Q.12 **Answer is "D"**

Solution:- See Einstein's photoelectric equation i.e

$$K.E_{max} = E_{photon} - \phi$$

Q.13 **Answer is "C"**

Solution:- $V_{\circ} \propto f$

Q.14 **Answer is "D"**

Solution:- $K.E = E_{photon} - \phi$

Q.15 **Answer is "A"**

Solution:- $Slope = \frac{\Delta\ K.E}{\Delta f} = h$

Q.16 **Answer is "C"**

Solution:- $\frac{\phi_1}{\phi_2} = \frac{f_1}{f_2} = \frac{\lambda_2}{\lambda_1}$

Q.17 **Answer is "D"**

Solution:- Stopping potential does not depend on distance and Intensity.

Q.18 Answer is "D"

Solution:-Davisson & Germer experiment shows wave nature of particles.

Q.19 Answer is "A"

Solution:- $\lambda = \frac{h}{mv} \Rightarrow \lambda \propto \frac{1}{v}$

Q.20 Answer is "A"

Solution:- $\lambda_1 = \lambda_2 \Rightarrow \frac{h}{m_1 v_1} = \frac{h}{m_2 v_2}$

$\Rightarrow \frac{v_1}{v_2} = \frac{m_2}{m_1} \Rightarrow v \propto \frac{1}{m}$

Q.21 Answer is "D"

Solution:-

$\lambda = \frac{h}{\sqrt{2mVe}}$

$\lambda = \frac{h}{\sqrt{2m\,K.E}}$

$\lambda \propto \frac{1}{\sqrt{K.E}}$

Q.22 Answer is "C"

Solution:-

$$\lambda = \frac{h}{\sqrt{2mVe}} \Rightarrow \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{m_2 e_2}{m_1 e_1}}$$

Q.23 Answer is "A"

Solution:-

$m = 40\ g = 0.04\ kg;\ v = 165\ m\ s^{-1}$

$\lambda = \frac{h}{mv} = \frac{6.63\times10^{-34}}{0.04\times165} = 1\times10^{-34} m$

Q.24 Answer is "A"

Solution:- Photoelectric current is zero at stopping potential. When potential is decreased from stopping potential to zero and then increased on positive side current increase for some time and then becomes constant.

Q.25 Answer is "B"

Solution:- $\lambda = \frac{h}{mv} = \frac{h}{p} \Rightarrow \lambda \propto \frac{1}{p}$

STEP

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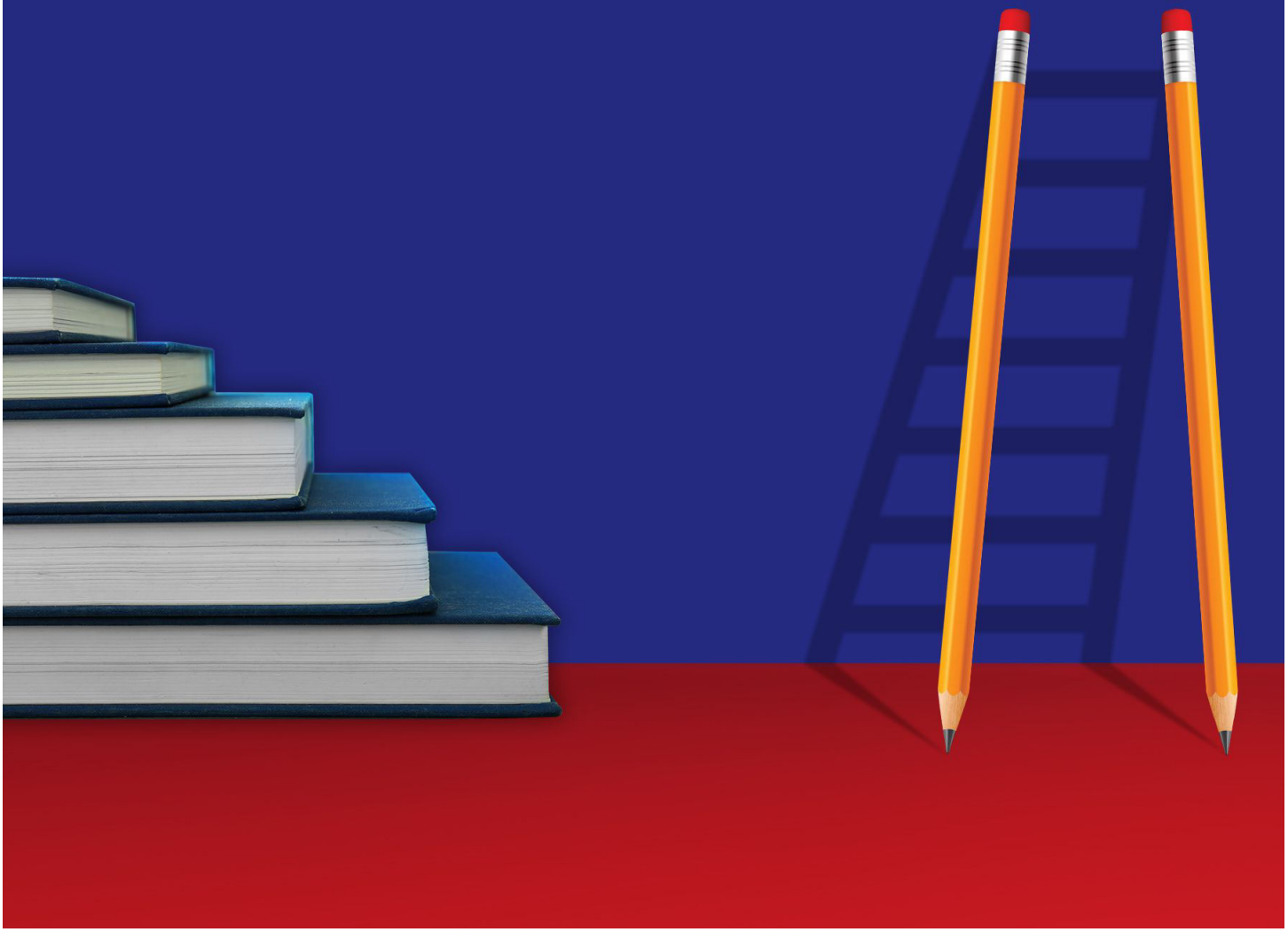

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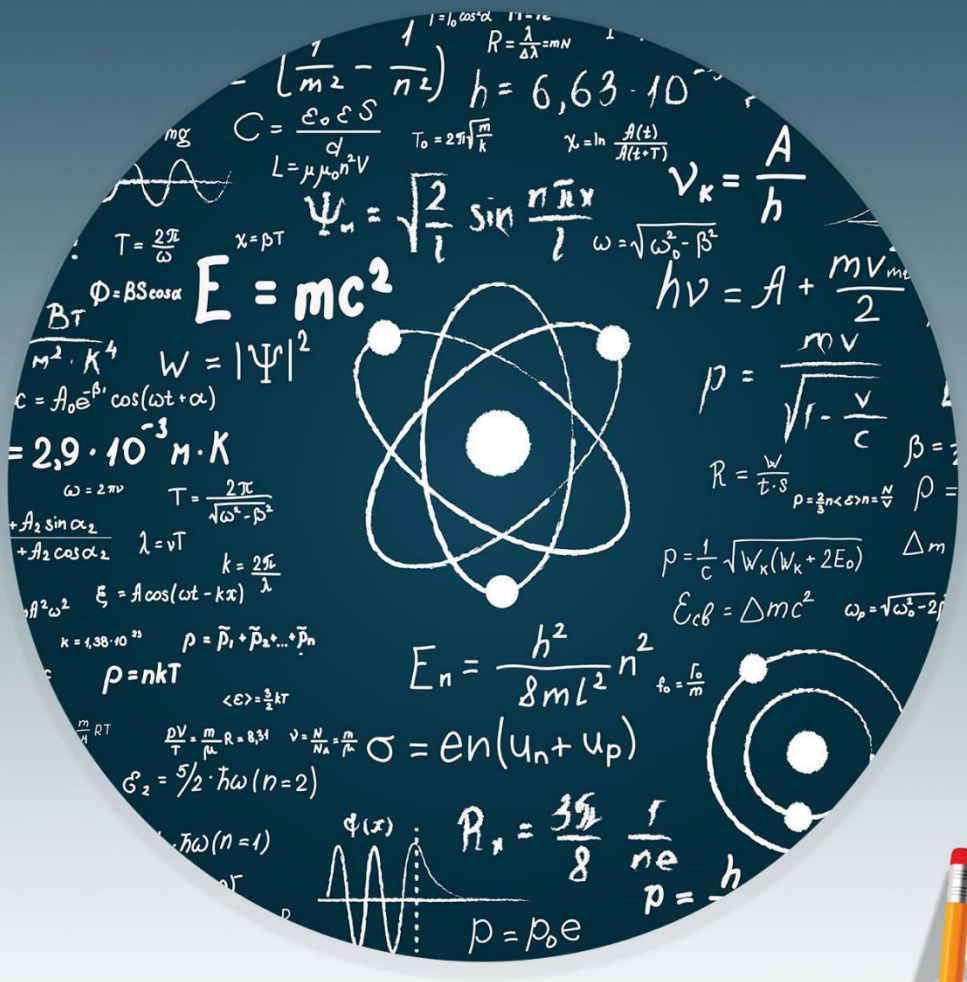

WORKSHEET-8

STEP

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Worksheet-08

Topics:- Hydrogen Spectrum, Bohr's Model of Hydrogen Atom, X-rays

USE THIS SPACE FOR SCRATCH WORK

Q.1 Transitions of electrons between the various shells can produce:

A) Continuous X – rays C) Both X-rays

B) Characteristic X-rays D) Soft X-rays

Q.2 K-series of characteristic X-rays are produced when all the transitions of inner-shell electrons terminate on:

A) M-shell C) K-shell

B) N-shell D) L-shell

Q.3 The reverse process of photo-electric effect is called:

A) Pair production C) X-rays production

B) Compton effect D) Radioactivity

Q.4 X-rays were discovered by:

A) Compton C) De-Broglie

B) Roentgen D) Maxwell

Q.5 X-rays can exhibit the phenomenon of:

A) Interference C) Polarization

B) Diffraction D) All of these

Q.6 The rest mass of X-rays photon is:

A) Infinite C) 9.1×10^{-31} kg

B) Zero D) 1.67×10^{-27} kg

Q.7 X-rays are:

A) Electromagnetic waves C) Mechanical waves

B) Longitudinal waves D) Matter waves

Q.8 The velocity of X-rays is equal to:

A) α – rays C) β – rays

B) γ – rays D) Sound waves

Q.9 X-rays can be used to:

A) Treat cancer C) Detect flaws in welding

B) Detect bone fractures D) All of above

Q.10 X-rays are deflected by:

A) Electric field only

B) Magnetic field only

C) Electric and magnetic field both

D) Can't be deflected

Q.11 X-Rays are produced in an evacuated glass tube called:

A) Wilson cloud tube C) Colloidal tube

B) G.M tube D) Coolidge tube

Q.12 Continuous X-Rays are produced by:

A) Accelerating electrons C) Both "A" and "B"

B) Decelerating electrons D) Inner shell transitions

Q.13 X-Rays can pass easily through:

A) Aluminum C) Human flesh

B) Wood D) All of these

Q.14 Which of the following characteristic X-Ray is most energetic:

A) K_α C) L_α

B) K_β D) L_β

Q.15 Generally softer X-Rays are used in:

A) CAT scanning C) Industry

B) Forensic applications D) Both "A" and "B"

Q.16 Wavelength of characteristics X-ray depend upon:

A) Filament current C) Nature of metal

B) Accelerating potential D) Both "B" and "C"

Q.17 Minimum wavelength of X-Rays depend upon:

A) Target material

B) Accelerating Voltage

C) Filament current

D) Intensity of incident electrons

Q.18 In Coolidge tube target material used may be:

A) Aluminum C) Tungsten

B) Molybdenum D) Both "B" and "C"

Q.19 Hydrogen atom is not capable of emitting X-rays because:

A) Its size is small

B) It contains infinite energy states

C) It's energy levels are very close to each other

D) It exists in molecular form

Q.20 X-Ray region lies between:

A) γ-rays and radio waves C) γ-rays and ultraviolet

B) Cosmic rays and γ-rays D) Visible and Infrared

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Q.21 If electron of 60 keV strike a heavy target. Then radiation emitted by target will be:

A) Visible light C) Ultraviolet

B) Radio waves D) X-rays

Q.22 When X-rays photograph of patient is taken, then majority of X – Rays are absorbed in?

A) Flesh C) Bones

B) Muscles D) All of these

Q.23 X-rays are not used in RADAR, because:

A) X-rays are not reflected by target

B) X-rays are completely absorbed by air

C) X-rays damage the target

D) All of the above

Q.24 X-ray photons are absorbed in tissues, they break molecular bonds and create highly reactive free radicals which in turn can disturb the molecular structure of the proteins and especially:

A) The genetic material C) Bones

B) Flesh D) Teeth

Q.25 For the production of X-rays cathode should have the following properties:

A) Low value of work function

B) High value of work function

C) A low heat capacity

D) Both "A" and "C"

Q.26 Computed Tomography is specially used to check the tumor in:

A) Brain C) Liver

B) Abdomen D) Lungs

Q.27 In CAT scanner the beam of X-rays used is of:

A) Spherical shaped C) Rectangular shape

B) Fan shaped D) All of these

Q.28 Which of the following X-rays depend upon target material for their speed?

A) Characteristic X-rays C) Both "A" and "B"

B) Continuous X-rays D) None of these

Q.29 The hardest photon coming out of X-rays tube must belong to:

A) Characteristic X-rays C) Both "A" and "B"

B) Continuous X-rays D) Can't be sure

Q.30 The hardness is:

A) Directly proportional to "*f*"

B) Inversely proportional to "λ"

C) Both "A" and "B"

D) Directly proportional to "λ"

Q.31 _____ deals with the study of wavelength and intensity of electromagnetic radiation spectrum emitted or absorbed by atoms.

A) Relativity C) Radioactivity

B) Spectroscopy D) Photoelectric effect

Q.32 Velocity of electron in the first orbit is:

A) 2.19×10^6 m s^{-1} C) 2.19×10^7 m s^{-1}

B) 2.18×10^7 m s^{-1} D) 2.2×10^6 m s^{-1}

Q.33 If a mono-atomic gas is ionized then it shows:

A) Line spectrum C) Band spectrum

B) Continuous spectrum D) visible spectrum

Q.34 Velocity of electron in an orbit is _____ to/of principal quantum number.

A) Directly proportional C) Inversely proportional

B) Not related D) Proportional to square

Q.35 Normally electrons in the hydrogen atom are in the:

A) Ground state C) Excited state

B) Ionized state D) Meta stable state

Q.36 Free electron may have energy:

A) Quantized C) Integral of E_o

B) Half of E_o D) Any amount

Q.37 Shortest wavelength of Lyman series is:

A) 91 nm C) 100 nm

B) 9.1 nm D) 10 nm

Q.38 Radiation with wavelengths longer than red light is:

A) Ultra violet C) Visible

B) X-rays D) Infrared

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Q.39 **The excitation energy of an electron to send it to n = ∞, is equal to:**

A) Potential energy C) Kinetic energy

B) Total energy D) Ionization energy

Q.40 **The ratio of kinetic energy and the total energy of the electron in the hydrogen atom is.**

A) 1:1 C) 1:2

B) 1: -1 D) 1: -2

Q.41 **Which of these series of hydrogen spectrum lies in the ultra-violet region?**

A) Paschen series C) Pfund series

B) Brackett series D) Lyman series

Q.42 **The ratio of longest and shortest wavelengths of Lyman series is:**

A) $\frac{4}{3}$ C) $\frac{9}{5}$

B) $\frac{9}{4}$ D) $\frac{16}{5}$

Q.43 **With increasing quantum number, the energy difference between adjacent levels in atoms:**

A) Increases C) Remains constant

B) Decreases D) Increases only for high Z

Q.44 **If L is angular momentum of electron in the 2nd orbit of hydrogen atom then angular momentum in the fourth orbit will be.**

A) 2L C) $\frac{3}{L}$

B) $\frac{L}{2}$ D) $\frac{L}{3}$

Q.45 **Photon of smallest wavelength will be absorbed when transition takes place from _____ to _____orbit.**

A) 2, 6 C) 3, 6

B) 1, 6 D) 4, 6

Q.46 **In an electronic transition, atom cannot emit.**

A) UV rays C) γ-rays

B) Visible light D) Infrared rays

USE THIS SPACE FOR SCRATCH WORK

Q.47 **When an electron in hydrogen atom jumps from second orbit to first orbit then energy of photon emitted is:**

A) 13.6 eV C) 10.2 eV

B) 3.4 eV D) 10.2 V

Q.48 **The longest wavelength of radiation for the paschen series is:**

A) 1094 nm C) 234 nm

B) 1875 nm D) 91 nm

Q.49 **The value of principal quantum to find maximum value of wavelength in Pfund series is:**

A) 3 C) 5

B) 4 D) 6

Q.50 **For the hydrogen atom, the ratio $\frac{\Delta r_{23}}{\Delta r_{34}} = \text{——}$, where $\Delta r_{23} = distance$ between 2^{nd} and 3^{rd} shell and $\Delta r_{34} = distance$ between 3^{rd} and 4^{th} shell.**

A) $\frac{3}{4}$ C) $\frac{3}{7}$

B) $\frac{5}{4}$ D) $\frac{5}{7}$

Q.51 **Which Postulate of Bohr's Model of the hydrogen atom contradict with classical physics?**

A) 1^{st} C) 3^{rd}

B) 2^{nd} D) All of these

Q.52 **The ratio of K.E to P.E for an electron in 5^{th} shell of hydrogen atom is:**

A) 2:1 C) 5:25

B) 1:2 D) 3:4

Q.53 **Which one is the example of continuous spectrum?**

A) Atomic spectrum

B) Molecular spectrum

C) Black body radiation spectrum

D) None of these

Q.54 **The excitation energy of electron is _____ than/to the ionization energy in Hydrogen atom?**

A) Greater C) Equal

B) Less D) Any of these

Q.55 The Rydberg constant has the dimensions:

A) Reciprocal of length C) Reciprocal of time

B) Reciprocal of wavelength D) Both A & B

USE THIS SPACE FOR SCRATCH WORK

ANSWER KEY (Worksheet-08)							
1	B	16	C	31	B	46	C
2	C	17	B	32	A	47	C
3	C	18	D	33	A	48	B
4	B	19	C	34	C	49	D
5	D	20	C	35	A	50	D
6	B	21	D	36	D	51	A
7	A	22	C	37	A	52	B
8	B	23	A	38	D	53	C
9	D	24	A	39	D	54	B
10	D	25	D	40	B	55	D
11	D	26	A	41	D		
12	B	27	B	42	A		
13	C	28	D	43	B		
14	B	29	B	44	A		
15	D	30	C	45	B		

SOLUTIONS

Unit – 10 (WS-08)

Q.1 Answer is "B"

Solution:- Transitions of electrons produce characteristic X-rays while deceleration of electrons produce continuous X-rays.

Q.2 Answer is "C"

Solution:- The name of series is same as the ground state of electrons in that series.

Q.3 Answer is "C"

Solution:- The reverse process of photoelectric effect is X-ray production.

Q.4 Answer is "B"

Solution:- X-rays were discovered by Roentgen in 1895.

Q.5 Answer is "D"

Solution:- X-rays are waves, so they exhibit all wave properties.

Q.6 Answer is "B"

Solution:- Rest mass of any photon is zero.

Q.7 Answer is "A"

Solution:- X-rays are electromagnetic waves as they require no medium for propagation.

Q.8 Answer is "B"

Solution:- X-rays & γ-rays are electromagnetic waves and have same velocity i.e $c = 3\times10^{8}$ m s^{-1}

Q.9 Answer is "D"

Solution:- Uses of X-rays.

Q.10 Answer is "D"

Solution:- X-rays are composed of photons which are neutral.

Q.11 Answer is "D"

Solution:- X-rays are produced in Coolidge tube.

Q.12 Answer is "B"

Solution:- Transitions of electrons produce characteristic X-rays while deceleration of electrons produce continuous X-rays.

Q.13 Answer is "C"

Solution:- X-rays can easily pass through soft media like human flesh.

Q.14 Answer is "B"

Solution:-

Energy order: K-series > L-series > M-series

Further in K-series, the energy order is;

$K_\alpha < K_\beta < K_\gamma$

Q.15 Answer is "D"

Solution:- Uses of X-rays

Q.16 Answer is "C"

Solution:- Properties of characteristic X-rays depend on nature of material of anode.

Q.17 Answer is "B"

Solution:- $\lambda_{min} = \frac{hc}{Ve}$

Q.18 Answer is "D"

Solution:- Target material should have high melting point and high conductivity along with high atomic number. Both Tungsten & Molybdenum have these properties.

Q.19 Answer is "C"

Solution:- Energy gap between shells of hydrogen atom is not sufficient to produce X-rays.

Q.20 Answer is "C"

Solution:- X-rays lie between U.V and gamma rays.

Q.21 Answer is "D"

Solution:- Heavy elements usually emit X-rays

Q.22 Answer is "C"

Solution:- X-rays are absorbed more in hard parts of body like bones.

Q.23 Answer is "A"

Solution:- X-rays have high penetration power.

Q.24 Answer is "A"

Solution:- X-rays disturb the structure of genetic material.

Q.25 Answer is "D"

Solution:- Cathode should have

1. High M.P
2. Low work function
3. Low heat capacity

Q.26 Answer is "A"

Solution:- CAT-scanning is usually used to check tumor in brain.

Q.27 Answer is "B"

Solution:-CAT – Scanner produces fan shaped beam of X-rays.

Q.28 Answer is "D"

Solution:- All X-rays travel with speed of light.

Q.29 Answer is "B"

Solution:- Hardest photon is that which has maximum energy and it belong to "Continuous X-rays".

Q.30 Answer is "C"

Solution:- Hardness $\propto$ Energy $\propto f \propto \frac{1}{\lambda}$

Q.31 Answer is "B"

Solution:- The study of wavelengths and Intensities of electromagnetic radiations emitted by atoms is called spectroscopy.

Q.32 Answer is "A"

Solution:- In first shell of hydrogen atom, electron moves with 2.19×10^6 m s^{-1}.

Q.33 Answer is "A"

Solution:- Atoms usually give Line spectrum, molecules give Band spectrum and Black body gives continuous spectrum.

Q.34 Answer is "C"

Solution:- $v \propto \frac{1}{n}$

Q.35 Answer is "A"

Solution:- Normally electrons in any atom stay in ground state.

Q.36 Answer is "D"

Solution:- Free electrons can have any amount of energy

Q.37 Answer is "A"

Solution:- $\frac{1}{\lambda} = R_H\left(\frac{1}{1^2} - \frac{1}{n^2}\right)$

For longest wavelength put n = 2, for shortest wavelength put $n = \infty$

Q.38 Answer is "D"

Solution:- Infrared radiation have longer wavelength than red light.

Q.39 Answer is "D"

Solution:- Energy to send electron to $n = \infty$ is called Ionization energy.

Q.40 Answer is "B"

Solution:- Take ratio of final formulae of total energy and K.E.

Q.41 Answer is "D"

Solution:- Lyman series lies in U.V region.

Q.42 Answer is "A"

Solution:- $\frac{1}{\lambda} = R_H\left(\frac{1}{1^2} - \frac{1}{n^2}\right)$

For longest wavelength put n = 2, for shortest wavelength put $n = \infty$.

Q.43 Answer is "B"

Solution:- Energy difference between adjacent shells decreases while moving away from nucleus.

Q.44 Answer is "A"

Solution:- $L_n = n\, L_1$

Q.45 Answer is "B"

Solution:- Smallest wavelength corresponds to maximum energy which is emitted when electron moves from n=6 to n=1.

Q.46 Answer is "C"

Solution:- Gamma rays are emitted by radioactive decay.

Q.47 Answer is "C"

Solution:- Simply take energy difference

Q.48 Answer is "B"

Solution:- Paschen series is;

$\frac{1}{\lambda} = R_H\left(\frac{1}{3^2} - \frac{1}{n^2}\right)$

Put n = 4 and solve.

Q.49 Answer is "D"

Solution:- For λ_{max}, energy gap should be minimum which is n = 6 for Pfund series.

Q.50 Answer is "D"

Solution:- $r_n = n^2 r_1$

Q.51 Answer is "A"

Solution:- 1st Postulate contradicts with classical physics.

Q.52 Answer is "B"

Solution:- $K.E_n = \frac{ke^2}{2r_n} \Rightarrow P.E_n = \frac{ke^2}{r_n}$

Q.53 Answer is "C"

Solution:- Atoms usually give line spectrum, molecules give Band spectrum and Black body gives continuous spectrum.

Q.54 Answer is "B"

Solution:- Excitation energy is less than ionization energy.

Q.55 Answer is "D"

Solution:- R_H has units reciprocal of wavelength.

STEP

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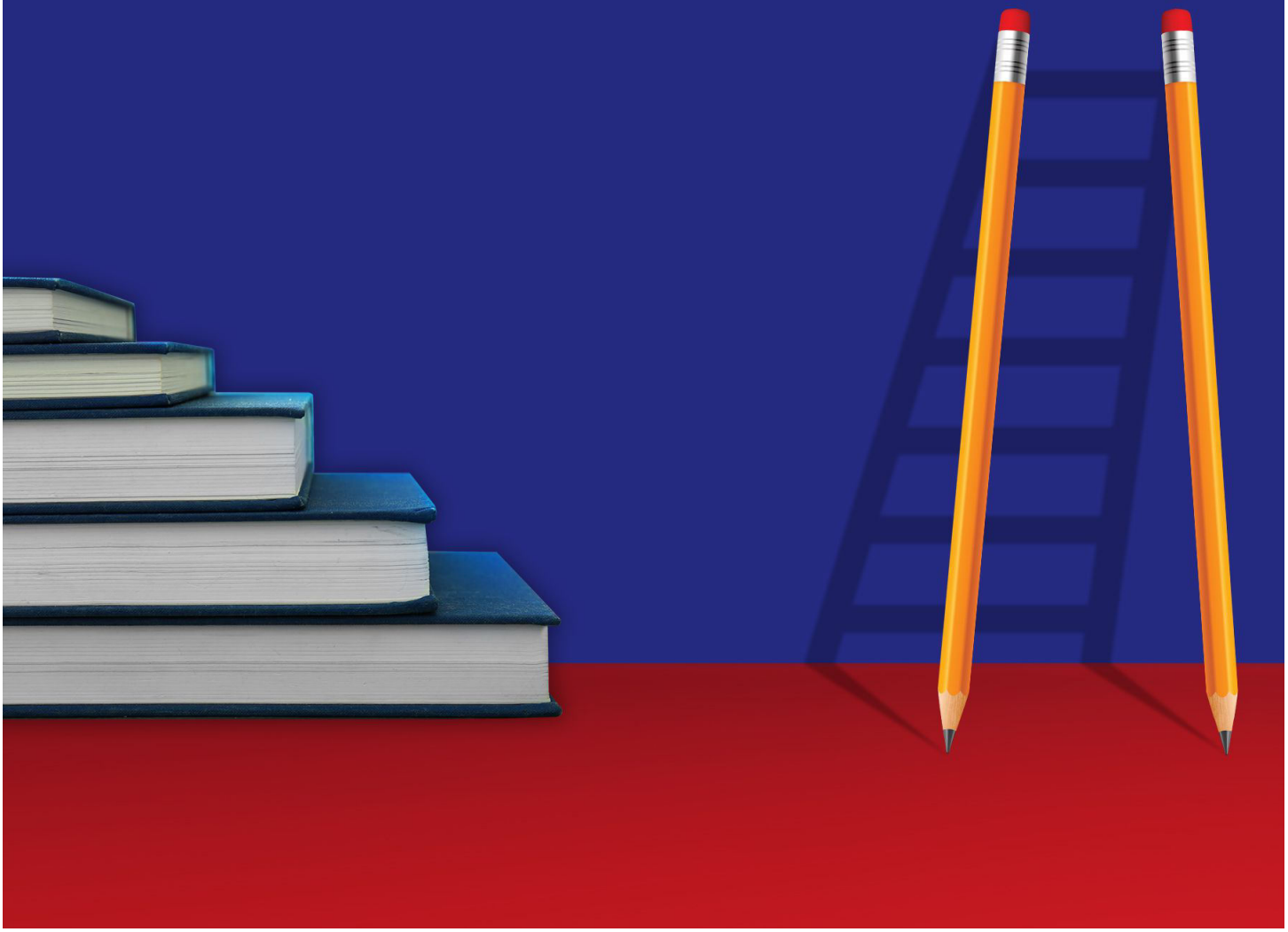

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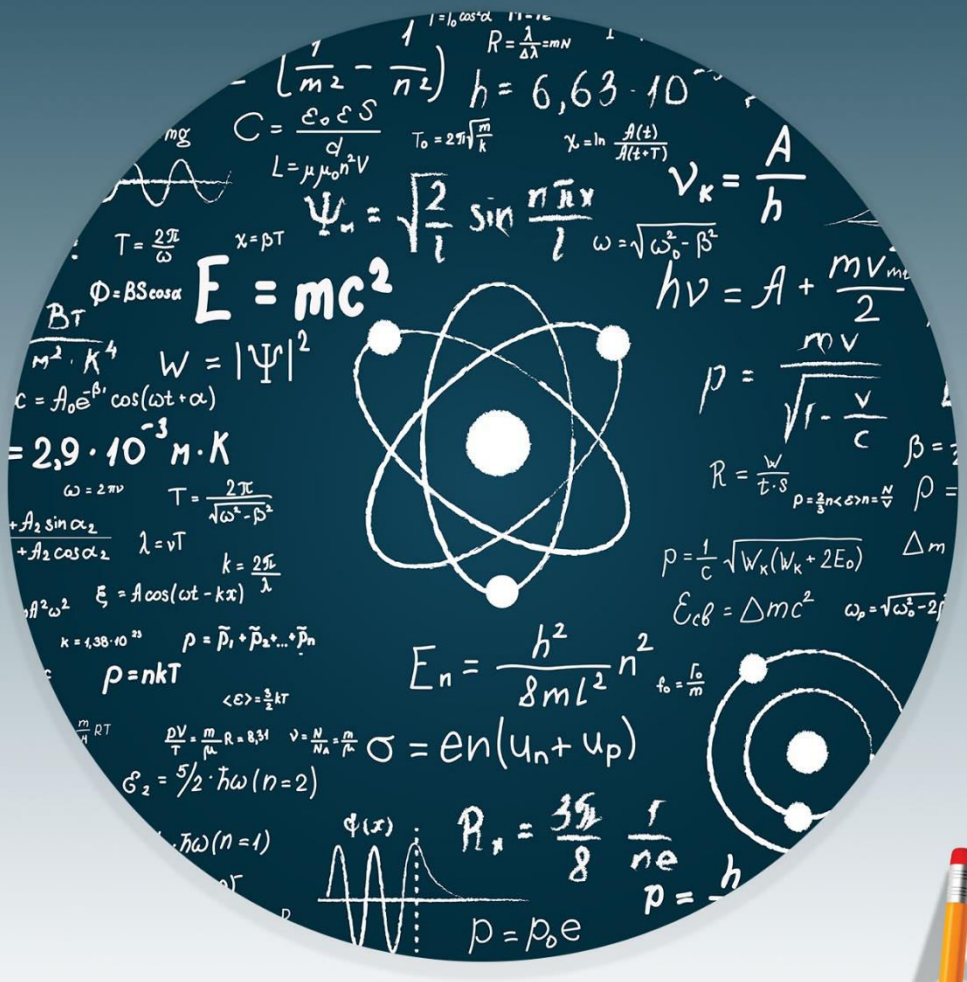

WORKSHEET-9

STEP

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Worksheet-9

Topics:- Atomic Nucleus, Radio Activity, Nuclear Transmutation, Mass-Defect & Binding Energy

USE THIS SPACE FOR SCRATCH WORK

Q.1 Isotopes have same:

A) Chemical properties C) Both of these

B) Physical properties D) None of these

Q.2 Which of following element has maximum number of isotopes?

A) Xenon C) Nitrogen

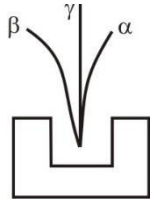
B) Cesium D) Both A & B

Q.3 The neutron to proton ratio for $^{16}_{8}O$ is:

A) 2:1 C) 1:1

B) 1:2 D) 8:16

Q.4 In a radioactive phenomenon observation shown in figure where α deviates lesser than β in some electric or magnetic field (not shown in the figure). What is the reason of less deviation of α?



A) α is charged particle C) α is neutral particle

B) α is heavier particle D) α is lighter particle

Q.5 What is the charge number of an α-particle emitted during the phenomena of radioactivity?

A) –e C) –2e

B) +2e D) +2

Q.6 Which one is a container for storing radioactive substance?

A) Lead C) Cadmium

B) Iron D) Copper

Q.7 Which of the following is true for γ-rays?

	Charge	Rest mass
A)	Positive	$m_o c^2$
B)	Negative	Zero
C)	Neutral	$m_o c^2$
D)	Neutral	Zero

USE THIS SPACE FOR SCRATCH WORK

Q.8 γ-radiation are emitted due to:

A) De-excitation of atom
C) De-excitation of nucleus
B) Excitation of atom
D) Excitation of nucleus

Q.9 The phenomenon of radioactivity is associated with:

A) Decay of nucleus
B) Fusion of nuclei
C) Transmission of radio waves
D) Nuclear reactions caused by cosmic rays

Q.10 After α-emission from $^{226}_{88}Ra$, the daughter nucleus will be:

A) $^{226}_{86}Ra$
C) $^{226}_{86}Rn$
B) $^{224}_{86}Ra$
D) $^{222}_{86}Rn$

Q.11 After β-emission from neutron, which particle is found?

A) Proton
C) Neutron
B) Electron
D) Proton and electron

Q.12 An α-emission is always accompanied by:

A) β-emission
C) Both "A" and "B"
B) γ-emission
D) Neutron emission

Q.13 The equation $_{Z}X^{A} \longrightarrow {}_{z+1}Y^{A} + {}_{-1}e^{o} + \bar{\upsilon}$ represents:

A) β-decay
C) γ-decay
B) α–decay
D) Proton decay

Q.14 In an α-decay:

A) The parent and daughter nuclei have same number of protons
B) The daughter nucleus has one proton more than parent nucleus
C) The daughter nucleus has two protons less than parent nucleus
D) The daughter nucleus has two neutrons more than parent nucleus

USE THIS SPACE FOR SCRATCH WORK

Q.15 When a radioactive nucleus emits an α-particle, the N/Z ratio?

A) Increases C) Remains same

B) Decreases D) Any of these

Q.16 When a radioactive nucleus emits a β-particle, the mass number of the atom?

A) Increases by one C) Remains the same

B) Decreases by one D) Decreases by four

Q.17 The decay constant λ of a radioactive sample:

A) Decreases as the age of atoms increases

B) Increases as the age of atoms increases

C) Is independent of the age

D) Depends on the nature of activity

Q.18 Half life of a radioactive substance depends upon:

A) Temperature C) Nature of substance

B) Pressure D) Electric & magnetic field

Q.19 The half life of radium is about 1600 years. If 100 g radium existing now, 25 g will remain un-decayed after:

A) 4800 years C) 6400 years

B) 6400 years D) 3200 years

Q.20 Half-life of radium is 1600 years. In how many years shall the earth lose all its radium due to radioactive decay?

A) 1590×10^6 years C) 1590×10^{24} years

B) 1590×10^{12} years D) Never

Q.21 The half-life of a certain element is 7 days at S.T.P .If the temperature is doubled and pressure is reduced to half then half-life of the same element will be:

A) 1.75 days C) 3.5 days

B) 7 days D) 14 days

Q.22 Which of the following rays are more energetic?

A) $\alpha - rays$ C) $\beta - rays$

B) $\gamma - rays$ D) All of these

USE THIS SPACE FOR SCRATCH WORK

Q.23 Due to emission of β^+-rays:

A) Mass of the Nucleus Increases

B) Mass of the Nucleus Decreases

C) Charge on the Nucleus Increases

D) Charge on the Nucleus Decreases

Q.24 The Uranium Nucleus $^{238}_{92}U$ undergoes successive decays, emitting respectively $\alpha - particle$, $\beta - particle$ and $\gamma - ray$. What is the atomic number and atomic mass of the resulting nucleus?

A) 90 ,238 C) 91, 234

B) 92,236 D) 92,238

Q.25 A nucleus $^{210}_{81}X$ decays to another nucleus $^{A}_{82}Y$ in four successive radioactive decays. Each decay involves, the emission of either an $\alpha - decay$ or $\beta - decay$. What is the value of A?

A) 210 C) 208

B) 206 D) 204

Q.26 A Radioactive Isotope $^{238}_{92}U$ decays to $^{234}_{92}U$ the particles emitted are:

A) One α and one β C) Two α and one β B) One α and two β D) Two α and two β

Q.27 Which one of the following radiation possesses maximum penetrating power?

A) α-rays

B) γ-rays

C) β-rays

D) All have equal penetrating power

Q.28 After α-decay, the parent and daughter nuclei are called:

A) Isomers C) Isobars

B) Isotones D) Isodiapheres

Q.29 The emission of β-particle results in:

A) Isomers C) Isobars

B) Isotones D) Isodiapheres

Q.30 Which one is not true about radioactivity?

A) Radioactivity is a stochastic process

B) Half-life only depends on nature of element

C) Decay rate decreases exponentially with time

D) None of these

Q.31 The number of atoms decayed in four half-lives are:

A) $\frac{N_\circ}{16}$ C) $\frac{N_\circ}{8}$

B) $\frac{7N_\circ}{8}$ D) $\frac{15N_\circ}{16}$

Q.32 If the half-life of an element is 10 second, the mean life will be:

A) 14.4 sec C) 9.93 sec

B) 10 sec D) Can't be predicted

Q.33 The mass defect per nucleon _____ as the atomic number increases till iron, for iron the mass defect per nucleon _____ and after iron the mass defect per nucleon _____as atomic number increases further.

A) Decreases, minimum, increases

B) Decreases, maximum, decreases

C) Increases, maximum, decreases

D) None of these

Q.34 Among the following which nucleus has maximum mass defect and binding energy:

A) Fe C) He

B) Kr D) U

Q.35 Mass defect of 10u is equal to:

A) 1.66×10^{-27} kg C) 166×10^{-28} kg

B) 1.66×10^{-26} kg D) Both B and C

USE THIS SPACE FOR SCRATCH WORK

ANSWER KEY (Worksheet-09)							
1	A	11	A	21	B	31	D
2	D	12	B	22	A	32	A
3	C	13	A	23	D	33	C
4	B	14	C	24	C	34	D
5	D	15	A	25	B	35	D
6	A	16	C	26	B		
7	D	17	C	27	B		
8	C	18	C	28	D		
9	A	19	D	29	C		
10	D	20	D	30	D		

SOLUTIONS

Unit – 11 (WS-09)

Q.1 Answer is "A"

Solution:- Isotopes have same chemical properties while their physical properties are different.

Q.2 Answer is "D"

Solution:- Both Xenon and Cesium have maximum number of isotopes (Both have 36 isotopes).

Q.3 Answer is "C"

Solution:- For $^{16}_{8}O$; Z=8, N=8

Q.4 Answer is "B"

Solution:- Heavier particles deflect lesser.

Q.5 Answer is "D"

Solution:- Charge no. for α particle is "+2", but charge is "+2e".

Q.6 Answer is "A"

Solution:- Lead absorbs radiations without becoming unstable.

Q.7 Answer is "D"

Solution:- Gamma rays are photons, so there rest mass and charge both are zero.

Q.8 Answer is "C"

Solution:- γ-rays are emitted due to de-excitation of nucleus.

Q.9 Answer is "A"

Solution:- Radioactivity is purely a nuclear phenomenon.

Q.10 Answer is "D"

Solution:-

$^{226}_{88}\text{Ra} \longrightarrow {}^{222}_{86}\text{Rn} + \alpha\text{-Particle}$

Q.11 Answer is "A"

Solution: - $^{1}_{0}n \longrightarrow {}^{1}_{1}H + {}^{0}_{-1}e + \bar{\nu}$

Q.12 Answer is "B"

Solution: - α and β emissions are always accompanied by γ –emission.

Q.13 Answer is "A"

Solution: - The given equation represents a negative beta decay.

Q.14 Answer is "C"

Solution: - In α-decay, the daughter nucleus have 2 protons less than parent nucleus.

Q.15 Answer is "A"

Solution:- $^{226}_{88}Ra \longrightarrow {}^{222}_{86}Rn + {}^{4}_{2}He$

Check $\frac{N}{Z}$ ratio for parent and daughter nucleus.

Q.16 Answer is "C"

Solution:- The mass number remains same whether β^+ is emitted or β^- is emitted.

Q.17 Answer is "C"

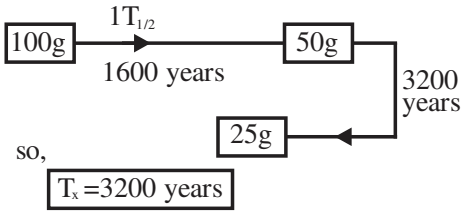
Solution:- "λ" only depend on nature of element.

Q.18 Answer is "C"

Solution:- Half-life only depend on Nature of substance.

Q.19 Answer is "D"

Solution:-



Q.20 Answer is "D"

Solution:- Complete life of any radioactive element is always infinite.

Q.21 Answer is "B"

Solution:- Half-life only depends on nature of element.

Q.22 Answer is "A"

Solution:- Usually α-radiations are most energetic and γ-rays are least energetic.

Q.23 Answer is "D"

Solution:- During β^+ decay the charge number of daughter nucleus is one less than parent nucleus.

Q.24 Answer is "C"

Solution:-

$$^{238}_{92}U \xrightarrow{\alpha} ^{234}_{90}X_1 \xrightarrow{\beta} ^{234}_{91}X_2 \xrightarrow{\gamma} ^{234}_{91}X_3$$

Q.25 Answer is "B"

Solution:- $^{210}_{81}X \xrightarrow{\alpha} ^{206}_{79}X_1 \xrightarrow{3\beta} ^{206}_{82}Y$

Q.26 Answer is "B"

Solution:- $^{238}_{92}U \xrightarrow{\alpha} ^{234}_{90}X_1 \xrightarrow{2\beta} ^{234}_{92}U$

Q.27 Answer is "B"

Solution:- Penetration power of γ-rays is maximum and it is minimum for α-particles.

Q.28 Answer is "D"

Solution:- Isodiapheres are nuclei which have same neutron excess.

Q.29 Answer is "C"

Solution:- α-Particle emission results in isodiapheres, β-particle emission results in isobars and γ-rays emission result in isomers.

Q.30 Answer is "D"

Solution:- All given options A, B & C are true.

Q.31 Answer is "D"

Solution:-

No. of decayed atoms = $N_\circ - \left(\frac{1}{2}\right)^n N_\circ$

Q.32 Answer is "A"

Solution:- $T_{mean} = 1.44T_{\frac{1}{2}}$

Q.33 Answer is "C"

Solution:- See graph from book

Q.34 Answer is "D"

Solution:- (Mass defect of nucleus)

= A × (Mass defect per nucleon)

So, total mass defect of uranium nucleus will be greater than other options.

Q.35 Answer is "D"

Solution:- 1 u = 1.66×10^{-27} kg

STEP

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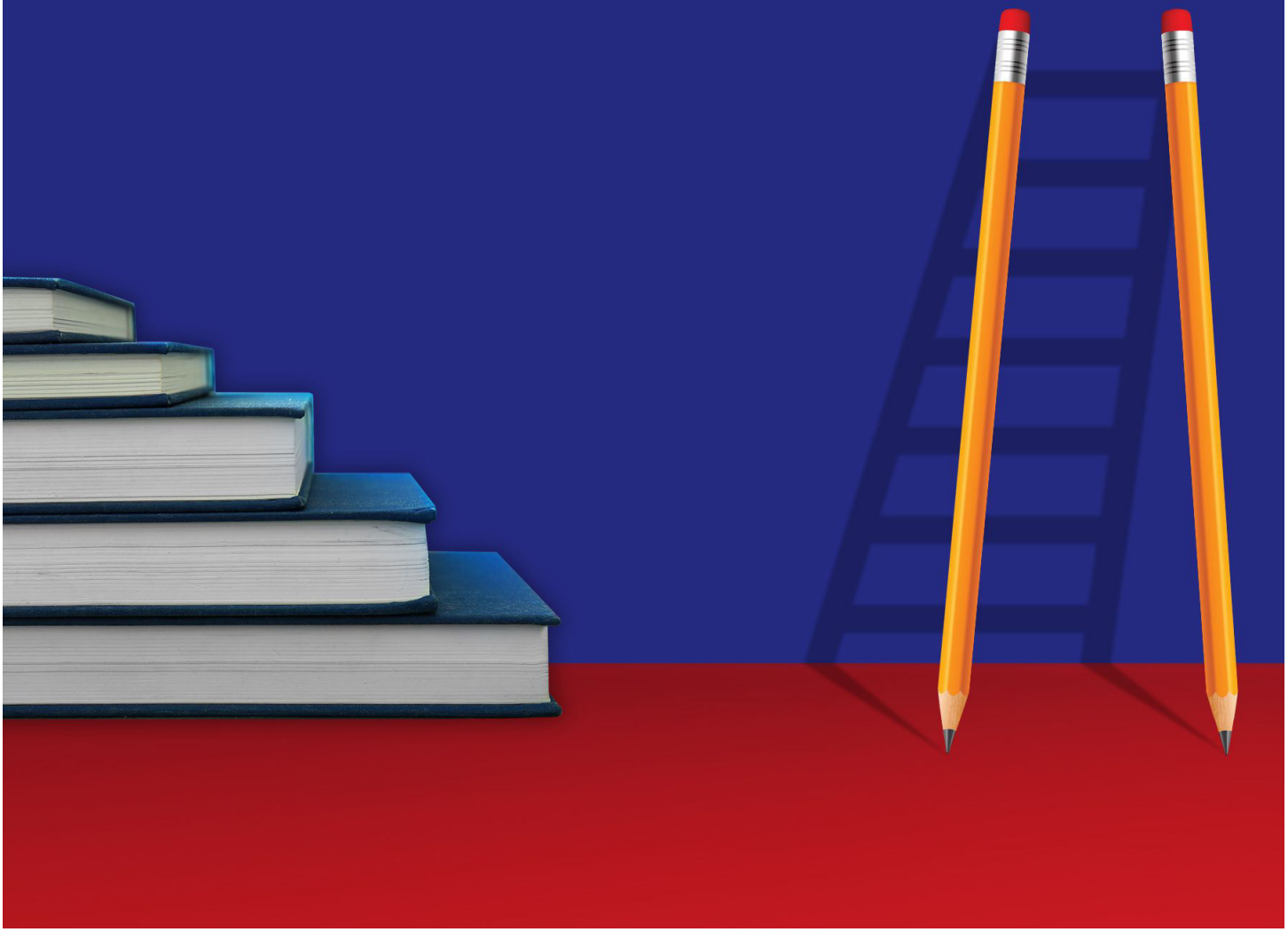

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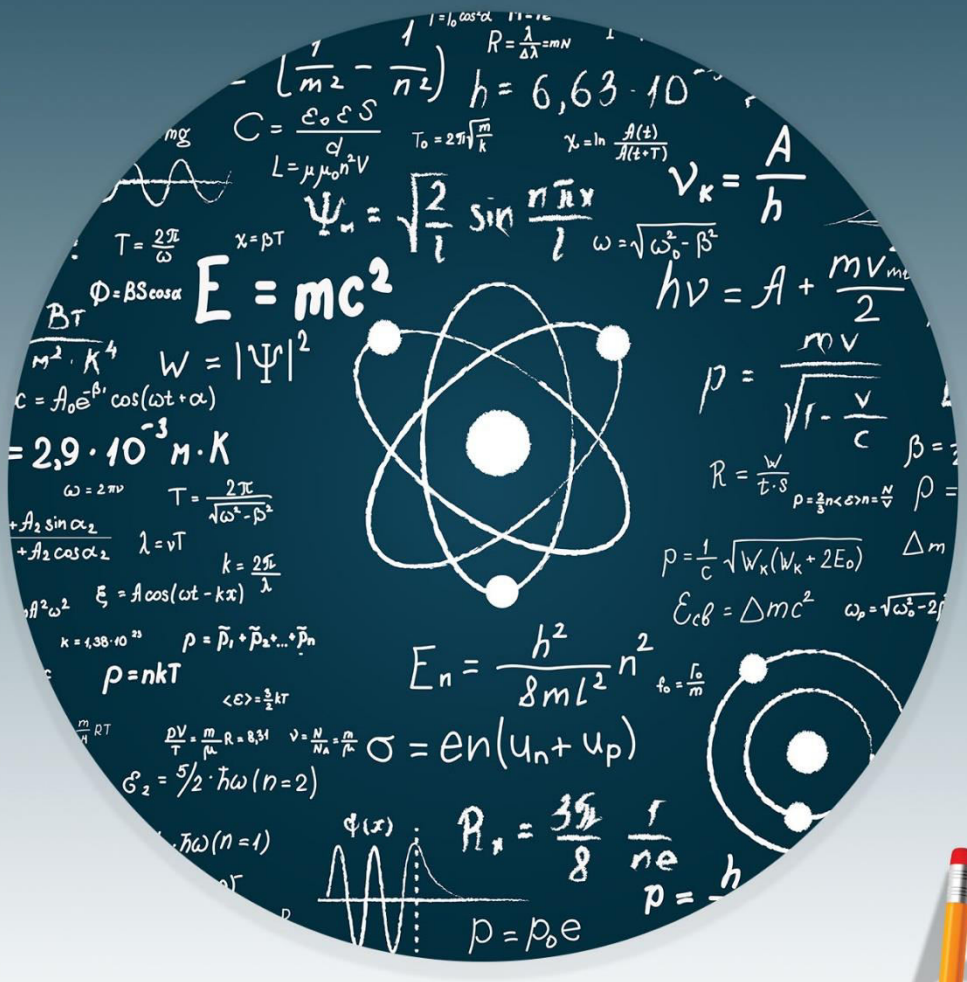

WORKSHEET-10

STEP

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Worksheet-10

Topics:- Nuclear Fission & Fusion Reactions, Elementary Particles

USE THIS SPACE FOR SCRATCH WORK

Q.1 Proton belongs to:

A) Leptons C) Mesons

B) Baryons D) Neutrinos

Q.2 Which of following belong to leptons?

A) Electrons C) Neutrinos

B) Protons D) Both A & C

Q.3 Which of following has mass smaller than proton:

A) Baryon C) Neutron

B) Meson D) None of these

Q.4 Which of following is not an elementary particle?

A) Photons C) Leptons

B) Hadrons D) Muons

Q.5 A proton is assumed to be made up of _____ quarks.

A) 2u+1d C) 2u+2d

B) 2d+1u D) 3u+1d

Q.6 In any nuclear reaction, the energy is released if the binding of reactants is _____ than binding energy of products:

A) Less C) Equal

B) Greater D) Any of these

Q.7 If an α-particle moving with energy 1 MeV strikes with Nitrogen atom $^{14}_{7}N$, the product formed is $^{14}_{7}N + ^{4}_{2}He \rightarrow$ _____?

A) $^{16}_{8}\mathrm{O} + ^{1}_{1}\mathrm{H} + ^{1}_{0}\mathrm{H}$ C) $^{17}_{8}\mathrm{O} + ^{1}_{0}\mathrm{n} + ^{0}_{+1}\mathrm{e}$

B) $^{17}_{8}\mathrm{O} + ^{1}_{1}\mathrm{H}$ D) Reaction can't happen

Q.8 The missing particle in following nuclear reaction is:

$^{9}_{4}Be + ^{4}_{2}He \rightarrow ^{12}_{6}C +$ _____

A) $^{1}_{1}H + ^{0}_{-1}e$ C) $^{1}_{0}n$

B) $^{1}_{1}H + ^{0}_{+1}e$ D) None of these

USE THIS SPACE FOR SCRATCH WORK

Q.9 **During the nuclear fission of $^{235}_{92}U$ into $^{132}_{50}Sn$ and $^{101}_{42}Mo$, the number of neutrons emitted are:**

A) 2 C) 4

B) 3 D) 1

Q.10 **The mass of uranium used in atomic bomb is _____ than/to critical mass?**

A) Less C) Equal

B) More D) Much smaller

Q.11 **In a nuclear reactor, the quantity of ^{235}U is increased from:**

A) 0.7 to 1% C) 5 to 10%

B) 2 to 4% D) None of these

Q.12 **Which of following is used as a moderator?**

A) Water C) Hydrocarbon

B) Heavy water D) All of these

Q.13 **The temperature of steam coming out of turbine is:**

A) 200° C C) 500° C

B) 300° C D) 700° C

Q.14 **Fast reactors are designed to make use of _____.**

A) ^{235}U C) ^{238}U

B) ^{239}U D) ^{233}U

Q.15 **When two deuterons are fused to form a Helium atom, the energy given out is:**

A) 17 MeV C) 6 MeV

B) 24 MeV D) 4 MeV

Q.16 **The nuclear waste is dumped into:**

A) Old salt mine C) Populated areas

B) Oceans D) None of these

Q.17 **In a nuclear reactor the mass of uranium used is _____ than/ to critical mass:**

A) Greater C) Equal

B) Less D) Any of these

Q.18 **In Karachi nuclear power plant _____ is used as moderator.**

A) Water C) Hydrocarbons

B) Heavy water D) None of these

Q.19 **The missing reactant in the reaction is:**

$${}^{3}_{2}He + \_\_\_\_ \rightarrow {}^{4}_{2}He + 2{}^{1}_{1}H + energy$$

A) ${}^{2}_{1}H$ C) ${}^{3}_{1}H$

B) ${}^{3}_{2}He$ D) $2{}^{1}_{1}H$

Q.20 **The temperature of core of sun is:**

A) 10 million degree Celsius

B) 6000 degree Celsius

C) 20 million degree Celsius

D) None of these

Q.21 **The number of protons taking part in P-P reaction:**

A) 4 C) 5

B) 6 D) 2

Q.22 **The number of protons used in one complete P-P reaction:**

A) 4 C) 5

B) 6 D) 2

Q.23 **In the P-P reaction, the energy given out per nucleon is:**

A) 25.7 MeV C) 4.0 MeV

B) 17.6 MeV D) 6.4 MeV

Q.24 **In the following reaction, the energy given out is:**

$${}^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n + \_\_\_\_$$

A) 17.6 MeV C) 24 MeV

B) 3.3 MeV D) 4.0 MeV

Q.25 **The sun is primarily composed of:**

A) Hydrogen C) Helium

B) Oxygen D) Neon

USE THIS SPACE FOR SCRATCH WORK

ANSWER KEY (Worksheet-10)					
1	B	11	B	21	B
2	D	12	D	22	A
3	B	13	B	23	D
4	B	14	C	24	A
5	A	15	B	25	A
6	A	16	A		
7	D	17	C		
8	C	18	B		
9	B	19	B		
10	B	20	C		

SOLUTIONS

Unit – 11 (WS-10)

Q.1 Answer is "B"

Solution:- Particles with mass equal or greater than protons belong to baryons.

Q.2 Answer is "D"

Solution:- Electrons, muons and neutrinos are leptons.

Q.3 Answer is "B"

Solution:- Particles with mass less than protons belong to mesons.

Q.4 Answer is "B"

Solution:- Hadrons are not elementary particles but are composed of elementary particles called Quarks.

Q.5 Answer is "A"

Solution:- A proton is made up of two up one down quark.

Q.6 Answer is "A"

Solution:- Energy released = $B.E_P - B.E_R$

Q.7 Answer is "D"

Solution:- For this nuclear reaction, minimum energy of α-particle must be 1.13 MeV.

Q.8 Answer is "C"

Solution:- Balance mass on both sides

Q.9 Answer is "B"

Solution:-

$$^{235}_{92}\mathrm{U} + ^{1}_{0}\mathrm{n} \longrightarrow ^{132}_{50}\mathrm{Sn} + ^{101}_{40}\mathrm{Mo} + 3^{1}_{0}n + Q$$

Q.10 Answer is "B"

Solution:- The mass of uranium used in atomic bomb is greater than critical mass.

Q.11 Answer is "B"

Solution:- In a nuclear reactor, the quantity of uranium is increased from 2 to 4%, this process is called enrichment.

Q.12 Answer is "D"

Solution:- Moderators can be water, heavy water, carbon or hydrocarbon etc.

Q.13 Answer is "B"

Solution:- The temperature of the core is about 500 °C. The temperature of the steam coming out of the turbine is about 300 °C.

Q.14 Answer is "C"

Solution:- Fast reactors are designed to make use of U-238, which is about 99% content of natural Uranium.

Q.15 Answer is "B"

Solution:- The reaction in which two deuterons are fused to form helium is

$$^{2}_{1}\mathrm{H} + ^{2}_{1}\mathrm{H} \longrightarrow ^{4}_{2}\mathrm{He} + 24\ \mathrm{MeV}$$

Q.16 Answer is "A"

Solution:- Unfortunately, there is no proper arrangement of the disposal of the nuclear waste. This cannot be dumped

into oceans or left in any place where they will contaminate the environment, such as through the soil or the air. They must not be allowed to get into the drinking water. The best place so far found to store these wastes is in the bottom of old salt mines.

Q.17 Answer is "C"

Solution:- In a nuclear reactor the mass of uranium used is equal to critical mass to carry fission chain reaction at constant speed.

Q.18 Answer is "B"

Solution:- In Karachi nuclear power plant (KANUP), heavy water is used as a moderator and for the transportation of heat also from the reactor core to heat exchanger, heavy water is used.

Q.19 Answer is "B"

Solution:-

$${}_{2}^{3}He + {}_{2}^{3}He \rightarrow {}_{2}^{4}He + 2{}_{1}^{1}H + energy$$

Q.20 Answer is "C"

Solution:- The temperature of core of sun is 20 million degree Celsius.

Q.21 Answer is "B"

Solution:- The no. of protons taking part in P-P reaction are 6 while no. of protons used in one P-P reaction are 4.

Q.22 Answer is "A"

Solution:- The no. of protons taking part in P-P reaction are 6 while no. of protons used in one P-P reaction are 4.

Q.23 Answer is "D"

Solution:- In P-P reaction, the energy given out per nucleon is 6.4 MeV.

Q.24 Answer is "A"

Solution:- In this given fusion reaction the energy released is 17.6 MeV.

Q.25 Answer is "A"

Solution:- The sun is primarily composed of Hydrogen.

STEP

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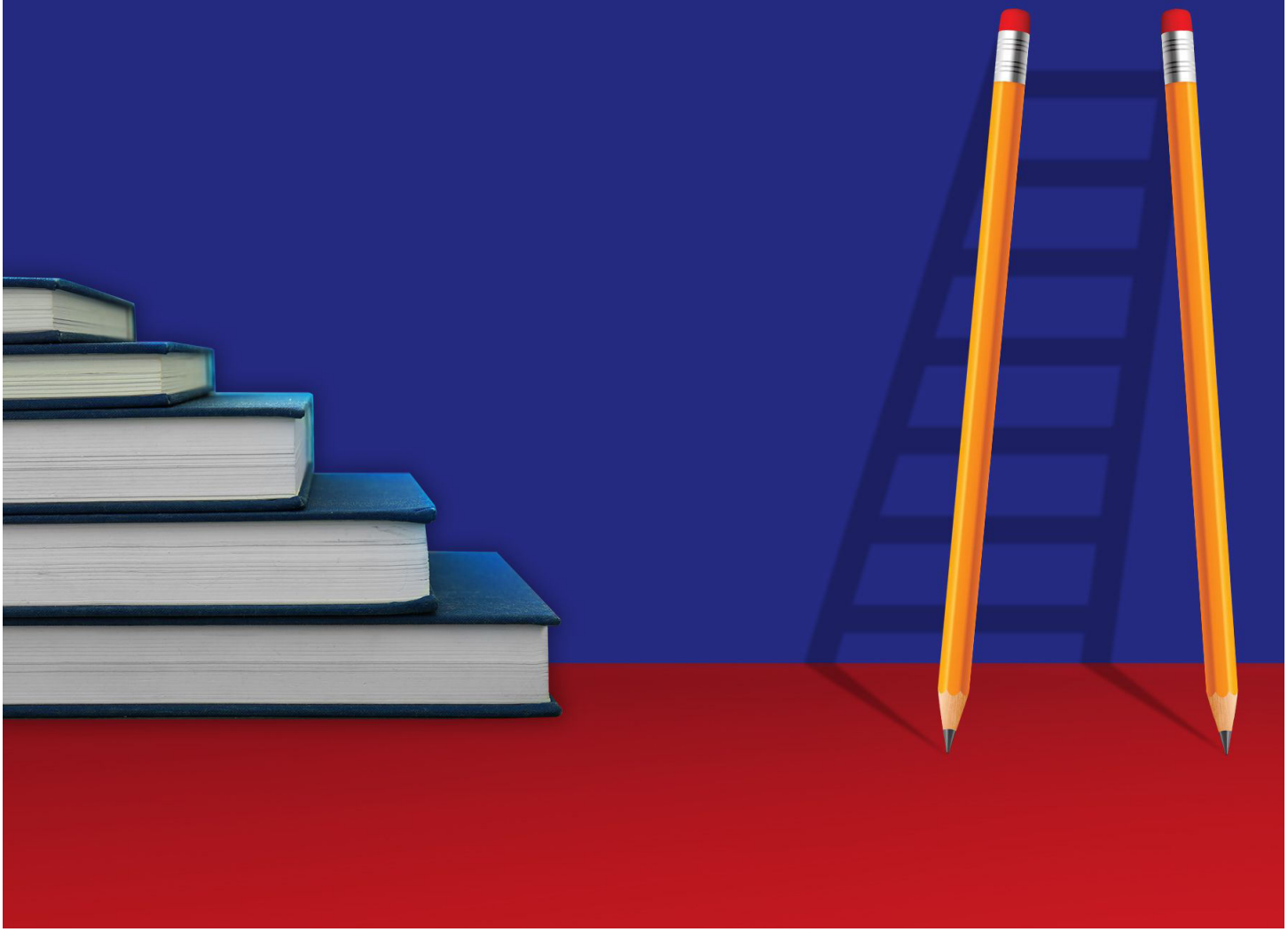

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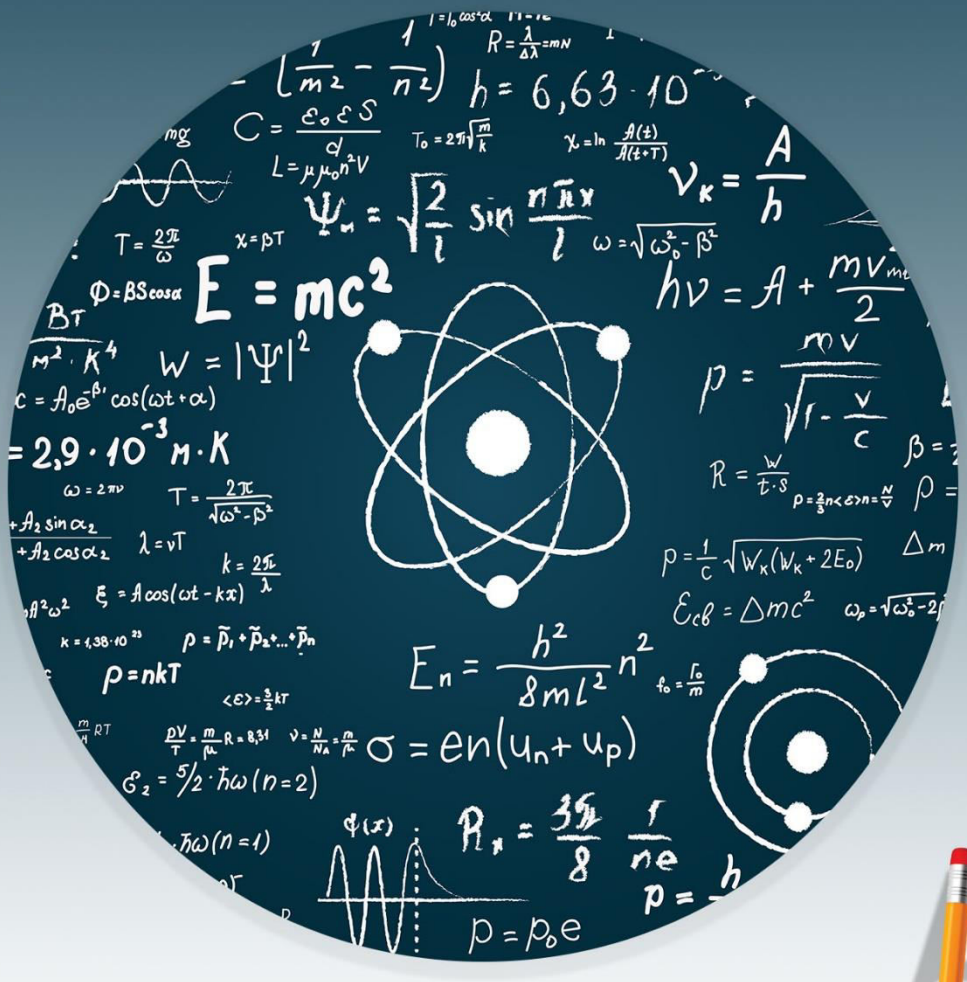

WORKSHEET-11

STEP

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Worksheet-11

Topics:- Physical Quantities, Units, Errors, Uncertainties & Prefixes

USE THIS SPACE FOR SCRATCH WORK

Q.1 Supplementary units are:

A) Two C) Four

B) Three D) Five

Q.2 A set of supplementary units are:

A) radian, kilogram C) radian, steradian

B) radian, mole D) second and meter

Q.3 Example of Base quantity is:

A) Area C) Velocity

B) Light year D) Volume

Q.4 S.I unit of plane angle is:

A) steradian C) candela

B) radian D) unitless

Q.5 Which one is not the principal characteristic of an ideal standard?

A) Accessible C) Both A and B

B) Invariable D) Variable

Q.6 How many kinds of units are there in SI-Unit system?

A) Seven C) Five

B) Three D) Two

Q.7 S.I unit of amount of substance is:

A) ampere C) mole

B) candela D) joule

Q.8 The units of pressure in base units are:

A) $kg\ m^{-1}\ s^{-2}$ C) $kg\ m^{-2}\ s^{-2}$

B) $kg\ m\ s^{-2}$ D) $kg^{2}\ m\ s^{-2}$

Q.9 Which of the following is the least sub-multiple?

A) pico C) atto

B) femto D) nano

Q.10 The units of $\frac{X}{Y}$, where $X = \frac{1}{\sqrt{\mu_\circ \varepsilon_\circ}}$ and $Y = \frac{E}{B}$, where E=electric intensity and B=magnetic intensity is:

A) $kg^{0}\ m\ s^{-1}$ C) $kg^{0}\ m^{0}\ s^{0}$

B) $kg^{0}\ m^{0}\ s^{-1}$ D) kg m s

Q.11 Which one is the biggest unit of plane angle?

USE THIS SPACE FOR

A) radian C) steradian

B) revolution D) degree

Q.12 The units of force are:

A) kg m^2 s^{-2} C) kg m s^{-2}

B) kg^2 m^2 s^{-2} D) kg m^2 s^{-1}

Q.13 The angle subtended at the centre of football by an area of its surface equal to one half of total area will be:

A) π sr C) 2π sr

B) 3π sr D) 4π sr

Q.14 The units of power are:

A) kg m^2 s^{-2} C) kg m^2 s^{-3}

B) kg m^{-1} s^{-1} D) kg m^{-2} s^{-2}

Q.15 The base units of torque are:

A) kg m^{-1} s C) kg m^2 s^{-2}

B) kg m^2 s^{-1} D) None of these

Q.16 The units of viscosity are:

A) kg m^{-1} s C) kg m^{-1} s^{-1}

B) kg m^2 s^{-1} D) kg m^{-1} s^{-2}

Q.17 Units of impulse are same as of:

A) Momentum C) Power

B) Force D) Torque

Q.18 The base units of gravitational constant G are:

A) kg m^2 s^{-2} C) kg^2 m^{-1} s^{-2}

B) kg^{-1} m^3 s^{-2} D) kg m^{-2} s^{-1}

Q.19 One dyne is equal to:

A) 10^{-5} N C) 10^{-4} N

B) 10^{+5} N D) 10^{+4} N

Q.20 In the relation of Bernoulli's equation $P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$ **which term has same units as that of stress?**

A) P C) ρgh

B) $\frac{1}{2}\rho v^2$ D) All of these

Q.21 Which of the following have same units as that of the

SCRATCH WORK

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energy density (energy per unit volume)?

A) Pressure C) P.E per unit volume

B) Young's modulus D) All of these

Q.22 **In the relation $E = \sigma T^4$, the units of E are same as that of:**

A) Solar constant C) Energy

B) Energy intensity D) Both "A" & "B"

Q.23 **Three different readings are taken by three instruments Vernier caliper, meter rod and screw gauge. Which reading will be more precise?**

A) Vernier caliper's reading C) Meter rod reading

B) Screw gauge's reading D) All have same precision

Q.24 **Two measurements have fractional uncertainties 0.04 and 0.02, which measurement will be more accurate?**

A) Measurement with 0.04 uncertainty

B) Measurement with 0.02 uncertainty

C) Both are equally accurate

D) Can't be predicted

Q.25 **Diameter of a wire is measured by screw gauge. Which of following can be the possible value?**

A) 8.1 mm C) 8.125 mm

B) 8.12 mm D) 8.1250 mm

Q.26 **Two measurements $x_1 = 10.5 \pm 0.1$ cm & $x_2 = 26.8 \pm 0.2$ cm are being subtracted. The uncertainty in final answer will be:**

A) Zero C) 0.2 cm

B) 0.1 cm D) 0.3 cm

Q.27 **In a square plate on increasing temperature, error in the length is 1%. The percentage error in area will be:**

A) 1% C) 3%

B) 2% D) 4%

Q.28 **If % age errors in moment of inertia and angular velocity are 2% and 4% respectively then % age error in rotational K.E is:**

A) 2% C) 4%

B) 10% D) 8%

Q.29 **The time for 20 vibrations of simple pendulum is recorded by a stop watch of least count 0.1 s is 54.6 s. The uncertainty in time period will be:**

SCRATCH WORK

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A) 0.1 s C) 0.005 s

B) 0.001 s D) 0.003 s

Q.30 For power factor formulae like $V = \frac{4\pi r^3}{3}$, %age uncertainty in V = ____.

A) (% uncertainty in r)^3 C) $\frac{\%\text{ uncertainty in r}}{3}$

B) $3 \times$ % uncertainty in r D) % uncertainty in r^3

Q.31 1 femto = _____ giga?

A) 10^{-18} C) 10^{-12}

B) 10^{-15} D) 10^{-24}

Q.32 A student measures the length & diameter of cylinder by screw gauge both readings have an error of "0.05 mm", which type of error is in these readings:

A) Random error C) Systematic error

B) Personal error D) All of these

Q.33 Out of following which have same power in base units of viscosity and spring constant?

A) metre C) Both A & B

B) second D) kilogram

Q.34 The ratio of units of surface tension & spring constant produces the units same as that of:

A) Refractive index C) Both A & B

B) Magnification D) Plank's constant

Q.35 Which of following pair have same base units?

A) Strain, relative permittivity

B) Surface tension, spring constant

C) Stress, energy density

D) All of these

ANSWER KEY (Worksheet-11)							
1	A	11	B	21	D	31	D
2	C	12	C	22	D	32	C
3	B	13	C	23	B	33	D
4	B	14	C	24	B	34	C
5	D	15	C	25	B	35	D
6	B	16	C	26	D		
7	C	17	A	27	B		
8	A	18	B	28	B		
9	C	19	A	29	C		
10	C	20	D	30	B		

SOLUTIONS

Unit – 1 (WS-11)

Q.1 Answer is "A"

Solution:- There are two supplementary units named "Radian" and "Steradian".

Q.2 Answer is "C"

Solution:- There are two supplementary units named "Radian" and "Steradian".

Q.3 Answer is "B"

Solution:- Light year is the distance covered by light in one year. As light year is distance, so it is measured in metres which is a base unit.

Q.4 Answer is "B"

Solution:-

- SI-unit of plane angle is radian.
- SI-unit of solid angle is steradian.

Q.5 Answer is "D"

Solution:- An ideal standard has two characteristics:

i. Accessible

ii. Invariable

Q.6 Answer is "B"

Solution:- The kinds of units in system International are three i-e base units, derived units and supplementary units.

Q.7 Answer is "C"

Solution:- The amount of substance is measured in mole.

Q.8 Answer is "A"

Solution:-

$$P = \frac{F}{A} = \frac{N}{m^2} = \frac{kg\ m\,s^{-2}}{m^2} = kg\ m^{-1}\ s^{-2}$$

Q.9 Answer is "C"

Solution:-

- 1 atto = 10^{-18}
- 1 femto = 10^{-15}
- 1 pico = 10^{-12}
- 1 nano = 10^{-9}

Q.10 Answer is "C"

Solution:- Both relations $Y=\frac{E}{B}$ and

$X=\frac{1}{\sqrt{\mu_\circ \varepsilon_\circ}}$ represent speed, X represents speed of light while Y represents speed of a charge particle in velocity selector. So, the ratio X/Y will surely be unit-less.

Q.11 Answer is "B"

Solution:- Plane angle (2D-angle) is measured in radian (SI-unit), degree and revolution. These units can be arranged in descending order as:

revolution > radian > degree

Q.12 Answer is "C"

Solution:- $F = ma = kg\ m\ s^{-2}$

Q.13 Answer is "C"

Solution:- The general formula for solid (3D-angle) angle is:

$$\theta = \frac{\text{Area of Patch}}{\text{Square of radius}} = \frac{A}{r^2}(sr)$$

For half football

$A = 2\pi r^2$ (for full sphere; $A = 4\pi r^2$)

So,

$$\theta = \frac{2\pi \cancel{r^2}}{\cancel{r^2}} = 2\pi \ sr$$

Q.14 Answer is "C"

Solution:- $P = \frac{W}{t} = \frac{J}{\text{sec}} = \frac{N\ m}{s}$

$$P = \frac{\left(kg\ \frac{m}{s^2}\right)m}{s} = kg\ m^2\ s^{-3}$$

Q.15 Answer is "C"

Solution:-

$$\tau = N\,m = \left(kg\ \frac{m}{s^2}\right)m$$

$$\tau = kg\ m^2\ s^{-2}$$

Q.16 Answer is "C"

Solution:- $\eta = \frac{N\ s}{m^2} = \frac{\left(kg\ \frac{m}{s^2}\right)s}{m^2}$

$$\eta = kg\ m^{-1}\ s^{-1}$$

Q.17 Answer is "A"

Solution:- As impulse is equal to change in momentum, so its units are same as that of momentum. i.e

Impulse = $F \times t = mv_f - mv_i$

Impulse = kg m s^{-1}

Q.18 Answer is "B"

Solution:-

$$F = G\frac{Mm}{r^2}$$

$$G = \frac{Fr^2}{Mm}$$

$$G = \frac{Nm^2}{kg^2} = \frac{\left(kg\ m\ s^{-2}\right)m^2}{kg^2}$$

$$G = kg^{-1}m^3s^{-2}$$

Q.19 Answer is "A"

Solution:- Dyne is the C.G.S unit of force and it is related with SI unit of force as;

$$1\ dyne = 1\ gm\ cm\ s^{-2}$$

1 dyne = $(10^{-3}$ kg$)(10^{-2}$ m$)(s^{-2})$

1 dyne = 10^{-5} N

Q.20 Answer is "D"

Solution:- In the Bernoulli's equation, all the terms are pressures i.e

P=static pressure

$\frac{1}{2}\rho v^2$ = dynamic Pressure

ρgh = Pressure in depth

So, all terms have units of pressure which are same as that of stress.

Q.21 Answer is "D"

Solution:- All these quantities pressure, stress, energy density, P.E per unit volume, K.E per unit volume and elastic modulus have same units which are N m^{-2} or pascal.

Q.22 Answer is "D"

Solution:- In the given relation 'E' is not energy rather it is energy intensity(energy per second per unit area). Also the solar constant is measured in the same units as that of energy intensity.

Q.23 Answer is "B"

Solution:- A precise measurement is the one which has least absolute uncertainty i.e least count.

Q.24 Answer is "B"

Solution:- An accurate measurement is the one which has least fractional or percentage uncertainty.

Q.25 Answer is "B"

Solution:- A screw gauge measures up to second decimal value in (mm) unit. So, the reading which contains two digits after decimal fraction is correct.

Q.26 Answer is "D"

Solution:- U.C of final result in addition & subtraction = sum of absolute U.Cs of individual measurements.

Q.27 Answer is "B"

Solution:- Use relation, $A = \ell^2$, Also in power factor we simply multiply percentage error with power.

Q.28 Answer is "B"

Solution:- Use relation;

$$K.E_{rot}=1/2\ I\omega^2$$

% U.C in $K.E_{rot}$ = (% U.C in moment of inertia) + 2(% U.C in angular velocity)

Q.29 Answer is "C"

Solution:-

$$\text{U.C in time period} = \frac{\text{L.C}}{\text{no.of vibrations}}$$

Q.30 Answer is "B"

Solution:- Simple power factor rule i.e

% U.C in V = 3(% U.C in radius)

Q.31 Answer is "D"

Solution:- $\frac{1\ femto}{1\ giga} = \frac{10^{-15}}{10^{+9}} = 10^{-24}$

Q.32 Answer is "C"

Solution:- Both readings have equal error when measured by same instrument, this is the definition of systematic error i.e

"System error refers to an effect that influences all measurements of a particular quantity equally."

Q.33 Answer is "D"

Solution:-

Viscosity = N s m^{-2} = (kg m s^{-2}) s m^{-2}

= kg m^{-1} s^{-1}

Spring constant = N m^{-1}=(kg m s^{-2}) m^{-1} = kg s^{-2}

So, kg has same power in base units of viscosity and spring constant.

Q.34 Answer is "C"

Solution:- Both Spring constant and surface tension have same units i-e N m^{-1}, so their ratio is unit less just like refractive index and magnification.

Q.35 Answer is "D"

Solution:-

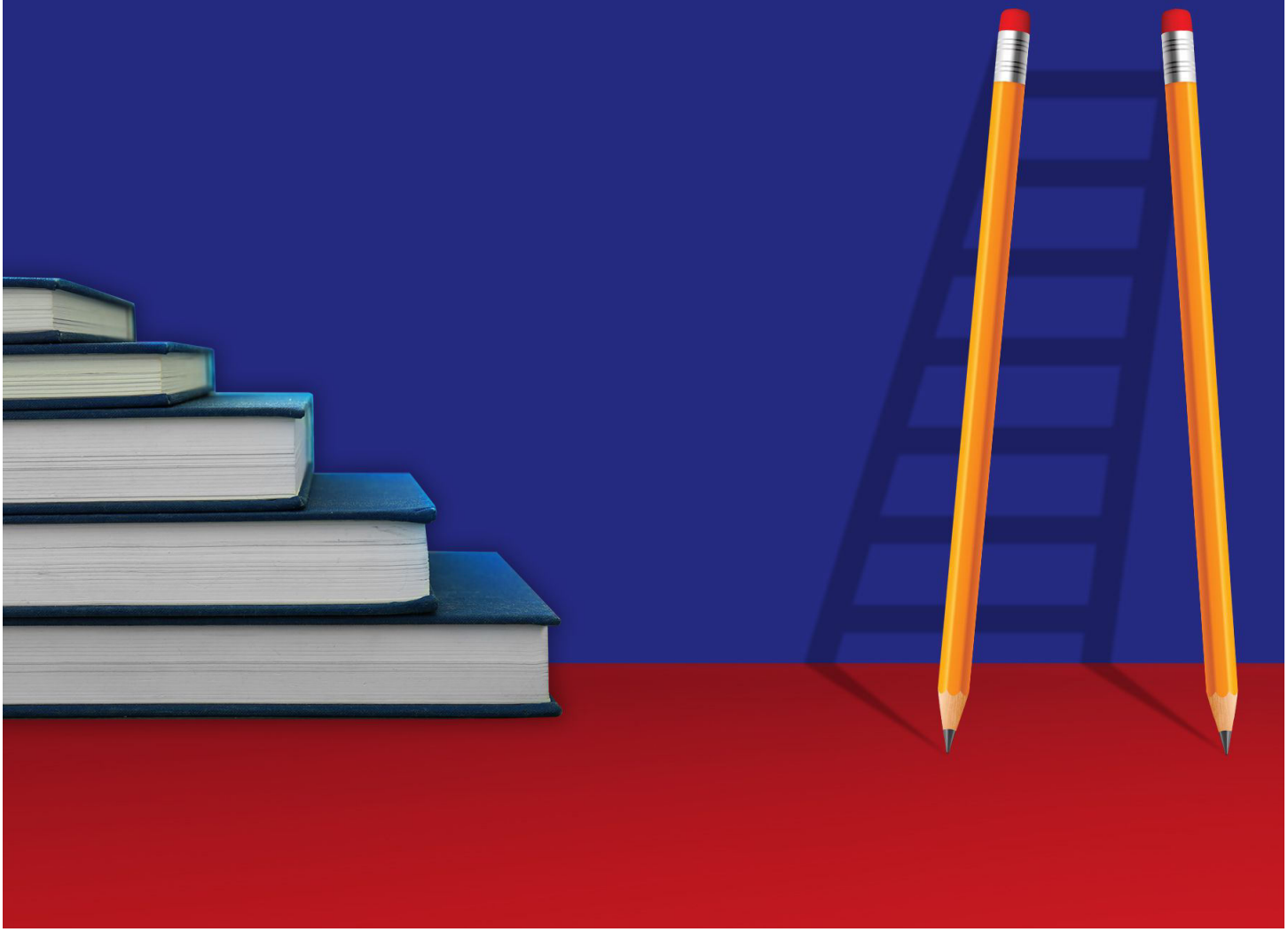
A) Both are unit less

B) Both have units N m^{-1}

C) Both have units N m^{-2}

STEP

A PROGRAM BY PUNJAB GROUP



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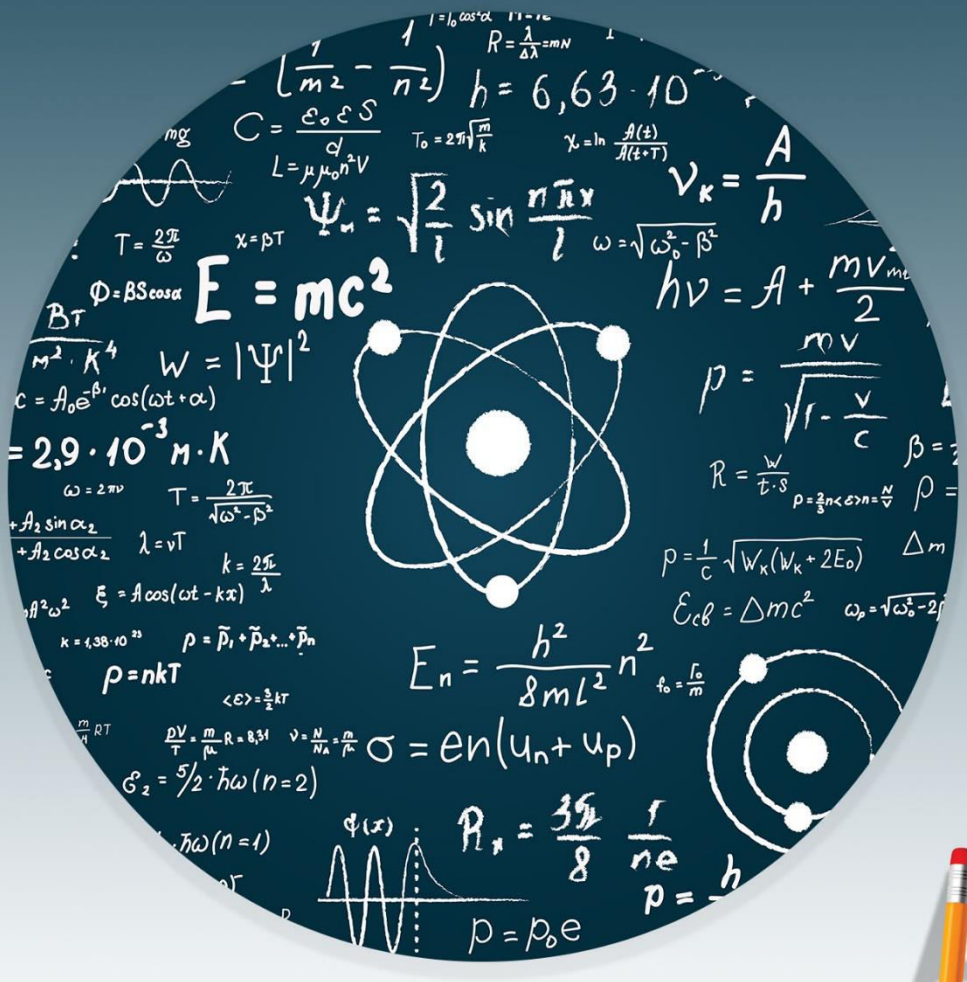

WORKSHEET-12

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-12

Topics:- Displacement, Velocity, Acceleration, Velocity-time Graph, Equations of Motion, Laws of Motion, Momentum and Conservation of Momentum, Impulse, Projectile Motion, Elastic & Inelastic Collisions

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Q.1 Pull of earth on a mass of 20 kg at surface of earth is:

A) 196 N C) 20 N

B) 1960 N D) 19.6 N

Q.2 Time rate of change of momentum is equal to:

A) Force C) Velocity

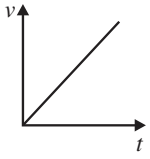
B) Impulse D) Force constant

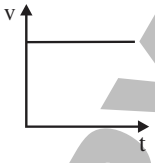
Q.3 Distance covered by a freely falling body in 2 seconds will be:

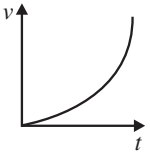
A) 4.9 m C) 39.2 m

B) 19.6 m D) 9.8 m

Q.4 For which of the following graph/graphs, both velocity and acceleration are constant:

A) 

C) 

B) 

D) None of these

Q.5 1st law of motion gives definition of:

A) Mass C) Force

B) Inertia D) Momentum

Q.6 One Newton is the force:

A) Of gravity on $\frac{1}{g} kg$ body

B) Of gravity on a 1 g body

C) That gives a 1 kg body an acceleration of 1 m s^{-2}

D) Both "A" and "C"

Q.7 A 7.0 kg ball experiences a net force of 7.0 N what will be its acceleration?

A) 10 m s^{-2} C) 1 m s^{-2}

B) 5.0 m s^{-2} D) 35.0 m s^{-2}

Q.8 **A force 2F acting on a particle of mass 10 kg produces an acceleration of 60 m s^{-2}. A force 5F acting on a particle of mass M produces an acceleration of 50 m s^{-2}. What is the mass M?**

A) 3.3 kg C) 21 kg

B) 4.8 kg D) 30 kg

Q.9 **The Newton's 2nd law:**

A) Defines force C) Balances force

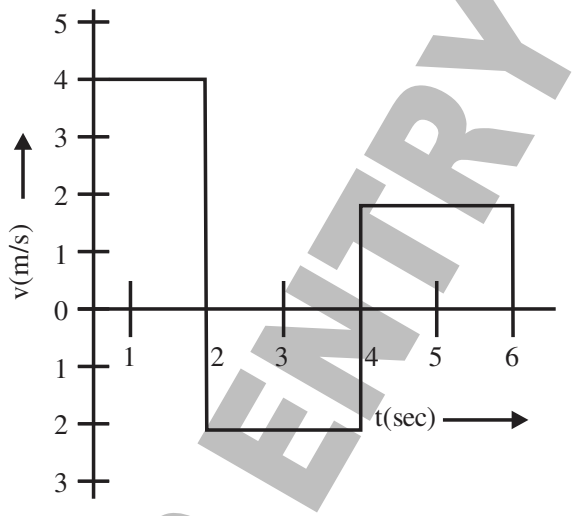
B) Measures force D) All of these

Q.10 **A ball of mass m_1 and another ball of m_2 are dropped from equal heights. If m_1 is twice as compared to m_2, then time taken by the balls t_1 and t_2 are related as:**

A) $t_1 = \frac{t_2}{2}$ C) $t_1 = 4t_2$

B) $t_1 = t_2$ D) $t_1 = \frac{t_2}{4}$

Q.11 **The velocity-time graph of a body moving in a straight line is shown in the figure. The displacement and distance travelled by the body in 6 sec, are respectively.**



A) 8 m , 16 m C) 16 m , 8 m

B) 16 m , 16 m D) 8 m, 8 m

Q.12 **A steel ball covers half the distance with velocity v_i and the other half with velocity v_f in the same straight line. The average velocity of ball is:**

A) $\frac{v_i + v_f}{2}$ C) $\frac{v_i v_f}{v_i + v_f}$

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B) $v_i + v_f$ D) $\frac{2v_i v_f}{v_i + v_f}$

Q.13 A 60 m long train is moving in a direction with speed 20 m s^{-1}. Another train moving with 30 m s^{-1} in the opposite direction and 40 m long crosses the first train in:

A) 5 s C) 2 s

B) 6 s D) 4 s

Q.14 A car covers 2/3 distance with 60 m s^{-1} and 1/3 distance with 20 m s^{-1}. Average speed is:

A) 36 m s^{-1} C) 66 m s^{-1}

B) 46 m s^{-1} D) 56 m s^{-1}

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Q.15 A person standing on a horizontal floor feels two forces: The downward pull of gravity and the upward supporting force from the floor. These two forces:

A) Have equal magnitude and form an action/reaction pair

B) Have equal magnitude but do not form an action/reaction pair

C) Have unequal magnitudes

D) Are equal forces

Q.16 An object with a constant speed:

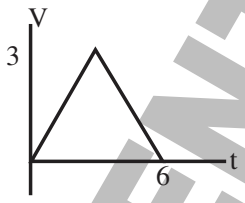
A) Is not accelerated

B) Might be accelerated

C) Is always accelerated

D) Also has a constant velocity

Q.17 In the figure, distance covered is:



A) 9 units C) 3 units

B) 6 units D) 18 units

Q.18 The ratio of distance to magnitude of displacement when a body covers a semicircle is:

A) $\frac{\pi}{2}$ C) $\frac{1}{\pi}$

B) πR D) $\frac{\pi}{4}$

Q.19 Distance travelled by a body falling freely starting from rest in the 1st, 2nd and 3rd seconds are in the ratio:

A) 1:4:9 C) 1:2:3

B) 1:3:5 D) 1:2:5

Q.20 Throwing a package onto shore from a boat that was previously at rest causes the boat to move outward from shore, is explained by:

A) Newton's 1st law of motion

B) Newton's 2nd law of motion

C) Newton's 3rd law of motion

D) Conservation of momentum

Q.21 A body is released from a height of 5 m. If friction is ignored then its velocity just before striking the ground will be ($g = 10\ m\ s^{-2}$):

A) 5 m s^{-1} C) 15 m s^{-1}

B) 10 m s^{-1} D) 20 m s^{-1}

Q.22 If momentum is increased by 20% then K.E. increases by:

A) 44% C) 66%

B) 55% D) 77%

Q.23 A boy throws a ball with velocity 10 m s^{-1} in vertically upward direction. If $g = 10\ m\ s^{-2}$, the ball rises to a height

A) 2 m C) 10 m

B) 5 m D) 25 m

Q.24 Two bodies of different masses m_1 and m_2 are dropped from two different heights h_1 and h_2. The ratio of times taken by the two bodies through these distances is:

A) $h_1 : h_2$ C) $\sqrt{h_1} : \sqrt{h_2}$

B) $\frac{m_1}{m_2} : \frac{h_2}{h_1}$ D) $h_1^2 : h_2^2$

Q.25 The distance traveled by a body dropped from the top of a tower is proportional to:

A) Mass of the body

B) Height of the tower

C) Weight of the body

D) Square of the time elapses

Q.26 An object is released from a height h above the ground reaches the ground in 8 s. The time taken by the object to cover the first half distance is:

A) $2\sqrt{2}$ s C) $4\sqrt{2}$ s

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B) $\frac{4}{\sqrt{52}}$ s D) $8\sqrt{2}$ s

Q.27 If a body starts from a point and returns back to the same point then its:

A) Average speed is zero but not average velocity

B) Average speed and velocity depend on the path

C) Both average speed and velocity are zero

D) Average velocity is zero but not average speed

Q.28 Which pair contains one scalar & one vector:

A) Acceleration, force C) Force, K.E

B) Momentum, velocity D) Work, P.E

Q.29 All statements are correct about third law of motion except:

A) Forces have equal magnitude

B) Both forces have opposite direction

C) Both forces are applied on different bodies

D) Both are applied on same body maintaining equilibrium

Q.30 If R is the maximum horizontal distance of projectile then the greatest height attained by projectile in this condition is:

A) R C) 2R

B) $\frac{R}{2}$ D) $\frac{R}{4}$

Q.31 During projectile motion if H = R then angle of projection with horizontal is

A) Tan^{-1} (4) C) $Tan^{-1}\left(\frac{1}{4}\right)$

B) $Tan^{-1}\left(\sqrt{4}\right)$ D) $Tan^{-1}\left(\frac{1}{\sqrt{4}}\right)$

Q.32 Range of projectile is R when angle of projection is 60^o, then the value of other angle of projection for same range is:

A) 40^o C) 50^o

B) 30^o D) 20^o

Q.33 A person can throw a stone to maximum range of 100 m. The greatest height with same conditions to which he can make the stone to rise is:

A) 50 m C) 100 m

B) 150 m D) 25 m

Q.34 During projectile motion the quantities that remain

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constant are:

A) Acceleration, v_x C) Force, velocity

B) Acceleration, K.E D) Acceleration, Momentum

Q.35 The path of projectile is:

A) Hyperbola C) Parabola

B) Straight line D) Ellipse

Q.36 Motion of projectile is _____ dimensional.

A) One C) Two

B) Three D) Four

Q.37 Four projectiles are launched at angles 20°, 30°, 40° and 50° respectively. Which of these projectiles will have maximum range?

A) Projectile launched at 20°

B) Projectile launched at 50°

C) Projectile launched at 30°

D) Both projectiles launched at 40° and 50°

Q.38 Which component of the velocity of projectile remains constant throughout the motion?

A) v_x C) a_x

B) v_y D) a_y

Q.39 Which of the following factors in a projectile motion remains same?

A) v_x C) a_x

B) a_y D) All of these

Q.40 At which angle when a projectile is launched R=H?

A) 45° C) 76°

B) 30° D) 60°

Q.41 At which angle when a projectile is launched $H = \frac{R}{4}$?

A) 45° C) 76°

B) 30° D) 60°

Q.42 The angle between velocity of projectile and acceleration at the highest point becomes:

A) 90° C) 0°

B) 180° D) 76°

Q.43 A person moving in a car at a constant velocity throws an apple vertically upwards. If we ignore air friction and suppose car to move with same velocity then according to an observer standing outside.

USE THIS SPACE FOR SCRATCH WORK

A) Apple will follow a parabolic path and will fall again in car

B) Apple will follow a parabolic path but will fall behind car

C) Apple will follow a linear path and will fall again in car

D) Apple will follow a parabolic path but will fall before car

Q.44 Two balls are thrown at angles of θ and (90°-θ) with the horizontal with same speed. Ratio of their time of flights is:

A) $\tan^2\theta : 1$ C) $\tan\theta : 1$

B) $1 : \tan\theta$ D) 1:1

Q.45 A bomber drops its bomb when it is vertically above the target, it misses the target due to (falls ahead):

A) Air resistance

B) Horizontal component of velocity

C) Vertical component of velocity

D) Gravity

Q.46 The maximum height of projectile has the largest value for which of the following angles of projection?

A) 0° C) 30°

B) 60° D) 75°

Q.47 A body drops a coin from the window of a moving train. The path of coin according to a stationary observer inside the train will be:

A) Vertical straight line C) Parabolic

B) Elliptical D) Circular

Q.48 A ball whose K.E is E, is projected at an angle of 45° with vertical then, its K.E at maximum height is

A) E C) $\frac{E}{2}$

B) $\frac{E}{\sqrt{2}}$ D) 2E

Q.49 In a competition, fielders are required to throw the cricket hard ball as far as possible. Under ideal conditions, the optimum throwing angle is 45°. What should this angle, with respect to ground, be in (i) Strong winds against the direction of throw; and (ii) Strong winds in the direction of throw?

A) (i) more than 45°, (ii) less than 45°

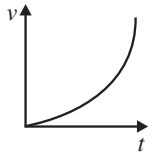
B) (i) less than 45°, (ii) more than 45°

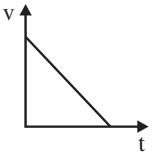
C) 45° in both cases

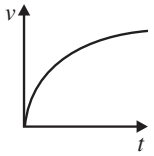
D) Depends on throwing speed

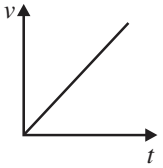
Q.50 Which of the following is decreasing acceleration graph?

USE THIS SPACE FOR SCRATCH WORK

A) 

C) 

B) 

D) 

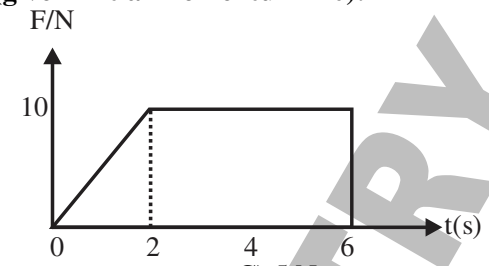
Q.51 A collision in which K.E of system remains constant is called:

A) Elastic Collision
B) Inelastic Collision
C) Partially elastic Collision
D) Any of these

Q.52 In the head on elastic collision of a heavy vehicle moving with a velocity of 20 m s^{-1} and a small stone at rest, the stone will fly away with a velocity equal to

A) 5 m s^{-1}
B) 10 m s^{-1}
C) 20 m s^{-1}
D) 40 m s^{-1}

Q.53 A body of mass 3 kg is acted upon by a force which varies as shown in the graph below. The momentum acquired during 6 s is given by (given initial momentum = 0):



A) Zero
B) 30 N s
C) 5 N s
D) 50 N s

ANSWER KEY (Worksheet-12)											
1	A	11	A	21	B	31	A	41	A	51	A
2	A	12	D	22	A	32	B	42	A	52	D
3	B	13	C	23	B	33	D	43	A	53	D
4	C	14	A	24	C	34	A	44	C		
5	C	15	B	25	D	35	C	45	B		
6	D	16	B	26	C	36	C	46	D		
7	C	17	A	27	D	37	D	47	A		
8	D	18	A	28	C	38	A	48	C		
9	B	19	B	29	D	39	D	49	C		
10	B	20	C	30	D	40	C	50	B		

SOLUTIONS

Unit – 2 (W-12)

Q.1 Answer is "A"

Solution:- $w = mg$

Q.2 Answer is "A"

Solution:- $F = \frac{\Delta p}{\Delta t}$

Q.3 Answer is "B"

Solution:- $S = \frac{1}{2}gt^2$

Q.4 Answer is "C"

Solution:-

- For option A, acceleration is constant but velocity is increasing uniformly.
- For option B, both velocity and acceleration are increasing.
- For option C, velocity is constant, so acceleration is zero which is also a constant.

Q.5 Answer is "C"

Solution:- First law of motion defines force while 2nd law of motion measures force.

Q.6 Answer is "D"

Solution:-

- One newton force in terms of g (gravitational acceleration)

$F = mg = 1\ \text{N}$

$m = \frac{1}{g}\ kg$

- One newton force by 2nd law of motion

$F = ma$ if $m = 1\ \text{kg}$ and $a = 1\ m\ s^{-2}$ then $F = 1\ \text{N}$

Q.7 Answer is "C"

Solution:- F = ma

Q.8 Answer is "D"

Solution:- $\frac{F_1}{F_2} = \frac{M_1 a_1}{M_2 a_2}$

Q.9 Answer is "B"

Solution:- First law of motion defines force while 2nd law of motion measures force.

Q.10 Answer is "B"

Solution:- All objects (massive or light) reach on earth with same acceleration "g" when dropped from same heights. Their free fall time is given as:

$t = \sqrt{\frac{2S}{g}}$

So $t_1 = t_2$

Q.11 Answer is "A"

Solution:- Both distance and displacement given as:

Distance= $(4\times2)+(2\times(4-2))+(2\times(6-4))$

Displacement = $(4\times2)+(-2\times(4-2))+(2\times(6-4))$

Q.12 Answer is "D"

Solution:-

$$v_{avg} = \frac{\text{total distance}}{\text{total time}}$$

$$\Rightarrow \quad v_{avg} = \frac{d_1 + d_2}{t_1 + t_2}$$

$$\Rightarrow \quad v_{avg} = \frac{\frac{d}{2}+\frac{d}{2}}{\frac{\frac{d}{2}}{v_i}+\frac{\frac{d}{2}}{v_f}}$$

Simplify it $\Rightarrow \; v_{avg} = \frac{2v_i v_f}{v_i + v_f}$

Q.13 Answer is "C"

Solution:- $t = \frac{\text{Total distance}}{\text{relative speed}}$

$$\Rightarrow \quad t = \frac{60+40}{30+20}$$

Q.14 Answer is "A"

Solution:- $v_{avg} = \frac{d_1 + d_2}{\frac{d_1}{v_1}+\frac{d_2}{v_2}}$

Q.15 Answer is "B"

Solution:- Since both of these forces act on one body, so these cannot make action-reaction pair as according to Newton's 3rd law of motion action reaction never act on same body.

Q.16 Answer is "B"

Solution:- An object moving with constant speed may or may not be accelerated.

Case-I

When object is moving with constant speed in same direction its acceleration is zero.

Case-II

When object is moving with constant speed on a circular path, its direction changes which results in centripetal acceleration which is not zero.

Q.17 Answer is "A"

Solution:- Simply find area under curve

Q.18 Answer is "A"

Solution:- $\frac{S}{d} = \frac{\pi R}{2R}$

Q.19 Answer is "B"

Solution:- Distance covered in n^{th} second is:

$$S = \frac{g}{2}(2n-1)$$

Q.20 Answer is "C"

Solution:- This is well according to Newton's 3rd law, the action force acts on package towards shore while the reaction force acts away from shore on boat.

Q.21 Answer is "B"

Solution:- $v = \sqrt{2gh}$

Q.22 Answer is "A"

Solution:- Use relation $P = \sqrt{2mE}$

Q.23 Answer is "B"

Solution:- Use 3rd equation of motion

Q.24 Answer is "C"

Solution:- $S = \frac{1}{2}gt^2$

Q.25 Answer is "D"

Solution:- $y = \frac{1}{2}gt^2$

Q.26 Answer is "C"

Solution:-

i. $S = \frac{1}{2}gt^2$

$$S = \frac{1}{2}\times 10 \times 8^2$$

$$S = 320 \text{ m}$$

ii. $\frac{S}{2} = 160 \text{ m}; t_x = ?$

$$\left(\frac{S}{2}\right)=\frac{1}{2}gt_x^2$$

Solve it

$$t_x=4\sqrt{2}\ \text{sec}$$

Q.27 Answer is "D"

Solution:- In a closed path distance ≠ zero but displacement = 0

Q.28 Answer is "C"

Solution:-

A) Acceleration and force both are vectors.

B) Momentum and velocity both are vectors.

C) Force is vector while K.E is scalar.

D) Work and P.E both are scalars.

Q.29 Answer is "D"

Solution:- In action reaction forces;

- Both forces have equal magnitudes but opposite directions.
- Both forces are applied on different bodies.
- As both forces acts on different bodies, so these cannot maintain equilibrium.

Q.30 Answer is "D"

Solution:- When $\theta=45°$, $R=max$ then

$$H=\frac{R}{4}$$

Q.31 Answer is "A"

Solution:- For a projectile;

If R=nH then

$$\theta=\tan^{-1}\left(\frac{4}{n}\right)=\tan^{-1}\left(\frac{4}{1}\right)=76°$$

For given question

$$R=1H\Rightarrow\theta=\tan^{-1}\left(\frac{4}{1}\right)$$

Q.32 Answer is "B"

Solution:- If sum of two angles is 90°, the ranges at those angles are equal if projected with same speed.

Q.33 Answer is "D"

Solution:- The maximum range and height are related as;

$$R=\frac{v_i^2}{g}\sin 2\theta\ ;\qquad h=\frac{v_i^2\sin 2\theta}{2g}$$

As range is maximum at $\theta=45°$, so;

$$R_{max}=\frac{v_i^2}{g}\ ;\quad h=\frac{v_i^2}{2g}(\sin 45°)^2$$

$$R_{max}=\frac{v_i^2}{g}\ ;\quad h=\frac{v_i^2}{4g}$$

$$h=\frac{R_{max}}{4}$$

Just remember this formula. This formula says at maximum range height is four times less than maximum range.

Q.34 Answer is "A"

Solution:- As friction is ignored so $v_x=constant$ also $a_x=0=constant$

And $a_y = g = constant$

Q.35 Answer is "C"

Solution:- Usually we consider ideal case in which air friction is ignored, so path of projectile is parabola.

Q.36 Answer is "C"

Solution:- Projectile motion is a two dimensional motion under constant acceleration due to gravity.

Q.37 Answer is "D"

Solution:- The range of projectile is maximum at 45°. But among given option 45° is not present, so range among given options will be maximum at that angle which is closest to 45° (no matter whether

it is closer with value less than 45° or greater than 45°). As 40° and 50° are equally closest to 45°, so range will be maximum at these angles.

Q.38 Answer is "A"

Solution:- As air friction is ignored in projectile motion, so no force acts along horizontal direction, hence horizontal component of velocity remains constant and horizontal component of acceleration remains zero. i.e

$$v_x = \text{constant} \;;\quad a_x = \frac{\Delta v_x}{\Delta t} = 0$$

Q.39 Answer is "D"

Solution:- $v_x = \text{constant}$,

$a_x = 0 = \text{constant}$, $a_y = g = \text{constant}$

Q.40 Answer is "C"

Solution:- For a projectile;

If R=nH then $\theta = \tan^{-1}\left(\frac{4}{n}\right)$

For given question

$$R = 1\text{H} \Rightarrow \theta = \tan^{-1}\left(\frac{4}{n}\right) = \tan^{-1}(4) = 76°$$

Q.41 Answer is "A"

Solution:- If R = nH

then $\theta = tan^{-1}\left(\frac{4}{n}\right)$

Q.42 Answer is "A"

Solution:- At highest point $v_y = 0$ so $v = v_x$ is $\perp_r'$ to a=g

Q.43 Answer is "A"

Solution:- Car will provide it horizontal component and person a vertical so combination makes a parabolic path.

Q.44 Answer is "C"

Solution:-

$$\frac{t_1}{t_2} = \frac{\left(\frac{2v_i sin\theta}{g}\right)}{\left(\frac{2v_i \sin(90-\theta)}{g}\right)} = \frac{\sin\theta}{\sin(90-\theta)}$$

$$\frac{t_1}{t_2} = \frac{\sin\theta}{\cos\theta} = \tan\theta$$

Q.45 Answer is "B"

Solution:-

Because of horizontal component of velocity, the bomb undergoes projectile motion rather than vertically downward motion so it misses the target.

Q.46 Answer is "D"

Solution:- Height of projectile is given as;

$$h = \frac{v_i^2 \sin^2\theta}{2g}$$

It is maximum at 90°, among given options 90° is not present, so height will be maximum at that angle which is closer to 90°.

Q.47 Answer is "A"

Solution:- The path will be projectile for an observer standing outside the train, while for an observer within the train the path will be straight line.

Q.48 Answer is "C"

Solution:-

Use relation; $K.E_H = K.E_i \times cos^2\theta$

For $P.E_H = K.E_i \times sin^2\theta$

Q.49 Answer is "C"

Solution:- Range can only be maximum at θ=45°.

Q.50 Answer is "B"

Solution:- The slope of velocity time graph gives acceleration. As the slope of v-t graph decreases to zero in option-B, so acceleration will also be decreasing in this case, while in option "C" the slope is negative but it is constant.

Q.51 Answer is "A"

Solution:- A Collision in which K.E of system remains constant is called elastic collision.

Q.52 Answer is "D"

Solution:- When a massive body collides with a light body then after collision velocity of light body is twice the initial velocity of massive body.

Q.53 Answer is "A"

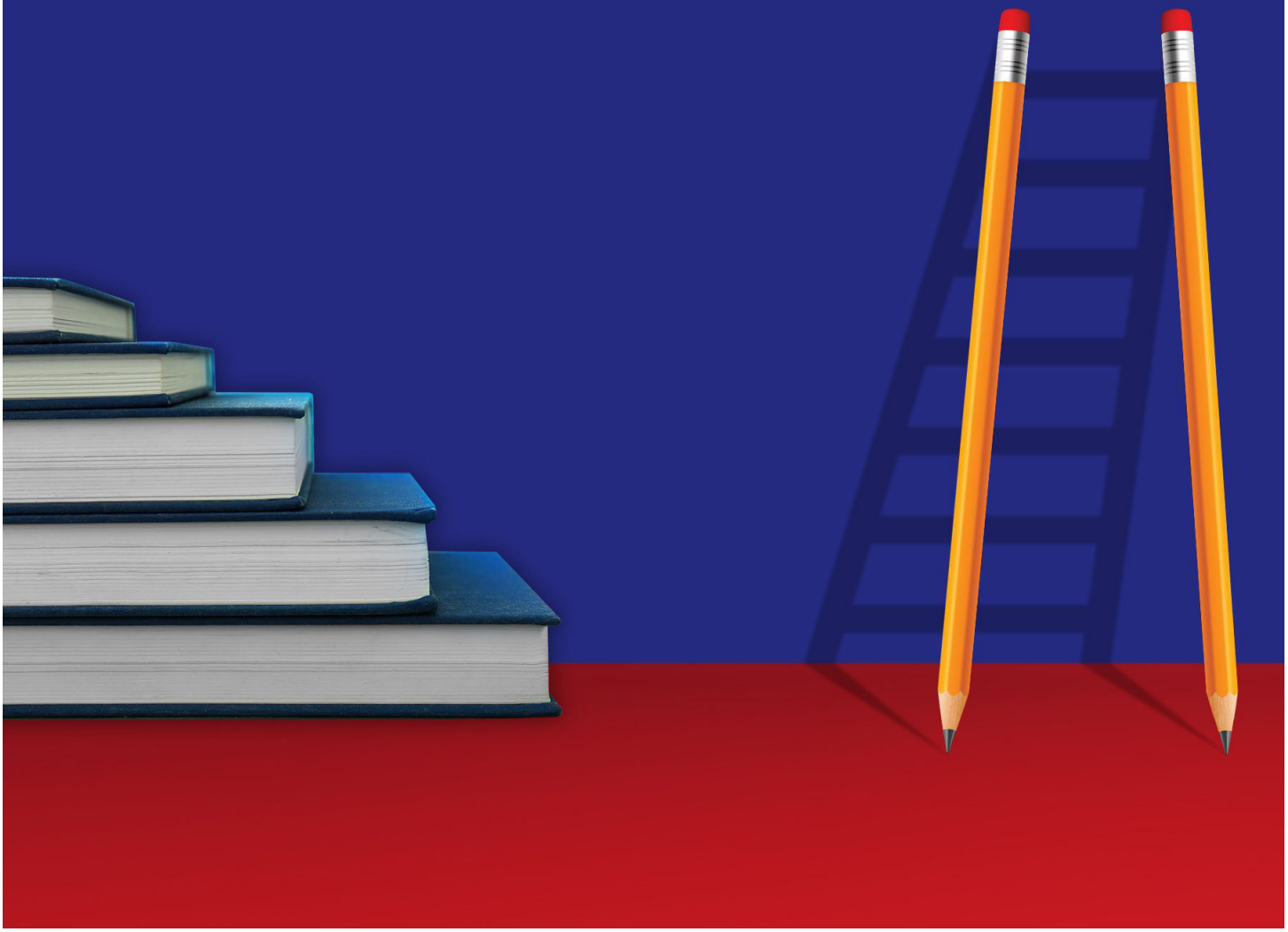
Solution:-

Area of F-t graph = change in momentum

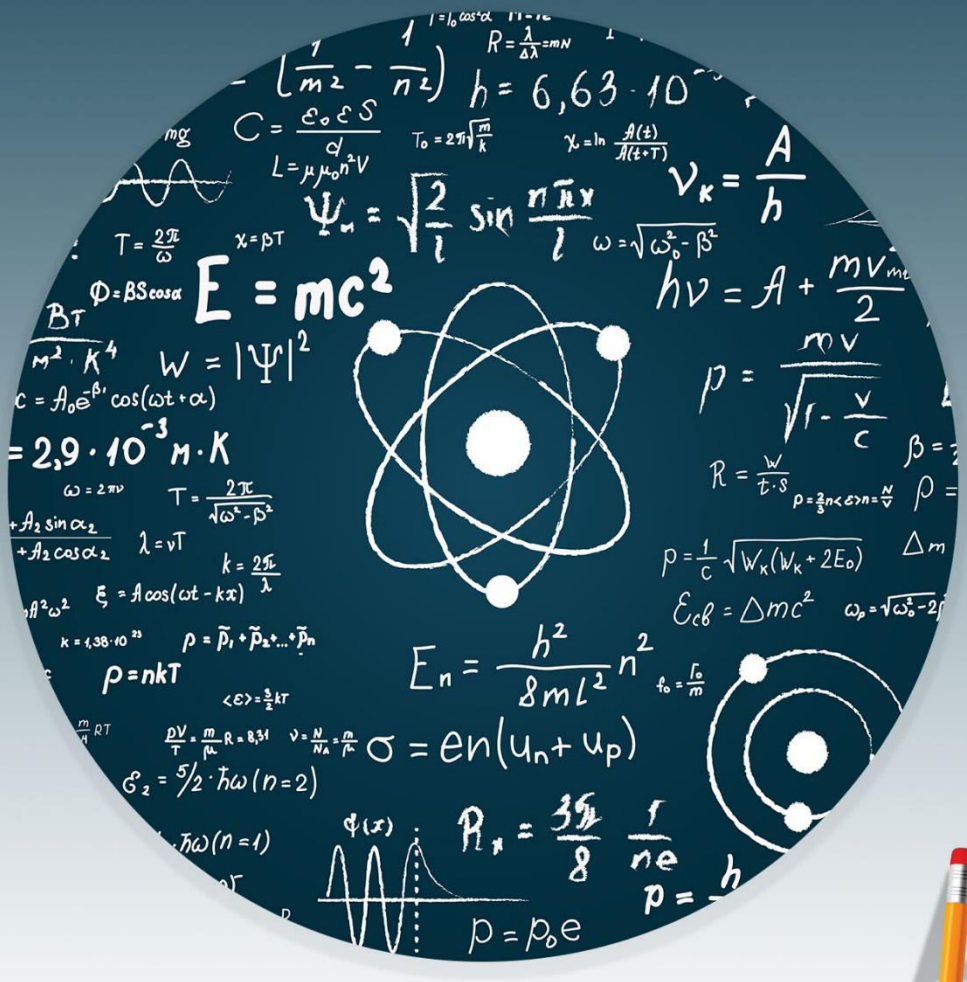
Area of F-t graph = $\frac{1}{2}(2)(10)+(6-2)(10)=50$ N s

STEP

A PROGRAM BY PUNJAB GROUP



PHYSICS



WORKSHEET-13

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-13

Topics:- Moment of Force, Equilibrium & Conditions

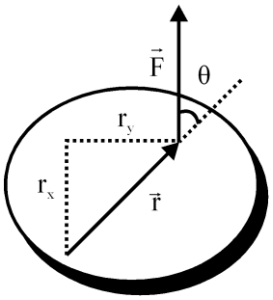
USE THIS SPACE FOR SCRATCH WORK

Q.1 The torque acting on a body will be half of maximum value when angle between force and position vector is:

A) 30° C) 60°

B) 45° D) 90°

Q.2 The torque in following figure is:



A) $r_x F\ \hat{n}$ C) $r\cos\theta F\ \hat{n}$

B) $r_y F\ \hat{n}$ D) Both "A" and "B"

Q.3 If the centre of gravity of a body does not shift when it is disturbed then the body is said to be in?

A) Stable equilibrium C) Neutral equilibrium

B) Unstable equilibrium D) Rotational equilibrium

Q.4 Which one is true statement:

A) A body in equilibrium implies that it is neither moving not rotating

B) If coplanar forces acting on a body form a closed polygon, then body is said to be in complete equilibrium

C) A body in equilibrium may move or rotate

D) Both "B" and "C"

Q.5 Torque is analogous to force for:

A) Translatory motion C) Rotational motion

B) Vibratory motion D) Linear motion

Q.6 The direction of torque in earth considering it to be an inertial frame of reference is:

A) Anti-clock wise C) Along axis of rotation

B) Clock wise D) Has no torque

Q.7 The torque produced by the weight of the body about the centre of gravity will be:

A) mgr C) $\vec{\omega}\times\vec{r}$

B) Zero D) $\vec{r}\times\vec{F}$

USE THIS SPACE FOR SCRATCH WORK

Q.8 Work done by torque will be equal to:

A) Fd C) Iα

B) $r\theta$ D) $\tau\theta$

Q.9 As for translational motion we use relation F=ma similarly for angular motion this relation appears as:

A) $\tau = m\alpha$ C) $\tau = I\alpha$

B) $\tau = Ia$ D) $\tau = mr^2a$

Q.10 If the line of action of force passes through the axis of rotation, then the value of torque will be:

A) Maximum C) Negative

B) Zero D) Positive

Q.11 What is not true of the two forces that give rise to couple?

A) They act in opposite direction

B) They both act on the same body

C) They both act at the same point

D) They both have the same magnitude

Q.12 When a body is disturbed from it's equilibrium state such that it is said to be in stable equilibrium then?

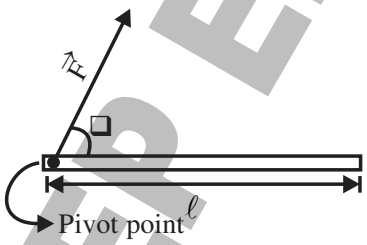
A) It returns to equilibrium position if released

B) It's P.E increases

C) It's line of action of weight remains within same base area

D) All of these

Q.13 For which value of "θ" in the figure shown torque becomes maximum?

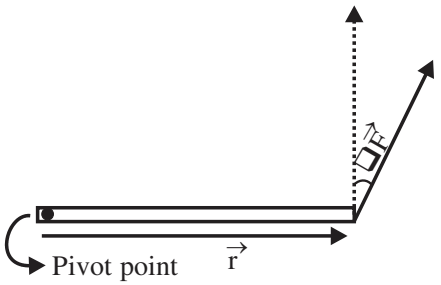


A) 0° C) 180°

B) 90° D) No torque is produced

Q.14 A force $\vec{F}$ acts on a rod as shown in the figure. What is the relation for torque in it?

USE THIS SPACE FOR SCRATCH WORK



A) $\tau = rF\sin\theta$ C) $\tau = rF\tan\theta$

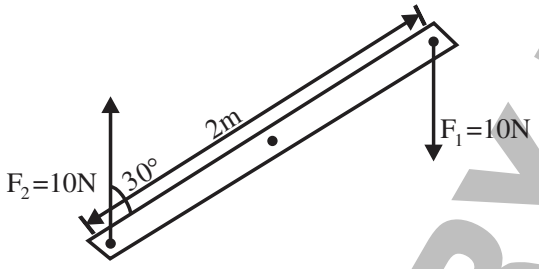
B) $\tau = rF\cos\theta$ D) $\tau = rF\cot\theta$

Q.15 In above Question for which value of "θ" torque becomes maximum?

A) θ=90° C) Both "A" and "B"

B) θ=270° D) θ=0°

Q.16 Consider the figure in which two forces act on a single rod of length 2 m as shown. What will be the value of moment of couple produced?



A) 20 N m C) 5 N m

B) 10 N m D) 30 N m

Q.17 The rate of change of angular momentum is equal to:

A) Linear momentum C) Torque

B) Force D) None of these

Q.18 The angular momentum of an object changes from 100 J s to 300 J s in 2 s. What will be the torque acting on it?

A) 100 N m C) 150 N m

B) 300 N m D) 0 N m

Q.19 Two objects having moment of inertia I_1:I_2=2:1. What will be the ratio of their respective rate of change of angular momenta (consider first object to be in equilibrium)?

A) 2:1 C) 0

B) 1:2 D) ∞

Q.20 An object is said to be in complete equilibrium if:

A) $\sum\vec{F}=0, \sum\vec{\tau}\neq 0$ C) $\sum\vec{F}=0, \sum\vec{\tau}=0$

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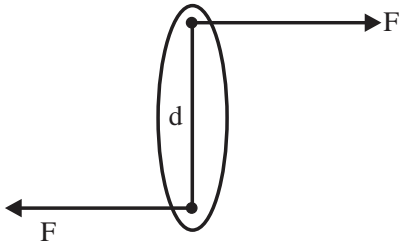
B) $\sum\vec{F}\neq 0, \sum\vec{\tau}=0$ D) $\sum\vec{F}\neq 0, \sum\vec{\tau}\neq 0$

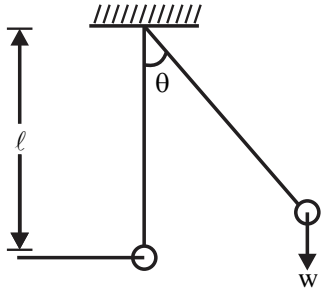
Q.21 What will be expression for moment of couple in the figure:



A) dF C) 2dF

B) dF/2 D) dF cosθ

Q.22 The expression of torque for following figure will be:



A) mg ℓ cosθ C) mg ℓ

B) mg ℓ sinθ D) mg ℓ tanθ

Q.23 The tyres of a car moving on road with constant velocity in a straight line are in _____ equilibrium.

A) Translational C) Dynamic

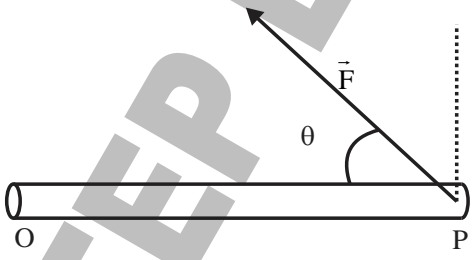
B) Rotational D) All of these

Q.24 The unit of "couple of forces" is same as that of:

A) Force C) Moment of couple

B) Torque D) Both B & C

Q.25 A force F is acting at point 'P' of uniform rod capable to rotate about "O" what is the torque about "O":



A) OPFsinθ C) OPFtanθ

B) OPFcosθ D) OPF

Q.26 A door requires a minimum torque of 100 N m in order to open it. What is the minimum distance of the handle from the hinge, if the door is to be pulled open with a

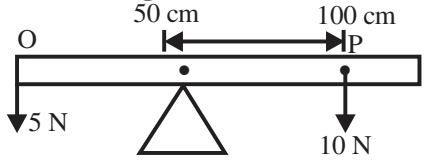
USE THIS SPACE FOR SCRATCH WORK

force at the handle not greater than 50 N.

A) 0.33 m C) 0.71 m

B) 2.0 m D) 1.54 m

Q.27 Two forces 5 N and 10 N are acting at 'O' and 'P' respectively on a uniform rod of length 100 cm suspended at the position of centre of gravity 50 cm mark as shown in figure.

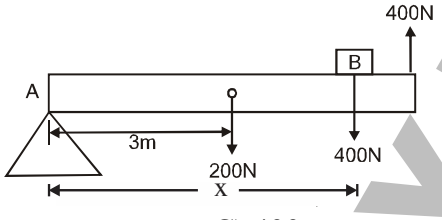


What is the position of P on meter rod?

A) 80 cm C) 75 cm

B) 70 cm D) 65 cm

Q.28 A uniform beam of 200 N is supported horizontally as show in fig. If the breaking tension of the rope is 400 N, how far can the block B of weight 400 N from point A on the beam as shown in fig.



A) 75 cm C) 400 cm

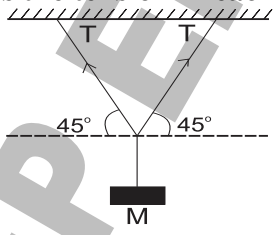
B) 300 cm D) 450 cm

Q.29 A uniform rod 30 cm long is pivoted at its centre. A 40-newton weight is hung 5 cm from the left end. Where must a 50-newton weight be hung to maintain equilibrium?

A) 5 cm from right end C) 6 cm from right end

B) 7 cm from right end D) 8 cm from right end

Q.30 A block of mass M shown in the figure below hangs motionless. What is the tension in each of the ropes?



A) Mg C) $\frac{Mg}{\sqrt{2}}$

B) $\frac{Mg}{2}$ D) $2Mg$

ANSWER KEY (Worksheet-13)					
1	A	11	C	21	A
2	B	12	D	22	B
3	C	13	D	23	D
4	C	14	B	24	A
5	C	15	D	25	A
6	D	16	B	26	B
7	B	17	C	27	C
8	D	18	A	28	D
9	C	19	C	29	B
10	B	20	C	30	C

SOLUTIONS

Unit – 2 (WS-13)

Q.1 Answer is "A"

Solution:- Magnitude of torque is given as:

$\tau = rF\sin\theta \rightarrow$ (i)

Given $\tau = \frac{\tau_{max}}{2} = \frac{rF}{2}$

Putting in (i)

$\frac{\cancel{rF}}{2} = \cancel{rF}\sin\theta$

$\frac{1}{2} = \sin\theta$

$\theta = 30°$

Q.2 Answer is "B"

Solution:- As $\vec{r}_x$ is parallel to $\vec{F}$, so torque due to this component is zero. All the torque produced will be due to $\vec{r}_y$.

Q.3 Answer is "C"

Solution:- If center of gravity of a body does not shift when it is disturbed then the body is said to be in neutral equilibrium.

Q.4 Answer is "C"

Solution:- By definition of equilibrium, a body is said to be in equilibrium if it is at rest or moving with constant velocity i.e its acceleration is zero, this means that a moving body or rotating body can be in equilibrium if its acceleration is zero.

Q.5 Answer is "C"

Solution:- Torque is the rotational analogous of force. It plays the same role in angular motion as the force plays in linear motion. Force produces linear acceleration & torque produces angular acceleration

Q.6 Answer is "D"

Solution:- $\tau = I\alpha$,

As $\omega = \text{constant}$ so $\alpha = 0, \tau = 0$

Q.7 Answer is "B"

Solution:- The weight of body is the force that passes through centre of gravity (which is the pivot point as well). So, the moment arm becomes zero, hence

$\tau = rF\sin\theta$

$r = 0$

$\tau = 0$

Q.8 Answer is "D"

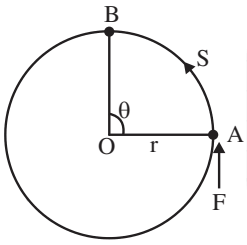
Solution:- Work done is given as:

$W = FS$

$W = F(r\theta)$

$W = (rF)\theta$

$W = \tau\theta$



$\tau = rF\sin\theta$

$\therefore$ between r and F in figure;

$\theta = 90°$

$\tau = rF$

Q.9 Answer is "C"

Solution:- 2nd law of motion for translational motion is;

$F = ma$

2nd law of motion for angular motion is;

$\tau = I\alpha$

Q.10 Answer is "B"

Solution:- When the line of action of force passes through pivot, moment arm becomes zero, so torque becomes zero.

Q.11 Answer is "C"

Solution:- Two forces acting on a body will give rise to couple if:

i. Both forces have same magnitude.

ii. Both forces have opposite direction.

iii. Both forces have different lines of action.

Q.12 Answer is "D"

Solution:- When a body in stable equilibrium is disturbed its P.E increases as it C.G point rises. Also the C.G point remains in the same base area.

Q.13 Answer is "D"

Solution:- As moment arm is zero so $\tau = 0$

Q.14 Answer is "B"

Solution:- Here angle between $\vec{F}$ and $\vec{r}$ is $90° - \theta$, which makes

$\tau = rF\sin(90° - \theta) = rF\cos\theta$

Q.15 Answer is "D"

Solution:- As the torque for given figure is;

$\tau = rF\cos\theta$

If $\theta = 0°$

$\tau = rF\cos 0°$

$\tau = rF = \max$

Q.16 Answer is "B"

Solution:-

τ_{couple} = (perpendicular distance between lines of action of forces) (magnitude of one force)

$\tau_{couple} = (r\sin\theta)(F_1)$

Q.17 Answer is "C"

Solution:- As $F = \frac{\Delta p}{\Delta t}$ so $\tau = \frac{\Delta L}{\Delta t}$

Q.18 Answer is "A"

Solution:- Torque in terms of angular momentum is given as;

$\tau = \frac{\Delta L}{\Delta t} = \frac{L_f - L_i}{\Delta t}$

$\tau = \frac{300 - 100}{2} = \frac{200}{2}$

$\tau = 100\,N\,m$

Q.19 Answer is "C"

Solution:- τ = rate of change of angular momentum $= I\alpha$

As First body is in equilibrium:

$\alpha_1 = 0$

$\tau_1 = 0$ so, $\frac{\tau_1}{\tau_2} = \frac{0}{\tau_2} = 0$

Q.20 Answer is "C"

Solution:- For complete equilibrium of a body, both conditions of equilibrium must be satisfied i.e

$\sum \vec{F} = \vec{0}$ and $\sum \vec{\tau} = \vec{0}$

Q.21 Answer is "A"

Solution:- Moment of couple = (perpendicular distance between lines of action of forces) (magnitude of one force)

Q.22 Answer is "B"

Solution:- Basic relation. Here moment $arm = \ell$, and $F = mg\ sin\theta$ so put in $r \times F$.

Q.23 Answer is "D"

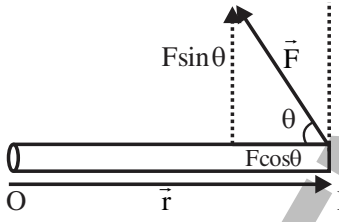
Solution:- The tyres of car spin about their axis with constant angular velocity and move in straight line with constant linear velocity, so both accelerations in body are zero and body is in translational, rotational and dynamic equilibrium.

Q.24 Answer is "A"

Solution:- Couple of forces has same units as that of force while moment of couple has the units same as that of torque.

Q.25 Answer is "A"

Solution:-



Torque is produced due to that component of force which is perpendicular to position vector $\vec{r}$. In the given figure Fsinθ is perpendicular to $\vec{r}$ or $\overrightarrow{OP}$, so

$\tau = \overline{OP}F\sin\theta$

Q.26 Answer is "B"

Solution:- Use relation; $\tau = rF$

Q.27 Answer is "C"

Solution:-

Step-I

Find distance "x" of "P" point from pivot by using

$\tau_{\text{clockwise}} = \tau_{\text{anticlockwise}}$

Step-II

Find distance of "P" from "O" by adding 50 cm in "x".

Q.28 Answer is "D"

Solution:-

Find distance x of "B" from pivot by using

$\tau_{\text{clockwise}} = \tau_{\text{anticlockwise}}$

Q.29 Answer is "B"

Solution:-

Find distance of 50 N weight from pivot by using

$\tau_{\text{clockwise}} = \tau_{\text{anticlockwise}}$

Then see what is the distance from right end.

Q.30 Answer is "C"

Solution:- Use relation; $2T_y = Mg$

STEP

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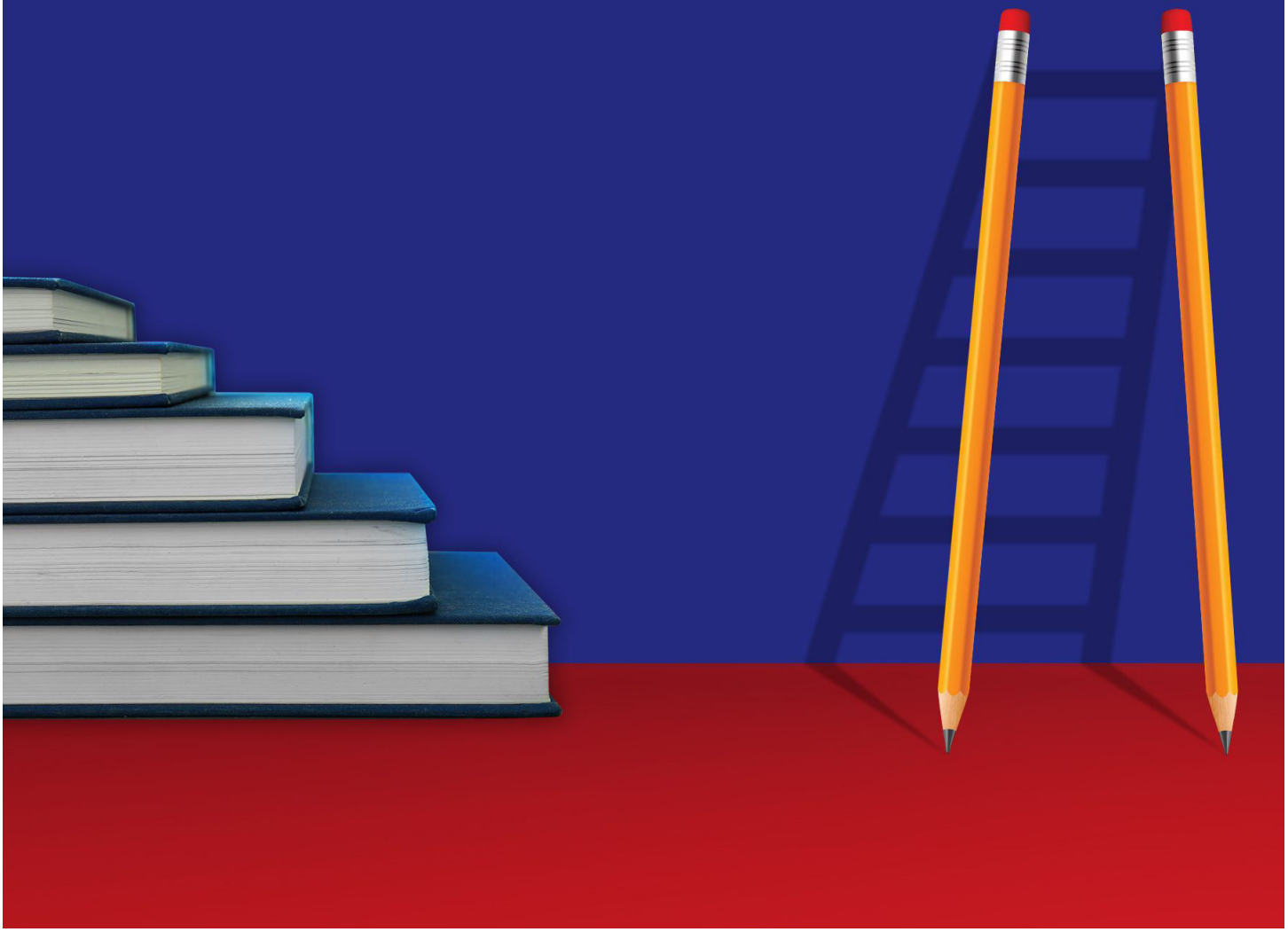

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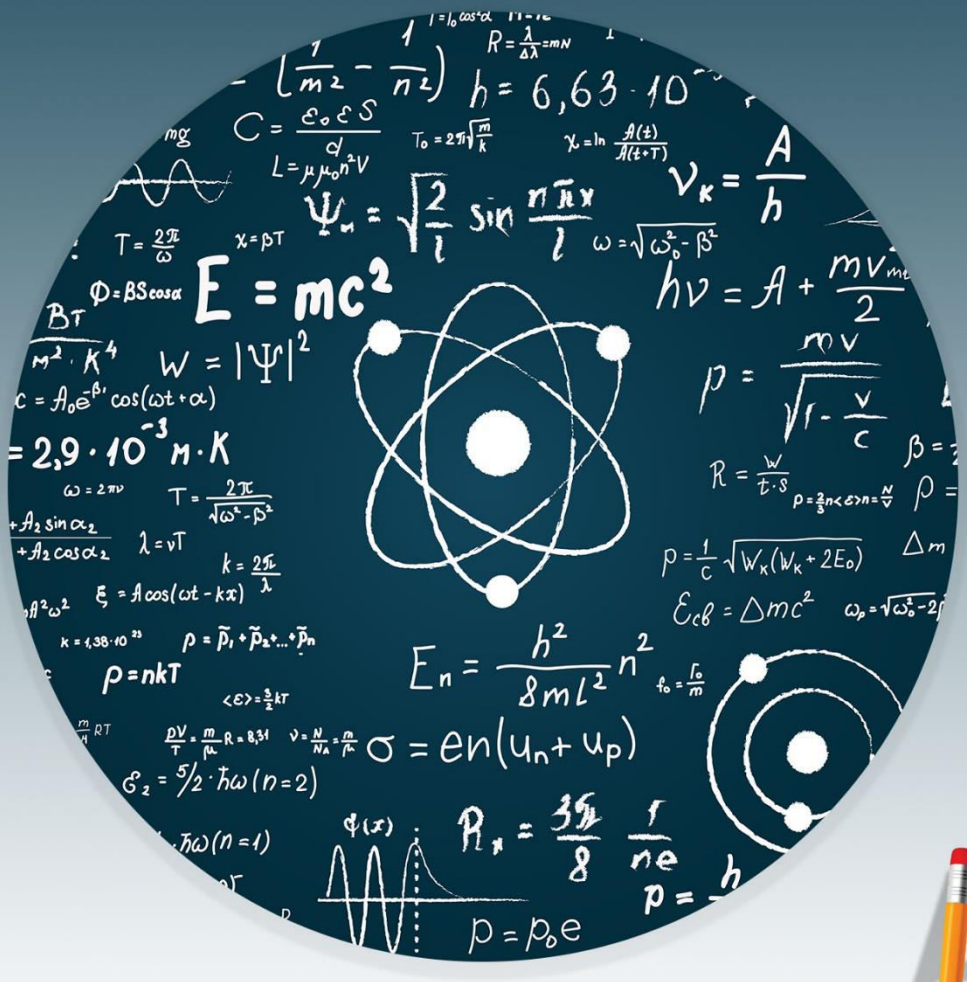

WORKSHEET-14

STEP

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Worksheet-14

Topics:- Work, Kinetic & Potential Energy, Inter Conversion of K.E & P.E, Power, Angular Displacement, Angular Velocity, Centripetal Force & Geostationary Orbits, Radian

USE THIS SPACE FOR SCRATCH WORK

Q.1 When a person lifts a body from ground work done by the lifting force is?

A) Positive C) Negative

B) Zero D) Half of positive maximum

Q.2 When a person lifts a body from ground work done by force of gravity is?

A) Positive C) Half of negative maximum

B) Negative D) Zero

Q.3 A force of $3\hat{i}+4\hat{j}$ N displaces the body through $4\hat{i}+3\hat{j}$ m the work done will be:

A) 12 J C) 28 J

B) 24 J D) – 12 J

Q.4 The following four particles have same K.E, then which of them has maximum momentum:

A) Proton C) Positron

B) Electron D) α-particle

Q.5 The power of a pump which can pump 100 kg of water to a height of 100 m in 5 sec is:

A) 20 kW C) 40 kW

B) 200 kW D) 4 kW

Q.6 1 MWh is equal to:

A) 3.6 kJ C) 3.6 MJ

B) 3.6 J D) 3.6 GJ

Q.7 Work done is equal to:

A) Change in K.E C) Change in elastic P.E

B) Change in P.E D) All of these

Q.8 Which of the following is unit of P.E:

A) eV C) joule

B) calorie D) All of these

Q.9 Slope of energy time graph is equal to:

A) Acceleration C) Power

B) Momentum D) Work

Q.10 Moving body may not have:

A) K.E C) P.E

B) Momentum D) All of these

Q.11 The base units of power are:

A) kg m s^{-1} C) kg m^2 s^{-3}

B) kg m s^{-2} D) kg m^2 s^3

Q.12 Which of the following work is greater?

A) +100 J C) +200 J

B) -500 J D) -1000 J

Q.13 For which angle work is said to be positive maximum?

A) 0° C) 90°

B) 180° D) 60°

Q.14 For which angle work is said to be negative maximum?

A) 0° C) 90°

B) 180° D) 60°

Q.15 For which angle work is said to be maximum?

A) 0° C) Both "A" and "B"

B) 180° D) 60°

Q.16 A force of 20 N acts on a body through a distance of 10 m. What must be the angle between force and displacement such that work comes out to be 100 J?

A) 90° C) 30°

B) 0° D) 60°

Q.17 For what angle between $\vec{F}$ and $\vec{d}$ work reduces to half of its maximum value?

A) 60° C) 45°

B) 30° D) 90°

Q.18 A loaded and an unloaded cart are moving with same kinetic energies such that same retarding force acts on them and they finally stop after covering "S_1" and "S_2" distances respectively, which of the following is true?

A) $S_1=S_2$ C) $S_1>S_2$

B) $S_1<S_2$ D) None of these

Q.19 When gravitational field does negative work then P.E of body.

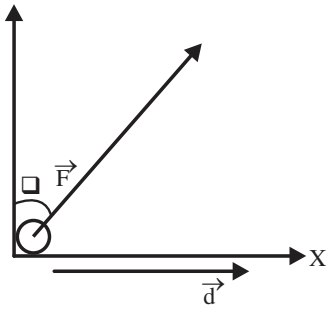
A) May increase C) Must increase

B) May decrease D) Must decrease

USE THIS SPACE FOR SCRATCH WORK

USE THIS SPACE FOR SCRATCH WORK

Q.20 Consider the figure in which a force $\vec{F}$ acts on a body through displacement $\vec{d}$:



For which value of "θ" work is said to be maximum?

A) 0° C) Both "A" & "B"

B) 180° D) 90°

Q.21 Considering figure of Q.20 what will be the mathematical formula for the calculation of work?

A) $W = Fd\cos\theta$ C) $W = Fd\tan\theta$

B) $W = Fd\sin\theta$ D) None of these

Q.22 A force of 2 N acts on body for 1 m distance, the maximum work done is:

A) 2 units C) 5 units

B) 3 units D) 6 units

Q.23 A mass is lifted to a height in 10 sec. Now if the same mass is lifted to the same height in 20 sec then work done in two cases are in the ratio:

A) 1:2 C) 1:1

B) 2:1 D) 4:1

Q.24 A body is released from a height of 5 m. If friction is ignored then its velocity just before striking the ground will be ($g = 10\ m\ s^{-2}$):

A) $5\ m\ s^{-1}$ C) $15\ m\ s^{-1}$

B) $10\ m\ s^{-1}$ D) $20\ m\ s^{-1}$

Q.25 The direction of angular displacement is:

A) Along axis of rotation

B) In the plane of rotation

C) Perpendicular to plane of rotation

D) Both A and C

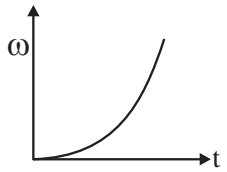
Q.26 The angular velocity of spin motion of earth is:

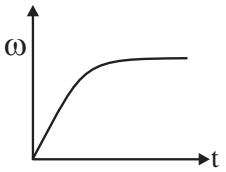
A) $\frac{\pi}{12}$ rev min^{-1} C) $\frac{\pi}{4}$ rev min^{-1}

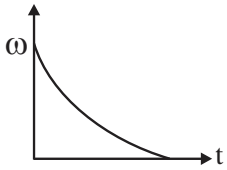
B) $\frac{\pi}{6}$ rad h^{-1} D) $\frac{\pi}{12}$ rad h^{-1}

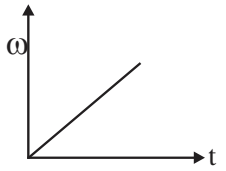
USE THIS SPACE FOR SCRATCH WORK

Q.27 The angular velocity time graph which corresponds to constant angular acceleration is:

A) 

C) 

B) 

D) 

Q.28 The ratio of units of angular acceleration to angular velocity gives units of:

A) Time C) Frequency

B) Length D) Mass

Q.29 An electric fan rotating at 3 rev s^{-1} is switched off. It comes to rest in 18 s. What will be the deceleration produced?

A) 0.5 rev s^{-2} C) 0.2 rev s^{-2}

B) 0.25 rev s^{-2} D) 0.16 rev s^{-2}

Q.30 If the radius of a circle is doubled keeping same angular velocity, then centripetal force becomes:

A) Double C) Half

B) Remains same D) Reduces by four times

Q.31 Time period of the orbital motion of a geostationary satellite is:

A) 5060 sec C) 24 hour

B) 84 min D) Any of these

Q.32 Which one is not true about communication satellites?

A) They use microwaves to communicate

B) Minimum three correctly positioned satellites are required for global coverage.

C) Their orbital speed is greater than orbital speed of low flying satellites

D) None of these

Q.33 An object is moving with a velocity of 15 m s^{-1} such that a constant force acts on it of 3 N. What must be the power developed in this case?

A) 5 W C) 30 W

B) 15 W D) 45 W

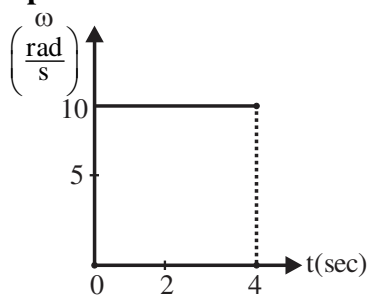
Q.34 The angular displacement covered by hour hand of a clock while moving from 12 O′clock to 3 O′clock is:

A) 90° C) 135°

B) 75° D) 45°

USE THIS SPACE FOR SCRATCH WORK

Q.35 The angular displacement covered by a body in the following graph is:



A) 40 rev C) 20 rev

B) 30 rad D) 40 rad

Q.36 Which statement is incorrect about two points "A" & "B" present on a spinning body having unequal distances from axis of rotation?

A) Both points have same angular acceleration

B) Both points have different velocity

C) Both points have same axis of rotation

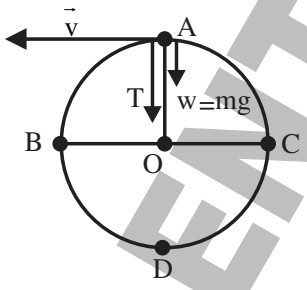
D) Both points have same acceleration

Q.37 If $\vec{r} = 4\hat{i}$ and $\vec{\omega} = 4\hat{k}$ then $\vec{v}$ is:

A) $16\hat{k}$ C) $16\hat{i}$

B) $16\hat{j}$ D) $-16\hat{k}$

Q.38 A ball tied to the end of a string, is swung in a vertical circle of radius "r" under the action of gravity as shown in figure. What will be tension in string at "A"?



A) Zero C) Equal to weight

B) Equal to centripetal force D) None of these

Q.39 The angular displacement covered by earth while orbiting around sun in a time equal to half of one year is:

A) $\frac{\pi}{2}$ *rad* C) $\frac{3\pi}{2}$ *rad*

B) π *rad* D) 2π *rad*

Q.40 The orbital speed of a geostationary satellite is:

A) 7.9 km s^{-1} C) 11.1 km s^{-1}

B) 3.1 km s^{-1} D) 5.9 km s^{-1}

ANSWER KEY (Worksheet-14)							
1	A	11	C	21	B	31	C
2	B	12	D	22	A	32	C
3	B	13	A	23	C	33	D
4	D	14	B	24	B	34	A
5	A	15	C	25	D	35	D
6	D	16	D	26	D	36	D
7	D	17	A	27	D	37	C
8	D	18	A	28	C	38	A
9	C	19	C	29	D	39	B
10	C	20	D	30	A	40	B

SOLUTIONS

Unit – 3 (WS-14)

Q.1 Answer is "A"

Solution:- As $\vec{F}$ & $\vec{d}$ are parallel so $W = +ve$

Q.2 Answer is "B"

Solution:- $\vec{F}$ & $\vec{d}$ are anti-parallel so $W = -ve$

Q.3 Answer is "B"

Solution:- Simply use relation; $W = \vec{F}.\vec{d}$

$W = F_x d_x + F_y d_y + F_z d_z$

Q.4 Answer is "D"

Solution:- Use relation; $p = \sqrt{2mE}$

As E = same so $p \propto \sqrt{m}$

Q.5 Answer is "A"

Solution:- $P = \frac{W}{t} = \frac{mgh}{t}$

Q.6 Answer is "D"

Solution:- Mega watt hour is related with joule as:

$1\text{MWh} = 1\times10^6 \times 3600 \text{ W s}$

$= 3.6\times10^9 \text{ J}$

$1\text{MWh} = 3.6 \text{ GJ}$

Q.7 Answer is "D"

Solution:- According to work-energy principle

"Work done on a body is equal to change in its K.E or change in its P.E or change in both energies."

i.e $W = \Delta K.E$ or $\Delta P.E$ or both

Q.8 Answer is "D"

Solution:- The different units of energy and their relation with SI-unit is as following:

- 1 kWh = 3.6 MJ
- 1 eV = 1.6×10^{-19} J
- 1 calorie = 4.18 J
- 1 erg = 10^{-7} J

Q.9 Answer is "C"

Solution:-

Slope = $\frac{\Delta y}{\Delta x} = \frac{\Delta Energy}{\Delta time} = Power$

Q.10 Answer is "C"

Solution:- It may be moving on plane surface, so its P.E with reference to that plane surface will be zero.

Q.11 Answer is "C"

Solution:- The base units of power are:

$P = \frac{\Delta W}{\Delta t} = \frac{J}{s} = \frac{N\ m}{s} = \frac{kg\ m s^{-2}\ m}{s}$

$P = kg\ m^2\ s^{-3}$

Q.12 Answer is "D"

Solution:- Whenever greater or smaller work is to be decided, compare all given options without their signs, the negative or positive signs just indicate the angle between the force & displacement, i.e

- W=+ve , if $\theta<90°$
- W=-ve , if $\theta>90°$
- W=0=minimum , if $\theta=90°$

Q.13 Answer is "A"

Solution:- When force and displacement are parallel, then;

W=Fdcosθ

θ=0° ; cos0°=+1=positive maximum

$W = +Fd$ = positive maximum

Q.14 Answer is "B"

Solution:- When force and displacement are antiparallel, then;

$W = Fd\cos\theta$

$\theta = 180°; \cos 180° = -1$ = negative maximum

$W = -Fd$ = negative maximum

Q.15 Answer is "C"

Solution:- Work done is positive maximum when $\vec{F}$ and $\vec{d}$ are parallel and it is negative maximum when $\vec{F}$ and $\vec{d}$ are anti-parallel. Physically both +ve maximum work and –ve maximum work are equal, -ve work does not mean work is less than zero.

Q.16 Answer is "D"

Solution:- Use relation; $W = Fd\cos\theta$

Q.17 Answer is "A"

Solution:-

$$W = \frac{W_{max}}{2} = \frac{Fd}{2}$$

$$Fd\cos\theta = \frac{Fd}{2}$$

$$\cos\theta = \frac{1}{2}$$

$$\theta = \cos^{-1}\left(\frac{1}{2}\right)$$

$$\theta = 60°$$

Q.18 Answer is "A"

Solution:

According to Work-Energy Principle

$\Delta K.E = W_{friction}$

$\Delta K.E = Fd\cos\theta$

Stopping distance = d

Since both cars have same K.E, so their stopping distances are also equal.

Q.19 Answer is "C"

Solution:- When gravity does –ve work "h" increases hence P.E increases

Q.20 Answer is "D"

Solution:- Making θ = 90°, $\vec{F}$ becomes parallel to the $\vec{d}$

Q.21 Answer is "B"

Solution:- Here angle between $\vec{F}$ & $\vec{d}$ is 90°-θ which makes

$W = Fd\cos(90° - \theta) = Fd\sin\theta$

Q.22 Answer is "A"

Solution:- Simply use relation;

W = maximum = Fd

Q.23 Answer is "C"

Solution:- Work done does not depend upon time.

Q.24 Answer is "B"

Solution:- Use relation $v = \sqrt{2gh}$

Q.25 Answer is "D"

Solution:- All angular quantities have same direction most of the time & is along axis of rotation.

Q.26 Answer is "D"

Solution:- $\omega = \frac{\theta}{t} = \frac{2\pi}{24}$ rad h^{-1}

Q.27 Answer is "D"

Solution:- Slope of ω-t graph=α

Q.28 Answer is "C"

Solution:- $\frac{\alpha}{\omega} = \frac{rad\ s^{-2}}{rad\ s^{-1}} = s^{-1}\ or\ Hz$

Q.29 Answer is "D"

Solution:- Use relation; $\alpha = \frac{\omega_f - \omega_i}{t}$ take

$\omega_f = 0\ rad\ s^{-1}$

Q.30 Answer is "A"

Solution:- Use relation $F_c = mr\omega^2$

Q.31 Answer is "C"

Solution:- The time period of a geostationary satellite is 24 hour which is exactly same as the time period of spin motion of earth.

Q.32 Answer is "C"

Solution:- Communication satellites are usually geostationary satellites for which orbital speed is 3.1 km s^{-1} while the orbital speed of low flying satellites is 7.9 km s^{-1} which is greater than communication satellites.

Q.33 Answer is "D"

Solution:- The power developed in terms of force & velocity is:

$P = \vec{F}.\vec{v} = Fv\cos\theta$

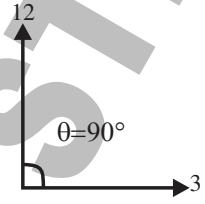
Here: $F = 3\ N, v = 15\ m\ s^{-1}, \theta = 0°$

$P = 3 \times 15\cos 0°$

$P = 45\ W$

Q.34 Answer is "A"

Solution:- When hour hand moves from 12 O'clock to 3 O'clock, it covers an angle of 90°.



Q.35 Answer is "D"

Solution:- Magnitude of angular displacement = Area of ω-t graph

$\theta = \omega t$

$\theta = (10)(4) = 40$ rad

Q.36 Answer is "D"

Solution:- All the point on a spinning rigid body have;

i. Same angular parameters

ii. Different linear parameters

Q.37 Answer is "C"

Solution:-

$\vec{v} = \vec{\omega} \times \vec{r} = \left(4\hat{k}\right) \times \left(4\hat{i}\right)$

$\vec{v} = 16\left(\hat{k} \times \hat{i}\right)\left(\therefore \hat{k} \times \hat{i} = \hat{j}\right)$

$\vec{v} = 16\hat{j}$

Q.38 Answer is "A"

Solution:- At the highest point of vertical circle

$T + w = \frac{mv^2}{r}$

$T = \frac{mv^2}{r} - w$

$T = m\left(\frac{v^2}{r} - g\right)$

$\therefore$ At highest point $g = \frac{v^2}{r}$,

so, tension=T=0

Q.39 Answer is "B"

Solution:- In one year (complete revolution) the earth covers an angular displacement = 2π

In half year (half revolution) the earth covers an angular displacement

$= \frac{2\pi}{2} = \pi\ rad$

Q.40 Answer is "B"

Solution:- Orbital speed for geostationary satellite is 3.1 km s^{-1}.

STEP

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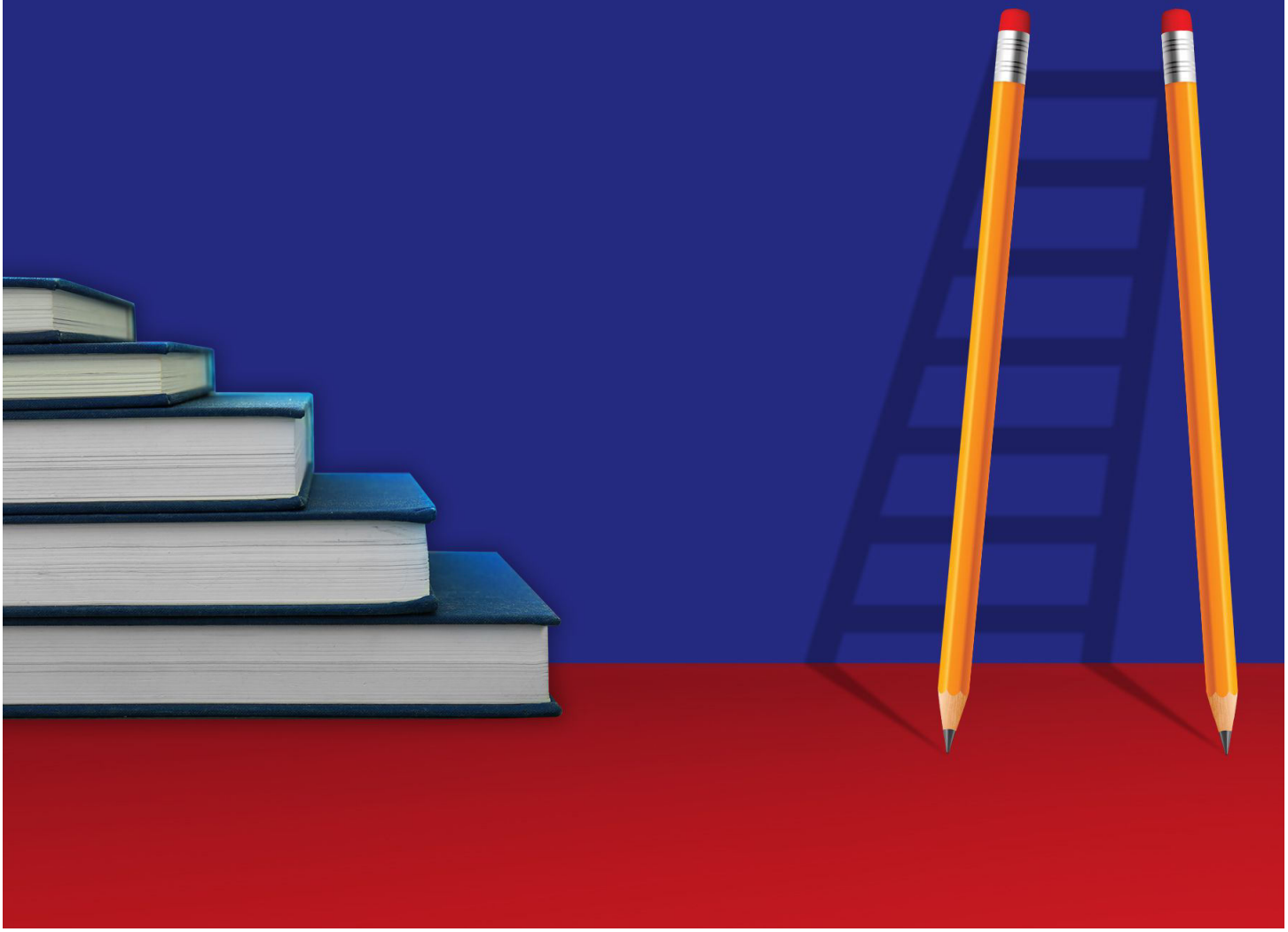

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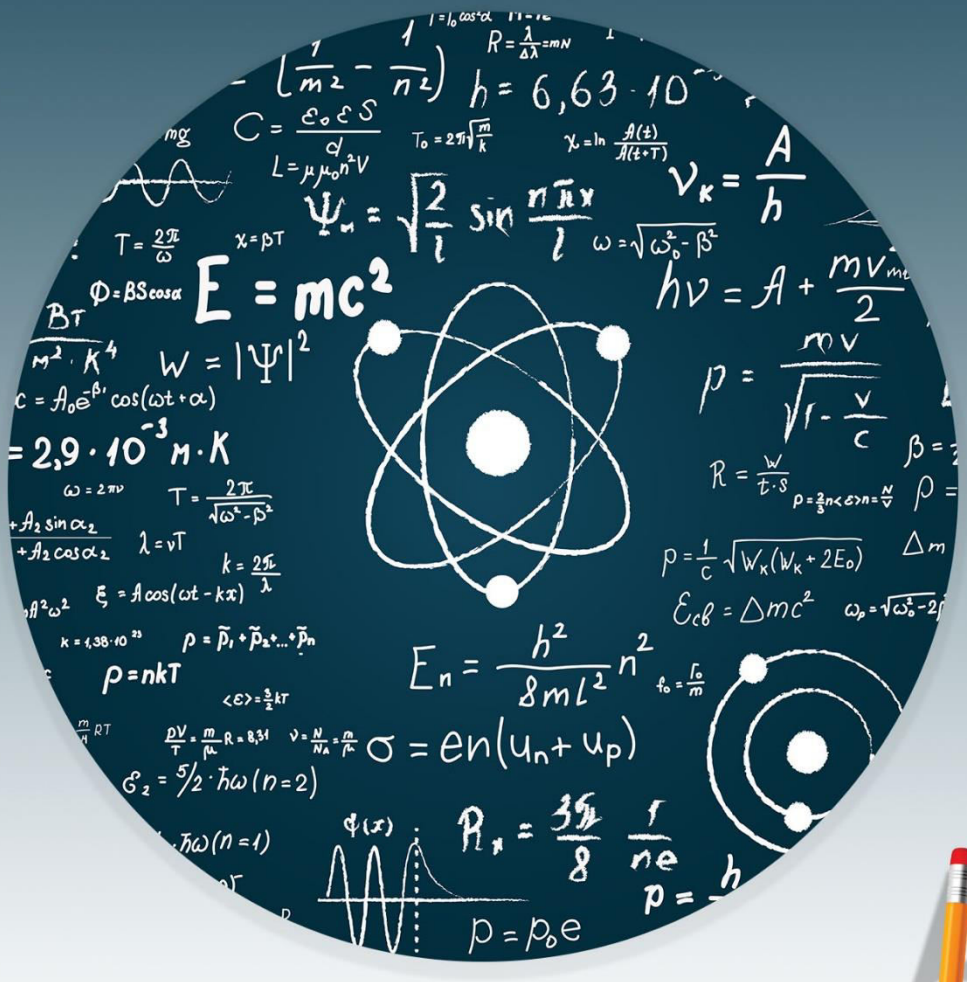


WORKSHEET-15

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-15

Topics:- SHM, SHM and Uniform Circular Motion, Simple Pendulum, Conservation of Energy in SHM, Free and Forced Oscillations, Resonance & its Applications, Principle of Superposition, Electromagnetic Spectrum

USE THIS SPACE FOR SCRATCH WORK

Q.1 The product of angular frequency (ω) and time period will be:

A) 1 C) 2π

B) $\frac{\pi}{2}$ D) π

Q.2 A simple pendulum is oscillating in a lift. If the lift starts moving upwards with a uniform acceleration then the time period will:

A) Remain unaffected C) Be longer

B) Be shorter D) May be "B" or "C"

Q.3 A particle is executing S.H.M, then the graph of velocity as a function of displacement is:

A) Straight line C) Ellipse

B) Circle D) Hyperbola

Q.4 A particle is executing S.H.M, then the graph of acceleration as a function of displacement is:

A) Straight line C) Ellipse

B) Circle D) Hyperbola

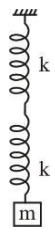
Q.5 A particle executing SHM has an acceleration of 64 cm s^{-2} when its displacement is 4 cm, its period in seconds is:

A) $\pi/2$ C) π

B) $\pi/4$ D) 2π

Q.6 If time period of this

is T, then the time period of this



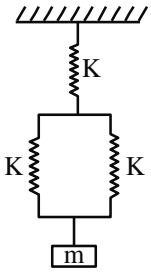
will be:

A) $T/\sqrt{2}$ C) $T/2$

B) $\sqrt{2}\,T$ D) 2T

USE THIS SPACE FOR SCRATCH WORK

Q.7 **If the time period of**  **is T, then the time period of this**



this will be:

A) $T/\sqrt{2}$ C) $\sqrt{2}\,T$

B) $T/2$ D) $\sqrt{\frac{3}{2}}T$

Q.8 **At t = 0 a body performing SHM is at mean position, when** $t = T/4$ **it will be at:**

A) At extreme position
B) Between mean and extreme position
C) Beyond extreme position
D) Again at mean position

Q.9 **The displacement of particle in SHM in one time period if its amplitude of vibration is "a" will be:**

A) Zero C) 2a
B) a D) 4a

Q.10 **A system can vibrate only if it has:**

A) Inertia C) Plasticity
B) Restoring force D) Both "A" and "B"

Q.11 **The maximum velocity of harmonic oscillator is 10** $cm\ s^{-1}$**. If its amplitude is 10 cm. What is its maximum acceleration?**

A) 100 $cm\ s^{-2}$ C) 10 $cm\ s^{-2}$
B) 1 $cm\ s^{-2}$ D) 0.1cm s^{-2}

Q.12 **The time in which a body executing SHM is at a distance of** $\frac{x_o}{2}$ **from the mean position is (where T is its time period):**

A) $\frac{T}{2}$ C) $\frac{T}{8}$

B) $\frac{T}{4}$ D) $\frac{T}{12}$

Q.13 A particle execute SHM with a time period of 2 s and amplitude 5 cm. Maximum value of its velocity is:

A) $10\ \pi$ cm s^{-1} C) $2.5\ \pi$ cm s^{-1}

B) $20\ \pi$ cm s^{-1} D) $5\ \pi$ cm s^{-1}

Q.14 The time period of simple pendulum measured inside a stationary lift is T. If the lift starts moving upward with an acceleration of g, what will be the time period?

A) $\frac{T}{3}$ C) $\sqrt{\frac{3}{2}}T$

B) $\frac{T}{\sqrt{2}}$ D) $\frac{\sqrt{3}}{2}T$

Q.15 The bob of a simple pendulum of period T is given a negative charge. If it is allowed to oscillate above a positively charged plate, the new time period will be:

A) Equal to T C) Less than T

B) More than T D) Infinite

Q.16 The relation of restoring force in a simple pendulum if it makes an angle "θ" with horizontal is:

A) $mg\sin\theta$ C) $mg\cos\theta$

B) $mg\tan\theta$ D) $mg\cot\theta$

Q.17 The time period of variation in total energy of a simple harmonic oscillator is:

A) 2T C) 0

B) $\frac{T}{2}$ D) Infinite

Q.18 The frequency of variation in K.E or P.E of a simple harmonic oscillator is:

A) f C) $3f$

B) $2f$ D) $\frac{f}{2}$

Q.19 The maximum number of equal parts in which time period of a simple harmonic oscillator can be divided are (when displacement is equal in each part):

USE THIS SPACE FOR SCRATCH WORK

A) 4 C) 8

B) 6 D) Infinite

USE THIS SPACE FOR SCRATCH WORK

Q.20 The relation for time period of a horizontal mass spring system is $T = 2\pi\sqrt{\frac{x}{g}}$. What will be it's time period if taken on moon (at moon $g_m = \frac{g}{6}$).

A) T will increase

B) T will remain same

C) T will decrease

D) T may increase or decrease

Q.21 k is spring constant, its unit is same as that of:

A) Pressure C) Surface tension

B) Tension D) Energy

Q.22 The spring constant of two springs are added for maximum equivalent when they are connected in:

A) Series C) Perpendicular

B) Parallel D) None of these

Q.23 When a spring of spring constant k is cut into two parts of same length, then the effective value of spring constant is:

A) 2k C) $\frac{k}{2}$

B) k D) $\frac{k}{4}$

Q.24 If the displacement in SHM is written by equation $x = x_o\cos\omega t$ the value of initial phase in this case is:

A) 0^o C) 90^o

B) 45^o D) 180^o

Q.25 Spring constant of a spring and its length are related as:

A) $k \propto l$ C) $k \propto \sqrt{l}$

B) $k \propto l^{-1}$ D) $k \propto l^{-\frac{1}{2}}$

Q.26 A simple pendulum has frequency of 2 Hz. How long does it take to move from mean to extreme position:

A) 0.12 s C) 0.5 s

B) 0.2 s D) 0.05 s

Q.27 Equation for displacement in SHM is $x = x_o \sin\omega t$. The value of acceleration at instant $t = \frac{T}{4}$ is:

A) $x_o\omega$ C) $x_o\sqrt{\omega}$

B) $x_o\omega^2$ D) $x_o\frac{\omega}{2}$

Q.28 The relation for instantaneous velocity for a simple harmonic oscillator is:

A) $v = \omega\sqrt{x_0^2 - x^2}$ C) $v = \sqrt{\frac{k}{m}\left(x_0^2 - x^2\right)}$

B) $v = \sqrt{\frac{g}{\ell}\left(x_0^2 - x^2\right)}$ D) All of these

Q.29 Which of the following can be true for "ω"?

A) $\sqrt{\frac{k}{m}}$ C) $\sqrt{\frac{g}{\ell}}$

B) $\frac{2\pi}{T}$ D) All of these

Q.30 For a simple harmonic oscillator which of the following is true for maximum acceleration?

A) $a = -\omega^2 x_\circ$ C) $a = \frac{-k}{m}x_\circ$

B) $a = \frac{-g}{\ell}x_\circ$ D) All of these

Q.31 The ratio of maximum velocity and maximum acceleration for simple harmonic oscillator can be written as:

A) $\frac{T}{2\pi}$ C) $\sqrt{\frac{\ell}{g}}$

B) $\sqrt{\frac{m}{k}}$ D) All of these

Q.32 The displacement covered by a simple harmonic oscillator in a time of $\frac{3}{2}T$ while starting from extreme position with amplitude "a":

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A) Zero C) 4a

B) 2a D) 6a

Q.33 Referring to data in Q.32, the distance covered is:

A) Zero C) 4a

B) 2a D) 6a

Q.34 The time taken by a simple harmonic oscillator to travel from extreme to half of mean $\left(x = \frac{x_\circ}{2}\right)$ is:

A) $\frac{T}{4}$ C) $\frac{T}{8}$

B) $\frac{T}{12}$ D) $\frac{T}{6}$

Q.35 A simple harmonic oscillator starts it's journey from mean and moves towards +ve extreme then what is true?

A) It's initial phase is zero

B) We use $x = x_\circ \cos\theta$ for it

C) We use $x = x_\circ \sin\theta$ for it

D) Both "A" & "C"

Q.36 Which of the following equations can be used for a simple harmonic oscillator?

A) $x = x_\circ \sin\theta$ C) $x = x_\circ \cos\theta$

B) $x = -x_\circ \cos\theta$ D) All of these

Q.37 A uniform circular motion is:

A) A periodic motion only

B) A simple harmonic motion only

C) Both periodic and harmonic motion

D) Neither periodic not harmonic motion

Q.38 In SHM when K.E is maximum then which of the following is incorrect?

A) P.E is zero C) Displacement is zero

B) Acceleration is zero D) None of these

Q.39 A pendulum has time period T on earth. As the value of g on the surface of moon is $\frac{1}{6}$th times than on earth, then the time period of such a pendulum on the moon's surface will be:

A) $\sqrt{6}T$ C) $\frac{T}{6}$

USE THIS SPACE FOR SCRATCH WORK

B) $\frac{T}{\sqrt{6}}$ D) 6T

Q.40 A simple pendulum is present in a lift which is accelerated downwards by g, then its time period in lift will become:

A) $\frac{1}{\sqrt{2}}$ times C) $\frac{2}{\sqrt{3}}$ times

B) 2 times D) Infinite

Q.41 In SHM when displacement is equal to $\frac{x_o}{2}$, then the ratio of P.E to K.E is:

A) 2:3 C) 3:2

B) 1:3 D) 3:1

Q.42 In simple pendulum at any instant tension of string is _____ when it makes angle "θ" with horizontal is:

A) T = mg C) T = mg sinθ

B) T = mg cosθ D) T= - mg sin θ

Q.43 In SHM how many times does K.E and P.E become equal during one period?

A) 1 time C) 3 times

B) 2 times D) 4 times

Q.44 When K.E and P.E in SHM become equal the displacement is?

A) $\frac{x_o}{2}$ C) $\sqrt{2}x_o$

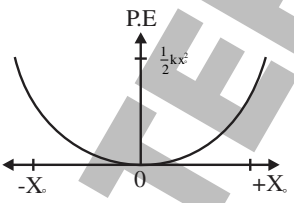
B) $\frac{x_o}{\sqrt{2}}$ D) $\frac{\sqrt{3}x_o}{2}$

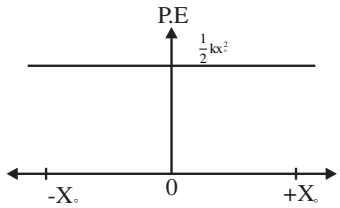
Q.45 The time period of a simple pendulum is independent of:

A) Length of pendulum C) Value of gravity

B) Centre of mass D) None of these

Q.46 The graph of P.E vs displacement for a harmonic oscillator is:

A) 

C) 

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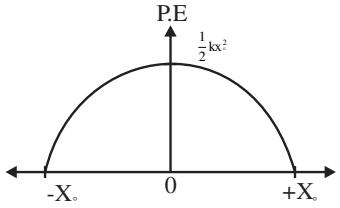


B) D) None of these

Q.47 A body performing SHM has displacement $x = x_\circ \sin(wt + \phi)$, when t=0, $x = x_\circ$. What is the value of phase initial?

A) π C) $\frac{\pi}{2}$

B) $\frac{\pi}{4}$ D) $\frac{\pi}{3}$

Q.48 Angular displacement of a point moving in a circle of radius 10 cm, when displacement of projection of this point along vertical diameter of circle is 8.66 cm, will be:

A) 30° C) 75°

B) 45° D) 60°

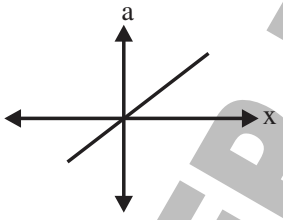
Q.49 In mass spring system, mass "m" is attached with spring of constant "k" with time period "T_1", then mass is replaced with "5m" with same spring. What will be the time period T_2 now:

A) $T_2 = \sqrt{5}T_1$ C) $T_2 = 5T_1$

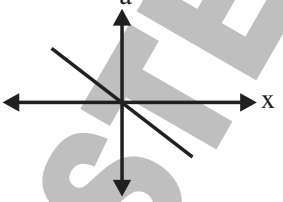
B) $T_2 = T_1$ D) $T_2 = \frac{T_1}{\sqrt{5}}$

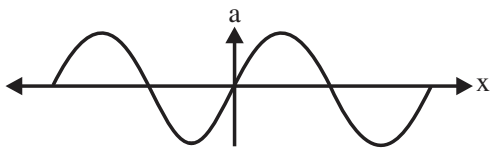
Q.50 The acceleration of a body executing SHM varies with instantaneous displacement as:

A)



B)



C) 

D) None of these

ANSWER KEY (Worksheet-15)									
1	C	11	C	21	C	31	D	41	B
2	B	12	D	22	B	32	B	42	C
3	C	13	D	23	A	33	D	43	D
4	A	14	B	24	C	34	D	44	B
5	A	15	C	25	B	35	D	45	D
6	B	16	C	26	A	36	D	46	A
7	D	17	D	27	B	37	A	47	C
8	A	18	B	28	D	38	D	48	D
9	A	19	A	29	D	39	A	49	A
10	D	20	B	30	D	40	D	50	B

SOLUTIONS

Unit – 4 (WS-15)

Q.1 Answer is "C"

Solution:- $T = \frac{2\pi}{\omega} \Rightarrow T\omega = 2\pi$

Q.2 Answer is "B"

Solution:- Use relation, $T = 2\pi\sqrt{\frac{\ell}{g+a}}$

Q.3 Answer is "C"

Solution:- The shapes of different graphs for a body executing SHM are:

i. Graph between velocity & displacement is an ellipse.

ii. Graph between K.E/P.E & displacement is a parabola.

iii. Graph between total energy & displacement is a straight line.

iv. Graph between force/acceleration & displacement is straight line.

v. Graph between displacement & time a sinusoid.

Q.4 Answer is "A"

Solution:- The shapes of different graphs for a body executing SHM are:

i. Graph between velocity & displacement is an ellipse.

ii. Graph between K.E/P.E & displacement is a parabola.

iii. Graph between total energy & displacement is a straight line.

iv. Graph between force/acceleration & displacement is straight line.

v. Graph between displacement & time a sinusoid.

Q.5 Answer is "A"

Solution:- Use relation; $a = \omega^2 x$ also put $\omega = \frac{2\pi}{T}$ and solve:

Q.6 Answer is "B"

Solution:- In series use formula $k_{eq} = \frac{k}{n}$

Q.7 Answer is "D"

Solution:- The equivalent spring constant of the final combination of springs:

$$k_{eq} = \frac{(2k)(k)}{2k+k} = \frac{2}{3}k \quad \text{so,}$$

$$T' = 2\pi\sqrt{\frac{m}{k_{eq}}} = 2\pi\sqrt{\frac{m}{\frac{2}{3}k}} = \sqrt{\frac{3}{2}}\left(2\pi\sqrt{\frac{m}{k}}\right)$$

$$T' = \sqrt{\frac{3}{2}}T$$

Q.8 Answer is "A"

Solution:- In $\frac{T}{4}$ time the body covers a distance equal to the amplitude, now as the body starts moving from mean position, it will reach to extreme position in $\frac{T}{4}$.

Q.9 Answer is "A"

Solution:- In one time period the particle returns back to same position from where it starts moving, so displacement becomes zero.

Q.10 Answer is "D"

Solution:- A body vibrates because of inertia and restoring force. Restoring force brings the body back to mean

position while inertia does not allow the body to stop at mean position.

Q.11 Answer is "C"

Solution:- $a_\circ = \omega^2 x_\circ$;

$$v_\circ = x_\circ \omega \quad \Rightarrow \quad a_\circ = \frac{v_\circ^2}{x_\circ}$$

Q.12 Answer is "D"

Solution:- Use relation:- $x = x_\circ \sin\theta$ and put $x = \frac{x_\circ}{2}$ and solve

Q.13 Answer is "D"

Solution:-

Use relation:- $v_o = \omega x_\circ = \frac{2\pi}{T} \times x_\circ$

Q.14 Answer is "B"

Solution:- Use relation: $T' = 2\pi\sqrt{\frac{\ell}{g+a}}$

put
a = g and solve

Q.15 Answer is "C"

Solution:- Attraction is produced, due to which pendulum moves faster towards mean position, hence "T" decreases and "f" increases.

Q.16 Answer is "C"

Solution:- Normally pendulum makes an angle "θ" with vertical then $F_r = mg\sin\theta$, but in this case as it makes angle "θ" with horizontal so relation becomes

$F_r = mg\cos\theta$

Q.17 Answer is "D"

Solution:- As total energy never changes so it may take an infinite time to be zero.

Q.18 Answer is "B"

Solution:- In a single oscillation two times K.E or P.E are completely converted into each other.

Q.19 Answer is "A"

Solution:- If we make four parts of time period each of value $\frac{T}{4}$, then in each part equal displacement i.e $x = x_\circ$ is covered. If we make more than four parts of time period. Then equal displacement will not be covered in each part, e.g body takes $\frac{T}{12}$ time to cover $\frac{x_\circ}{2}$ distance from mean position and $\frac{T}{6}$ to cover $\frac{x_\circ}{2}$ distance from extreme position.

Q.20 Answer is "B"

Solution:- At moon when $g' = \frac{g}{6}$ then x' also becomes $\frac{x}{6}$. So according to formula $T = 2\pi\sqrt{\frac{x}{g}} = \text{constant}$.

Q.21 Answer is "C"

Solution:- The units of spring constant and surface tension are same i.e N m^{-1}.

Q.22 Answer is "B"

Solution:- In parallel combination of springs;

$k_{eq} = k_1 + k_2 + k_3 + ...$

$k_{eq} > k_1, k_2 .....$

Q.23 Answer is "A"

Solution:- When a spring of spring constant "k" is divided into "n" equal

parts then spring constant of each part is given as:

$k_{part} = nk$

Q.24 Answer is "C"

Solution:- The general equation of instantaneous displacement for projection is:

$x = x_\circ \sin(\theta + \phi)$

If $\phi = 90°$

$x = x_\circ \cos\theta$

Q.25 Answer is "B"

Solution:- Longer the spring, larger will be change in its length i.e "x", smaller will be the spring constant.

i.e

$k = \frac{F}{x} \qquad (\therefore x = \Delta\ell \propto \ell)$

$k \propto \frac{1}{x}$

$k \propto \frac{1}{\ell}$

Q.26 Answer is "A"

Solution:-

Step-I

$T = \frac{1}{f}$

Step-II

From mean to extreme position body will take to $\frac{T}{4}$.

Q.27 Answer is "B"

Solution:- For the given displacement equation, initial phase is zero which means body is initially at mean position. In time $\frac{T}{4}$ it will move from mean to extreme position i.e x becomes $x_\circ$, so

$a = \omega^2 x = \omega^2 x_\circ$

Q.28 Answer is "D"

Solution:- The instantaneous velocity of projection of a body moving on a circular path is

$v = \omega\sqrt{x_0^2 - x^2}$

For mass spring system

$\omega = \sqrt{\frac{k}{m}}$ so, $v = \sqrt{\frac{k}{m}(x_0^2 - x^2)}$

For simple pendulum

$\omega = \sqrt{\frac{g}{\ell}}$ so, $v = \sqrt{\frac{g}{\ell}(x_0^2 - x^2)}$

Q.29 Answer is "D"

Solution:- Angular frequency of projection is

$\omega = \frac{2\pi}{T}$

Angular frequency of mass spring system is

$\omega = \sqrt{\frac{k}{m}}$

Angular frequency of simple pendulum is

$\omega = \sqrt{\frac{g}{\ell}}$

Q.30 Answer is "D"

Solution:- Maximum acceleration of projection, simple pendulum and mass spring system is given as respectively;

$a = -\omega^2 x_\circ$

$a = -\frac{g}{\ell} x_\circ$

$a = -\frac{k}{m} x_\circ$

Q.31 Answer is "D"

Solution:- The different relations of maximum velocity and accelerations are;

$$v_\circ = \omega x_\circ = x_\circ \sqrt{\frac{k}{m}} = x_\circ \sqrt{\frac{g}{\ell}}$$

$$a_\circ = \omega^2 x_\circ = x_\circ \left(\sqrt{\frac{k}{m}}\right)^2 = x_\circ \left(\sqrt{\frac{g}{\ell}}\right)^2$$

Just take ratio.

Q.32 Answer is "B"

Solution:- In one time period T the body will move from the extreme position to other extreme position and back to the same extreme position, so displacement will be zero in "T". In next $\frac{T}{2}$ the body will move from extreme position to other extreme covering a displacement of $2x_\circ$.

Q.33 Answer is "D"

Solution:- Total distance in one time period $T = 4x_\circ$

Total distance in $\frac{3T}{2} = \frac{3}{2}(4x_\circ)$

Total distance in $\frac{3T}{2} = 6x_\circ$

Q.34 Answer is "D"

Solution:-

Use relation $x = x_\circ \cos\theta$

put $x = \frac{x_\circ}{2}$ and solve

Q.35 Answer is "D"

Solution:- $\phi = 0°$, $x = x_\circ \sin(\theta + \phi)$

Q.36 Answer is "D"

Solution:- The general equation of instantaneous displacement is:

$$x = x_\circ \sin(\theta + \phi)$$

- If $\phi = 0°$

  $x = x_\circ \sin\theta$

- If $\phi = 90°$

  $x = x_\circ \sin(\theta + 90°)$

  $x = x_\circ \cos\theta$

- If $\phi = 180°$

  $x = x_\circ \sin(\theta + 180°)$

  $x = -x_\circ \sin\theta$

- If $\phi = 270°$

  $x = x_\circ \sin(\theta + 270°)$

  $x = -x_\circ cos\theta$

Q.37 Answer is "A"

Solution:- It's only periodic not S.H.M

Q.38 Answer is "D"

Solution:- K.E is maximum at mean position i.e x=0. At x=0;

$a = -\omega^2 x = 0$

$x = 0$

$P.E = \frac{1}{2} kx^2 = 0$

All these A, B & C option are correct informations

Q.39 Answer is "A"

Solution:- At moon $g = \frac{g}{6}$ use relation

$$T = 2\pi\sqrt{\frac{\ell}{g}}$$

Q.40 Answer is "D"

Solution:- Use relation: $T = 2\pi\sqrt{\frac{\ell}{g-a}}$

$\therefore a = g$

So $T = \infty$

Q.41 Answer is "B"

Solution:- At $x = \frac{x_\circ}{2}$

$$P.E = \frac{1}{2}k\left(\frac{x_\circ}{2}\right)^2$$

$$P.E = \frac{1}{4}E_T \text{ ------- (i)}$$

K.E at $x = \frac{x_\circ}{2}$

$$K.E = E_T - P.E$$

$$K.E = E_T - \frac{1}{4}E_T$$

$$K.E = \frac{3}{4}E_T \text{ -------- (ii)}$$

Dividing equation (i) by (ii)

$$\frac{P.E}{K.E} = \frac{1}{3}$$

Q.42 Answer is "C"

Solution:- Generally string makes "θ" with vertical, so have that angle with vertical is 90°-θ, so tension becomes; $T = mg\sin\theta$.

Q.43 Answer is "D"

Solution:- In $\frac{T}{4}$ time when body moves from mean to extreme position, K.E and P.E become equal once at $x = \frac{x_\circ}{\sqrt{2}}$. So in "T" time K.E and P.E will become equal four times.

Q.44 Answer is "B"

Solution:- Put K.E = P.E and find "x".

Q.45 Answer is "D"

Solution:- Time period of simple pendulum is

$$T = 2\pi\sqrt{\frac{\ell}{g}}$$

$$\Rightarrow T \propto \sqrt{\ell}; T \propto \frac{1}{\sqrt{g}}$$

Furthermore, length of pendulum depends on position of centre of mass of bob.

Q.46 Answer is "A"

Solution:- The instantaneous P.E of a harmonic oscillator is;

$$P.E = \frac{1}{2}kx^2$$

$at\ x = 0$	$at\ x = +x_\circ\ or\ x = -x_\circ$
$P.E = 0$	$P.E = \frac{1}{2}kx_0^2$

Q.47 Answer is "C"

Solution:- Given $t = 0; x = x_\circ$, putting in following equation;

$$x = x_\circ \sin(\omega t + \phi)$$

$$x_\circ = x_\circ \sin(0 + \phi)$$

$$1 = \sin\phi$$

$$\phi = \sin^{-1}(1) = 90°$$

Q.48 Answer is "D"

Solution:- Radius $= r = x_\circ = 10cm$

Inst. Displacement=x=8.66 cm

$\theta = ?$

As we know

$$x = x_\circ \sin\theta$$

$$8.66 = 10\sin\theta$$

solving

$$\theta = 60°$$

Q.49 Answer is "A"

Solution:- Time period of mass spring system is given as;

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$T \propto \sqrt{m}$$

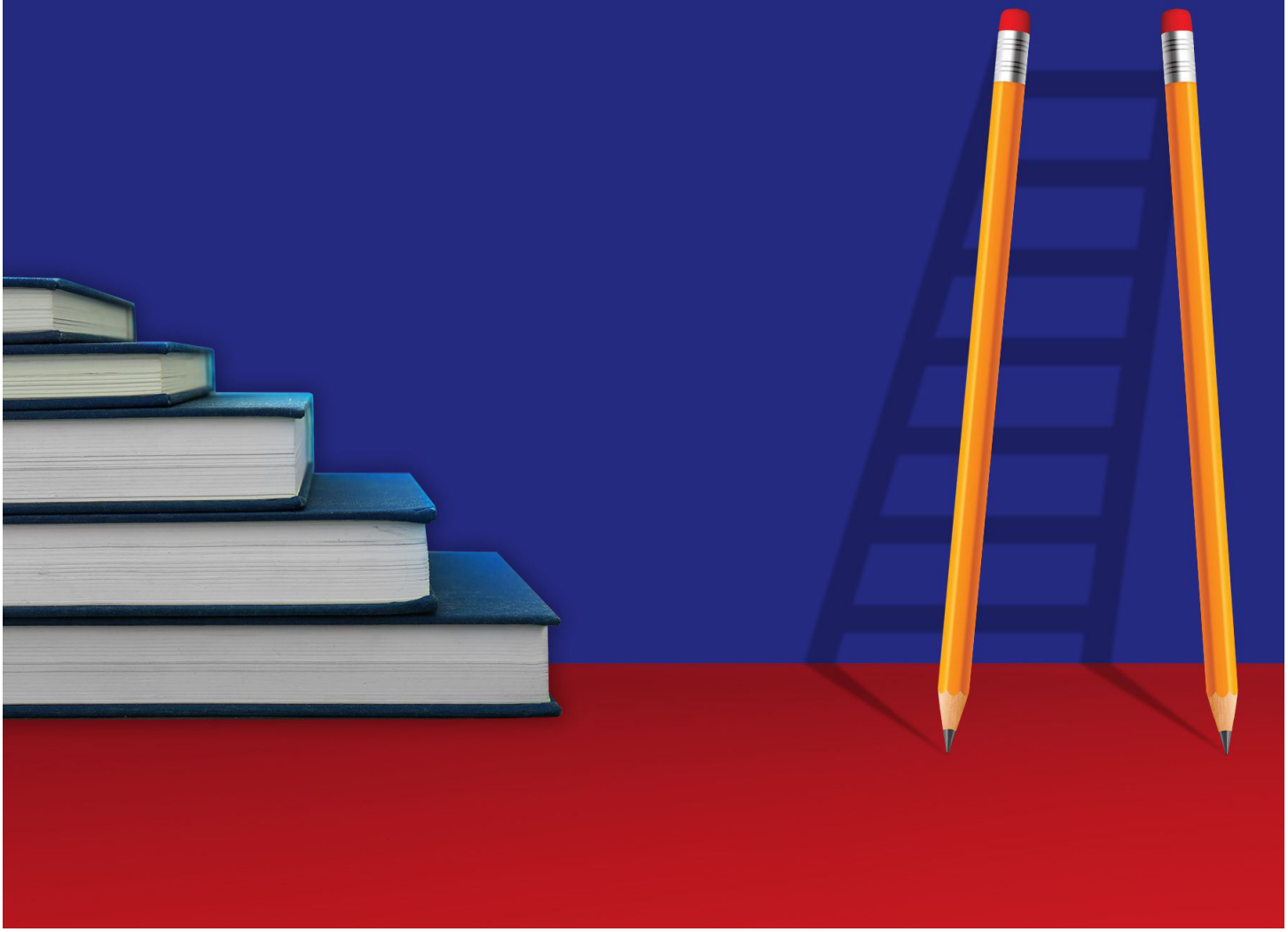
Q.50 Answer is "B"

Solution:- For a body executing SHM;

$$a \propto -x$$

STEP

A PROGRAM BY PUNJAB GROUP



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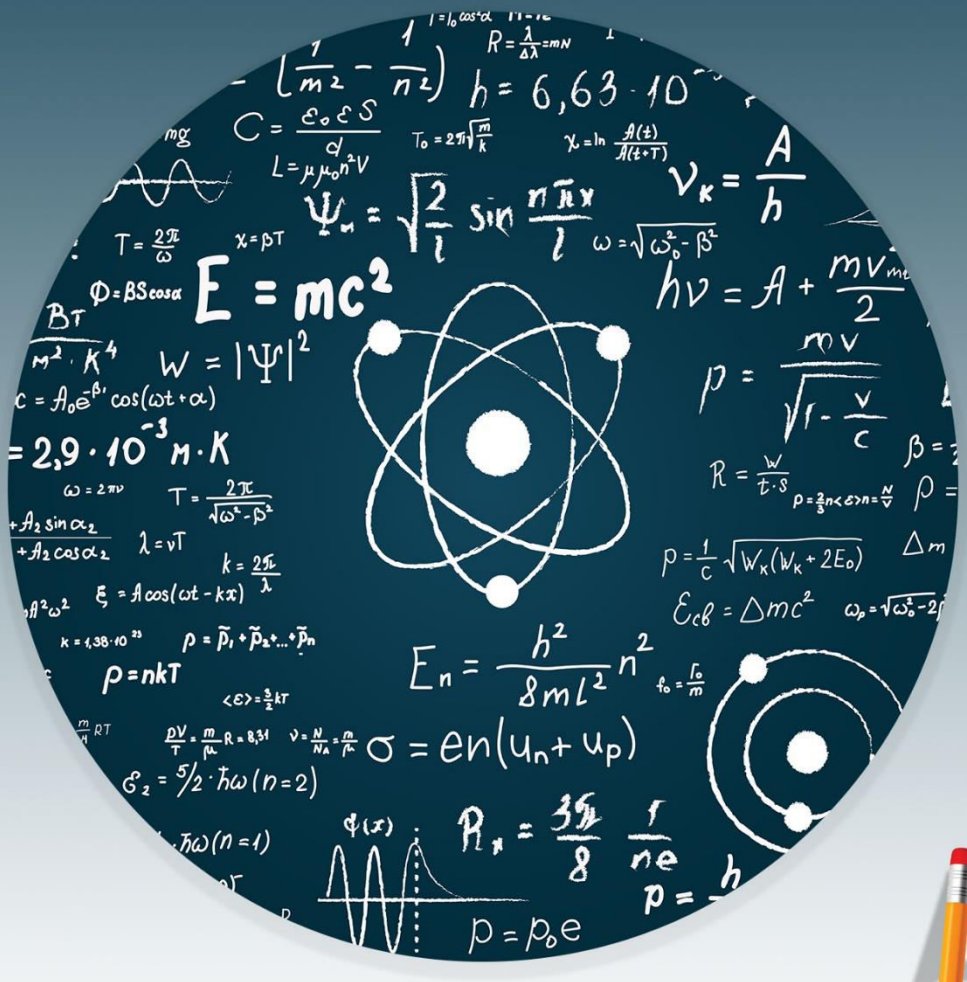

WORKSHEET-16

STEP

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Worksheet-16

Topics:- Mechanical Waves, Stationary Waves in Air Columns and Stretched String, Doppler's Effect & its Applications, Principle of Superposition, Electromagnetic Spectrum

USE THIS SPACE FOR SCRATCH WORK

Q.1 Doppler's effect applies to:

A) Sound wave only

B) Light wave only

C) Both sound and light waves

D) Neither sound nor light waves

Q.2 When the source of sound approaches the listener at rest, the frequency or pitch of sound received by him is:

A) Less than the frequency of sound produced by source

B) Greater than the frequency of sound produced by source

C) Same as that produced by source

D) Can't be predicted

Q.3 When the source of sound moves away from a stationary listener there is:

A) An apparent increase in wavelength

B) An apparent decrease in frequency

C) An apparent decrease in wavelength

D) Both "A" & "B"

Q.4 Which phenomenon can be applied to estimate the velocity of star with respect to earth:

A) Doppler's effect C) Stationary waves

B) Interference D) All of these

Q.5 The phase change of 180^o is equal to the path difference of:

A) λ C) 2λ

B) $\frac{\lambda}{2}$ D) 3λ

Q.6 In the following properties of a wave, the one that in independent of the others is:

A) Velocity C) Frequency

B) Amplitude D) Wavelength

Q.7 When you speak to your friend, and he speaks to you, which of following quantity is same in their sounds:

A) Amplitude C) Frequency

B) Speed D) Wavelength

Q.8 Wave motion cannot transfer:

A) Energy C) Mass

B) Momentum D) All of these

Q.9 The stationary waves produced in stretched string are _____ in nature.

A) Transverse C) Electromagnetic

B) Longitudinal D) None of these

Q.10 An explosion takes place on the surface of a planet, a person at surface of earth:

A) Can see only but can't hear explosion

B) Can't see but only hear explosion

C) Both see and hear explosion

D) Can't be predicted

Q.11 The waves which need medium for their propagation are called:

A) Electromagnetic waves C) Non-mechanical waves

B) Mechanical waves D) Matter waves

Q.12 The waves which do not require a material medium for their propagation are:

A) Electromagnetic waves C) Mechanical waves

B) Non-mechanical waves D) Both "A" and "B"

Q.13 Mechanical waves can be:

A) Longitudinal only

B) Transverse only

C) Both longitudinal and transverse

D) None of these

Q.14 The relation between phase difference ϕ and path difference x is:

A) $\phi = \frac{2\pi x}{\lambda}$ C) $\phi = \frac{2\pi}{x}$

B) $\phi = \frac{2\pi\lambda}{x}$ D) $\phi = \frac{2\pi}{\lambda}$

Q.15 If a wave is travelling at a speed of 130 m s^{-1} and has a wavelength of 5 m, then its frequency will be:

A) 650 Hz C) 26 Hz

USE THIS SPACE FOR SCRATCH WORK

B) 20 Hz D) 380 Hz

USE THIS SPACE FOR SCRATCH WORK

Q.16 When two identical waves moving in opposite direction reach at a point simultaneous such that they have same frequency then:

A) Interference takes place

B) Stationary waves are generated

C) Beats are produced

D) None of these

Q.17 We can produce stationary waves in:

A) Stretched string C) Both "A" and "B"

B) Air coloumn D) None of these

Q.18 In stationary waves generated on stretched string the relation for speed "v" of wave with tension "F" and mass per unit length "m" is:

A) $v \propto \sqrt{F}$ C) Both "A" and "B"

B) $v \propto \frac{1}{\sqrt{m}}$ D) None of these

Q.19 If for a stretched string tension is made from "F" to "4F" the speed of waves generated will be:

A) $v' = 4v$ C) $v' = \frac{v}{4}$

B) $v' = 2v$ D) $v' = \frac{v}{2}$

Q.20 To produce a single harmonic in a stretched string we will pluck it from:

A) $\frac{\ell}{4}$ C) $\frac{\ell}{6}$

B) $\frac{\ell}{2}$ D) $\frac{\ell}{8}$

Q.21 For stationary waves in a stretched string we always have _____ on two ends:

A) Node C) Trough

B) Anti-node D) Crest

Q.22 The distance between two nodes or anti-nodes is always:

A) $\frac{\lambda}{4}$ C) $\frac{\lambda}{6}$

B) $\frac{\lambda}{2}$ D) λ

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Q.23 The relation for fundamental frequency of stationary waves in stretched string is:

A) $f_1 = \frac{v}{2\ell}$ C) $f_1 = \frac{v}{\ell}$

B) $f_1 = \frac{v}{4\ell}$ D) $f_1 = \frac{3v}{4\ell}$

Q.24 The relation for fundamental wavelength of stationary waves generated in stretched string is:

A) $\lambda_1 = 2\ell$ C) $\lambda_1 = \frac{2\ell}{3}$

B) $\lambda_1 = 4\ell$ D) $\lambda_1 = \frac{4\ell}{3}$

Q.25 As the frequency for stationary waves in stretched string increases the value of:

A) Wavelength decreases

B) Speed remains same

C) Both "A" and "B"

D) Both wavelength & speed decreases

Q.26 What is true for first overtone?

A) $f_2 = 2f_1$ C) $\lambda_2 = \frac{\lambda_1}{2}$

B) $v = constant$ D) All of these

Q.27 A metallic wire of 2 m length hooked between two points has tension of 10 N. If mass per unit length of wire is 0.004 kg s^{-1} then fundamental frequency emitted by wire on vibration is:

A) 12.5 Hz C) 24 Hz

B) 48 Hz D) 6.25 Hz

Q.28 The minimum length of a tube, open at both ends, that resonates with a tuning fork of frequency 350 Hz is (where speed of sound is 350 m s^{-1}):

A) 0.25 m C) 0.5 m

B) 1 m D) 2 m

Q.29 The wavelength of fundamental mode of vibration of closed organ pipe is:

A) 2ℓ C) 4ℓ

B) ℓ D) $\frac{\ell}{2}$

Q.30 If two waves are superimposed to form a stationary wave, what will be speed of wave having frequency 300 Hz while the distance between the two nodes is 1.5 m:

A) 100 m s^{-1} C) 200 m s^{-1}

B) 450 m s^{-1} D) 900 m s^{-1}

Q.31 In Doppler effect change in frequency depends on:

A) Distance between source and listener

B) Speed of source and listener

C) Density of air

D) Frequency of source

Q.32 A sound source of frequency 600 Hz is moving towards an observer with velocity 20 m s^{-1}. The speed of sound is 340 m s^{-1}. The frequency heard by observer will be:

A) 565.5 Hz C) 725.5 Hz

B) 637.5 Hz D) 520.5 Hz

Q.33 If a sound source is moving toward a receiver at $\frac{1}{3}$ the speed of sound, what would be the resulting wavelength?

A) 6 times the emitted wavelength

B) $\frac{2}{3}$ times the emitted wavelength

C) $\frac{1}{3}$ times the emitted wavelength

D) Can't be found

Q.34 If the source of sound moves at the same speed or faster than the speed of wave then it results in:

A) Doppler effect C) Shock waves

B) Beats D) Refraction of sound

Q.35 Stars moving away from earth give:

A) Black shift C) Red shift

B) Blue shift D) Green shift

USE THIS SPACE FOR SCRATCH WORK

Q.36 According to principle of superposition, two waves having same frequency and travelling in same direction super pose to given rise to:

A) Beats
B) Interference
C) Stationary waves
D) Progressive waves

Q.37 In electromagnetic spectrum, which waves have longest wavelength and which waves have most energy among given options:

A) Radio-waves, γ-rays
B) Microwaves, X-rays
C) Infrared, Visible
D) Ultraviolet, X-rays

ANSWER KEY (Worksheet-16)							
1	C	11	B	21	A	31	B
2	B	12	D	22	B	32	B
3	D	13	C	23	A	33	B
4	A	14	A	24	A	34	C
5	B	15	C	25	C	35	C
6	B	16	B	26	D	36	B
7	B	17	C	27	A	37	A
8	C	18	C	28	C		
9	A	19	B	29	C		
10	A	20	B	30	D		

SOLUTIONS

Unit – 4 (WS-16)

Q.1 Answer is "C"

Solution:- Doppler's effect is applicable to all types of waves i.e Mechanical and Electromagnetic waves.

Q.2 Answer is "B"

Solution:- When source of sound approaches the listener, apparent frequency is given as:

$$f_{apparent} = \left(\frac{v}{v - u_s}\right) f_{actual}$$

$f_{app} > f_{act}$ Also

Pitch $\propto f_{app}$

So both apparent frequency and pitch increase.

Q.3 Answer is "D"

Solution:- When source of sound moves away from listener, apparent frequency and apparent wavelength are given as;

$$f_{app} = \left(\frac{v}{v + u_s}\right) f_{act}$$

$f_{app} < f_{act}$

Also

$\lambda_{app} = \lambda_{act} + \Delta\lambda$

$\lambda_{app} > \lambda_{act}$

Q.4 Answer is "A"

Solution:- Doppler's effect can be applied to estimate the velocity of star with respect to earth.

Q.5 Answer is "B"

Solution:- Relation between phase difference and path difference is given as:

$$\frac{\text{Path Difference}}{\lambda} = \frac{\text{Phase Difference}}{2\pi}$$

Q.6 Answer is "B"

Solution:- Amplitude does not depend on other three given parameters.

Q.7 Answer is "B"

Solution:- Speed of sound in one medium remains same regardless of frequency, amplitude or wavelength of the sound waves.

Q.8 Answer is "C"

Solution:- Wave is defined as

"A disturbance in a medium which carries momentum and energy without carrying the matter."

Q.9 Answer is "A"

Solution:-Stationary waves produced in stretched string are transverse stationary waves while stationary waves produced in air column are longitudinal stationary waves.

Q.10 Answer is "A"

Solution:- Sound need medium but light does not.

Q.11 Answer is "B"

Solution:- Waves which need medium for their propagation are called mechanical waves.

Q.12 Answer is "D"

Solution:- Waves which do not require medium for their propagation (also these waves possess changing electric and magnetic fields) are called electromagnetic waves.

Q.13 Answer is "C"

Solution:- Mechanical waves can be both longitudinal as well as transverse.

Q.14 Answer is "A"

Solution:- Relation between phase difference and path difference is given as:

$$\frac{\text{Path Difference}}{\lambda} = \frac{\text{Phase Difference}}{2\pi}$$

Q.15 Answer is "C"

Solution:- Use the relation;

$$v = f\lambda$$

$$f = \frac{v}{\lambda} = \frac{130}{5} = 26Hz$$

Q.16 Answer is "B"

Solution:- Basic conditions to produce stationary waves.

Q.17 Answer is "C"

Solution:- Stationary waves can be produced both in stretched string as well as air column. In stretched string the stationary waves are transverse stationary waves while in air column the stationary waves are longitudinal stationary waves.

Q.18 Answer is "C"

Solution:- Speed of stationary wave is given as:

$$v = \sqrt{\frac{F}{m}}$$ Here

F = tension in the string

m = mass per unit length of string.

Q.19 Answer is "B"

Solution:- Speed of stationary wave is given as;

$$v = \sqrt{\frac{F}{m}} \quad \Rightarrow \quad v \propto \sqrt{F}$$

Making "F" four times will make "v" two times.

Q.20 Answer is "B"

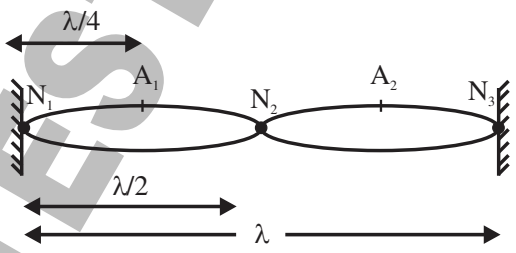
Solution:- Distance of point (from near end) from where string is to be plucked to vibrate in "n" loops is $= \frac{\ell}{2n}$.

Q.21 Answer is "A"

Solution:- On the ends of string particles of string can't move up & down, so nodes are formed on the ends always.

Q.22 Answer is "B"

Solution:-



Q.23 Answer is "A"

Solution:- For a stretched string:

$$f_n = \frac{nv}{2\ell}$$

For n=1

$$f_1 = \frac{v}{2\ell}$$

Q.24 Answer is "A"

Solution:- For a stretched string;

$$\lambda_n = \frac{2\ell}{n}$$

For n=1

$$\lambda_1 = \frac{2\ell}{1}$$

Q.25 Answer is "C"

Solution:- If the frequency of stationary wave in a stretched string increases, its wavelength decreases by same proportion, so according to formula.

$$v = \uparrow f\lambda \downarrow = \text{constant}$$

Speed remains constant.

Q.26 Answer is "D"

Solution:- First overtone means 2nd harmonic i.e n=2, so

$$f_n = nf_1 \qquad ;\lambda_n = \frac{\lambda_1}{n}$$

$$f_2 = 2f_1 \qquad ;\lambda_2 = \frac{\lambda_1}{2}$$

And

$$v = f_n\lambda_n = constant$$

Q.27 Answer is "A"

Solution:- Given

$$m = 0.004\ kg\,s^{-1}; F = 10\ N, \ell = 2\ m$$

$$f_1 = \frac{1}{2\ell}\sqrt{\frac{F}{m}} = \frac{1}{2\times 2}\sqrt{\frac{10}{0.004}}$$

$$f_1 = \frac{1}{4}\sqrt{\frac{10\times 10^3}{4}} = \frac{1}{4}\times\frac{10^2}{2}$$

$$f_1 = 12.5\ Hz$$

Q.28 Answer is "C"

Solution:- Use relation $f = \frac{v}{2\ell}$

Q.29 Answer is "C"

Solution:- For close ended pipe:

$$\lambda_n = \frac{4\ell}{n}$$

For fundamental mode

$$n = 1$$

So, $\lambda_1 = 4\ell$

Q.30 Answer is "D"

Solution:- Use relation; $v = f\lambda$ first find "λ" from distance between two nodes which is equal to $\frac{\lambda}{2}$.

Q.31 Answer is "B"

Solution:- In Doppler's effect the apparent change in frequency only depends on relative motion between source & observer (except the motion of source on a circular path making observer as center)

Q.32 Answer is "B"

Solution:- Apparent frequency when source moves towards observer is given as:

$$f_{app} = \left(\frac{v}{v - u_s}\right) f$$

$$f_{app} = \left(\frac{340}{340 - 320}\right) 600$$

$$f_{app} = \left(\frac{340}{320}\right) 600$$

$$f_{app} = 637.5\ Hz$$

Q.33 Answer is "B"

Solution:- When source moves towards observer, the apparent wavelength is given as:

$$\lambda_{app} = \lambda - \Delta\lambda$$

$$\lambda_{app} = \frac{v}{f} - \frac{u_s}{f}$$

$$\lambda_{app} = \frac{v}{f} - \frac{v}{3f}$$

$$\lambda_{app} == \frac{2}{3}\frac{v}{f} = \frac{2}{3}\lambda$$

Q.34 Answer is "C"

Solution:- If the sound source moves at or greater than the speed of sound wave then it results into shock waves.

Q.35 Answer is "C"

Solution:- Stars moving away from earth give red shift while moving towards earth give blue shift.

Q.36 Answer is "B"

Solution:- Read three points of principle of superposition in topic 8.4

Q.37 Answer is "A"

Solution:- Order of wavelength:

Radio waves > Microwaves > Infrared > Visible > U.V > X-rays > γ-rays

Order of Energy / Momentum / Frequency:

Radio waves < Microwaves < Infrared < Visible < U.V < X-rays < γ-rays

STEP

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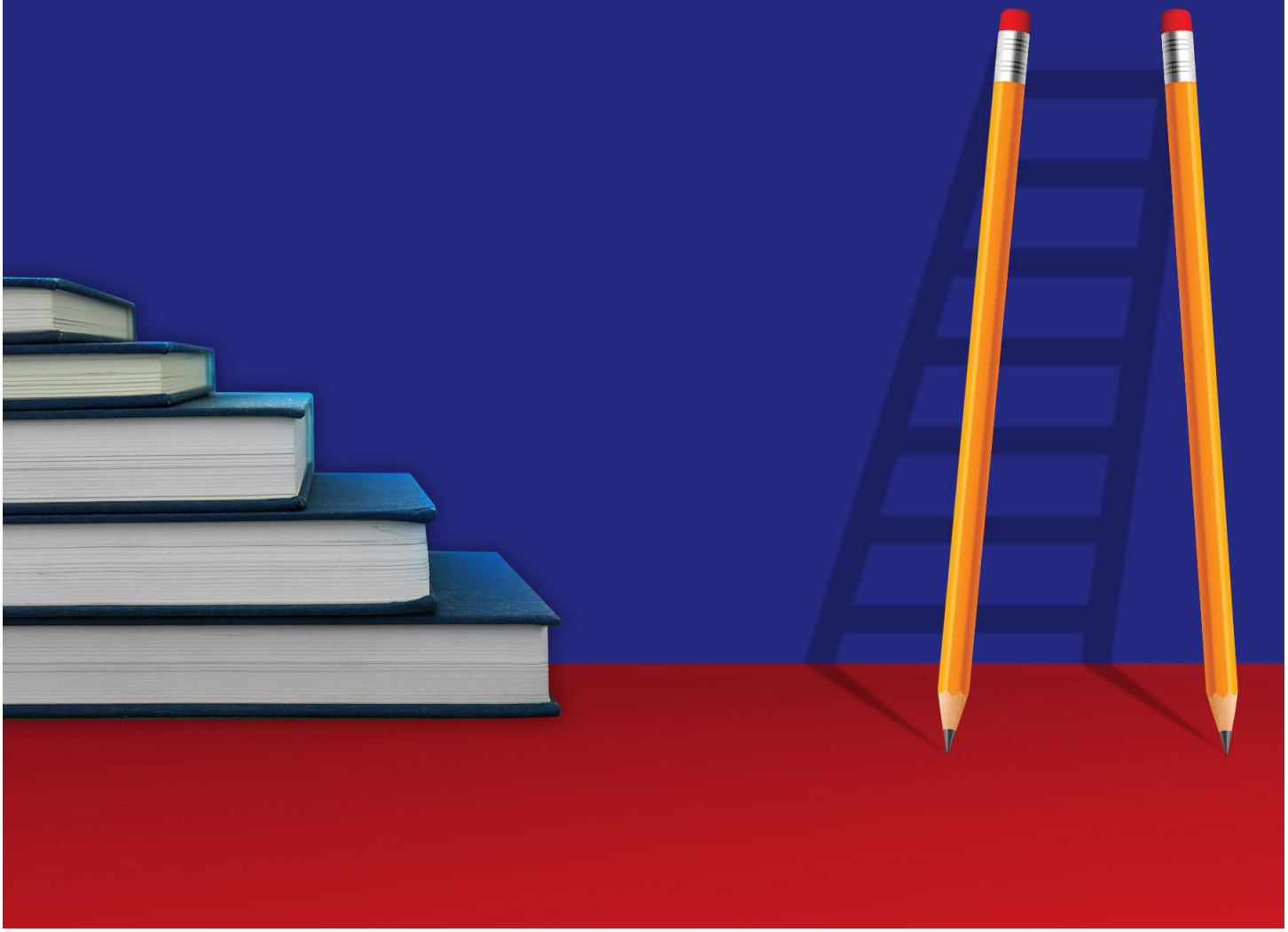

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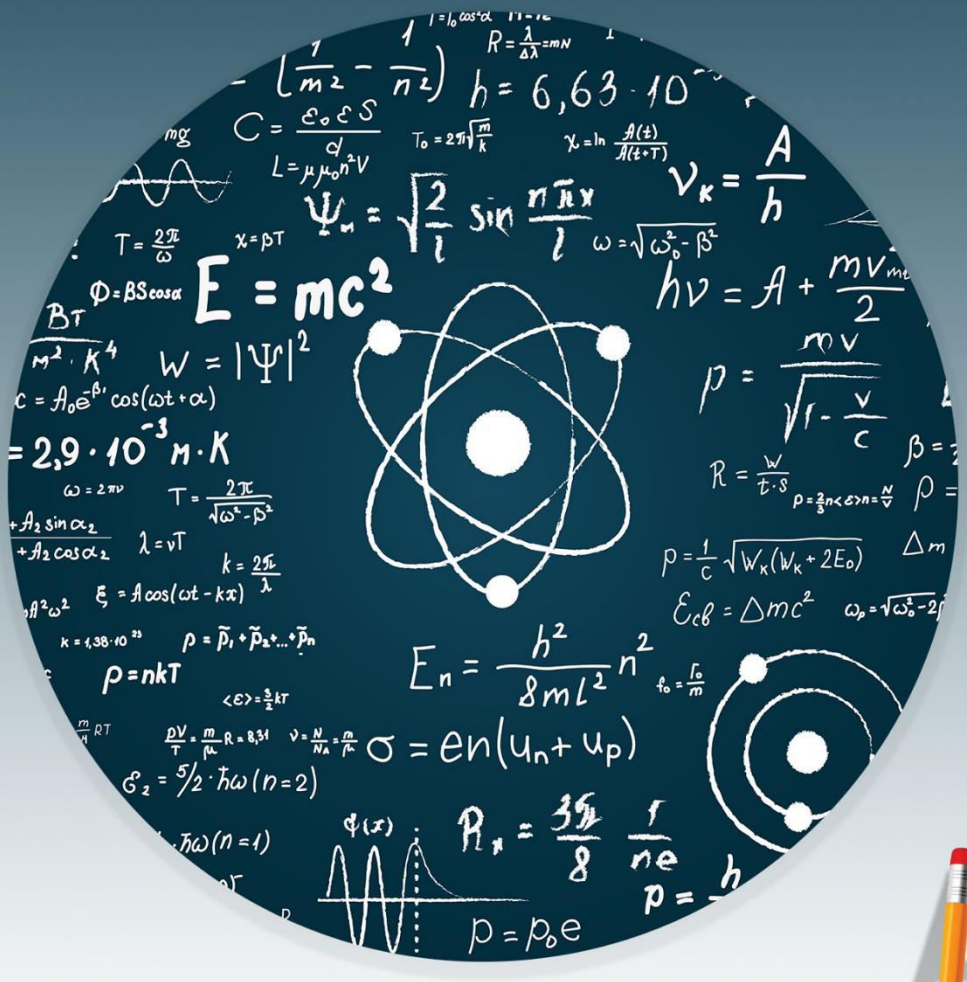

WORKSHEET-17

STEP

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Worksheet-17

Topics:- Interference of Light Waves, Young's Double Slit Experiment, Diffraction Grating

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Q.1 The wave nature of light was proposed by:

A) Thomas Young C) Newton

B) Maxwell D) Huygens

Q.2 Huygens principle states that:

A) Light travels in straight line

B) Light travels as electromagnetic waves

C) Light has dual nature

D) All points on primary wave front are sources of secondary wavelets

Q.3 The distance between any two consecutive dark or bright fringes is called:

A) Wavelength C) Amplitude

B) Wavelet D) Fringe spacing

Q.4 In Young's double slit experiment the condition for constructive interference (bright fringes) is:

A) $d\sin\theta = \left(m + \frac{1}{2}\right)\lambda$ C) $d\sin\theta = \left(m - \frac{1}{2}\right)\frac{\lambda}{2}$

B) $d\sin\theta = m\lambda$ D) $2d\sin\theta = m\lambda$

Q.5 In Young's double slit experiment the condition for destructive interference is:

A) $d\sin\theta = m\lambda$ C) $d\sin\theta = \left(\frac{m}{2} - \frac{1}{2}\right)\lambda$

B) $d\sin\theta = \frac{m\lambda}{2}$ D) $d\sin\theta = \left(m + \frac{1}{2}\right)\lambda$

Q.6 In Young's double slit experiment fringe spacing is equal to:

A) $\frac{d}{\lambda L}$ C) $\frac{\lambda d}{L}$

B) $\frac{\lambda L}{d}$ D) $\frac{2\lambda d}{L}$

Q.7 The diffraction phenomena is found to be prominent if:

A) Size of obstacle is smaller than wavelength of light

B) Wavelength of light is greater than size of slit

C) Size of slit is smaller than wavelength of light

D) All of these

Q.8 Diffraction is a special type of:

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A) Polarization C) Reflection
B) Interference D) Dispersion

Q.9 The appearance of colours in thin film is due to:
A) Diffraction C) Interference
B) Dispersion D) Polarization

Q.10 Newton's rings are formed due to:
A) Diffraction of light C) Polarization of light
B) Interference of light D) Reflection of light

Q.11 When Newton's rings interference is seen from above by means of reflected light the central spot is?
A) Red C) Bright
B) Blue D) Dark

Q.12 Bending of light around the edges of an obstacle is called:
A) Refraction C) Polarization
B) Interference D) Diffraction

Q.13 In YDSE the process taking place was:
A) Interference C) Both "A" and "B"
B) Diffraction D) Polarization

Q.14 To observe interference of light interfering beams must:
A) Be monochromatic C) Of same color
B) Be coherent D) All of these

Q.15 In "YDSE" the centre is:
A) Always bright C) May be bright or dark
B) Always dark D) None of these

Q.16 The centre of Newton's rings in case of transmitted light is:
A) Bright C) May be bright or dark
B) Dark D) None of these

Q.17 The blue colour of sky is due to _____ of light:
A) Diffraction C) Interference
B) Scattering D) None of these

Q.18 A diffraction pattern is obtained using a beam of red light. If the red light is replaced by blue light, then:
A) The diffraction pattern remains unchanged
B) Diffraction bands become narrower and crowded together
C) Bands become broader and farther apart
D) Bands disappear

Q.19 Two coherent sources produce a dark fringe when the phase difference between interfering waves is:

USE THIS SPACE FOR SCRATCH WORK

A) $(2n-2)\pi$, n= 1, 2, 3 …
C) $2n\pi$, $n = 1,2,3,4.....$
B) $n\pi$, $n = 1,2,3,.....$
D) $(2n-1)\pi$, n = 1, 2, 3, 4

Q.20 In Young's double slit experiment the distance between the slits is gradually increased. The width of the fringes:

A) Increases
B) Remains same
C) Decreases
D) First increases and then decreases

Q.21 The image of the tip of a needle is never sharp because of:

A) Polarization of light
C) Diffraction of light
B) Interference of light
D) Reflection of light

Q.22 When interference of light takes place?

A) Energy is created at the position of maxima
B) Energy is destroyed at the position of minima
C) Energy is neither created nor destroyed but it is merely redistributed
D) All of these

Q.23 If the apparatus of Newton's rings is moved from air to water, the rings spacing:

A) Remains same
C) Decreases
B) Increases
D) Becomes maximum

Q.24 In YDSE the process under observation is:

A) Interference
C) Both "A" & "B"
B) Diffraction
D) Polarization

Q.25 A student bought two identical lamps with same colour of bulbs and allowed to fall light of both lamps after passing through two narrow openings at screen but found no interference pattern, this is due to the reason that:

A) Rays were not monochromatic
B) Rays were coherent
C) Rays were monochromatic
D) Rays were not coherent

Q.26 In YDSE the centre is always a maxima, it's order is:

A) 1^{st} order
C) 0^{th} order
B) 2^{nd} order
D) 3^{rd} order

Q.27 As we know that relation for distance of any minima

USE THIS SPACE FOR SCRATCH WORK

from centre is written as $y_m = \left(m + \frac{1}{2}\right)\frac{\lambda L}{d}$. To find the closest minima to centre we:

A) Put m=0, Call it zeroth order minima

B) Put m=1, Call it 1st order minima

C) Put m=0, Call it 1st order minima

D) Put m=1, Call it 2nd order minima

Q.28 If in YDSE four fringes are observed above the centre then total number of fringes present on screen will be:

A) 4 C) 5

B) 9 D) Can't be predicted

Q.29 If instead of monochromatic light one uses white light in YDSE then:

A) No interference pattern will be observed

B) Centre will be white and coloured fringes will be observed on both sides

C) Same results will be observed as with monochromatic light

D) All of these

Q.30 If we use white light in YDSE then the coloured fringe closer to the central maxima will be:

A) Red C) Blue

B) Green D) Yellow

Q.31 A light wave has intensity I_o at 2 cm distance from source, what would be intensity at 4 cm?

A) Increases by factor 2 C) Increases by factor 3

B) Decreases by factor $\frac{1}{2}$ D) Decreases by factor $\frac{1}{4}$

Q.32 The diffraction pattern of single slit is best represented as:

A) 

B) 

C) 

D) None of these

ANSWER KEY (Worksheet-17)									
1	D	11	D	21	C	31	D		
2	D	12	D	22	C	32	B		
3	D	13	C	23	C	33			
4	B	14	D	24	A	34			
5	D	15	A	25	D	35			
6	B	16	A	26	C	36			
7	D	17	B	27	C	37			
8	B	18	B	28	B	38			
9	C	19	D	29	B	39			
10	B	20	C	30	C	40			

SOLUTIONS

Unit – 5 (WS-17)

Q.1 Answer is "D"

Solution:- The wave nature of light was proposed by Huygens in 1678 and it was experimentally proven by Thomas Young in 1801.

Q.2 Answer is "D"

Solution:- Huygen principle says all the points on a wavefront are the sources of secondary wavelets.

Q.3 Answer is "D"

Solution:- The distance between any two consecutive dark or bright fringes is called fringe spacing.

Q.4 Answer is "B"

Solution:- Conditions for constructive interference is;

Path difference = mλ where $m = 0, \pm 1, \pm 2....$

i.e Path difference = $0, \pm\lambda, \pm 2\lambda.....$

also Phase difference = $0, 2\pi, 4\pi, 6\pi, ...$

Q.5 Answer is "D"

Solution:- For destructive interference

Path difference $= \left(m + \frac{1}{2}\right)\lambda$

Where $m = 0, \pm 1, \pm 2.....$

i.e Path difference $= \pm\frac{1\lambda}{2}, \pm\frac{3\lambda}{2}, \pm\frac{5\lambda}{2}.....$

Also

Phase difference $= \pm\pi, \pm 3\pi, \pm 5\pi.....$

Q.6 Answer is "B"

Solution:- Fringe spacing or the distance between adjacent bright or dark fringes is given as:

$$\Delta y = \frac{\lambda L}{d}$$

Q.7 Answer is "D"

Solution:- The diffraction phenomena is found to be prominent when; (size of obstacle/slit) $\leq \lambda$

Q.8 Answer is "B"

Solution:- Diffraction is merely the bending of light around the edges of obstacle, after the bending the diffraction pattern is formed due to interference of light beams.

Q.9 Answer is "C"

Solution:- The beautiful colours in thin film are due to the interference of light.

Q.10 Answer is "B"

Solution:- Newton's rings are formed due to interference of light.

Q.11 Answer is "D"

Solution:- For reflected light

$x = \frac{\lambda}{2}, \phi = 180°$ so minima is formed.

Q.12 Answer is "D"

Solution:-"The bending of light around the edges of an obstacle and spreading of light into the geometrical shadow of obstacle is called diffraction."

Q.13 Answer is "C"

Solution:- First bending then interference takes place.

Q.14 Answer is "D"

Solution:- Basic conditions for interference.

Q.15 Answer is "A"

Solution:- At the centre of screen the path difference of the superposing light waves is zero which is a condition of constructive interference.

Q.16 Answer is "A"

Solution:- For transmitted light maxima is formed.

Q.17 Answer is "B"

Solution:- Scattering $\propto \frac{1}{\lambda}$

Q.18 Answer is "B"

Solution:- Fringe spacing $\propto \lambda$

Q.19 Answer is "D"

Solution:- For destructive interference

Path difference $= \left(m + \frac{1}{2}\right)\lambda$

Where $m = 0, \pm 1, \pm 2.....$

i.e Path difference $= \pm\frac{1\lambda}{2}, \pm\frac{3\lambda}{2}, \pm\frac{5\lambda}{2}.....$

Also

Phase difference $= \pm\pi, \pm 3\pi, \pm 5\pi.....$

This phase difference can be generalized as: phase difference=(2n-1)π, n=1, 2, 3, ……..

Q.20 Answer is "C"

Solution:- $\Delta y \propto \frac{1}{d}$

Q.21 Answer is "C"

Solution:- Due to prominent diffraction of light from needle tip its image is never sharp.

Q.22 Answer is "C"

Solution:- We can't go against law of conservation of energy.

Q.23 Answer is "C"

Solution:- $\Delta y \propto \lambda$; as "λ" decreases so fringe spacing also decreases.

Q.24 Answer is "A"

Solution:- Different lamps can't produce coherent beams.

Q.25 Answer is "D"

Solution:- When lamps changes the beams cannot be coherent

Q.26 Answer is "C"

Solution:- The central maxima is 0^{th} order maxima, generally;

Order of maxima = m

And

Order of minima = m+1

Q.27 Answer is "C"

Solution:- The central maxima is 0^{th} order maxima, generally;

Order of maxima = m

And

Order of minima = m+1

Q.28 Answer is "B"

Solution:- There are equal number of fringes above and below the central maxima on screen. So including the central fringe, four fringes above and four fringe below central fringe, total fringes are nine.

Q.29 Answer is "B"

Solution:- For white light in YDSE

- Central maxima will be white
- Moving away from central maxima, colored pattern is observed.
- That color is observed first whose wavelength is smaller.

Q.30 Answer is "C"

Solution:- Blue color is least diffracted or bended.

Q.31 Answer is "D"

Solution:- $I \propto \frac{1}{x^2}$

Q.32 Answer is "B"

Solution:- For diffraction Pattern

i. Centre of screen is a maxima with maximum width and intensity.

ii. Moving away from centre, width of maxima decreases and width of minima increases.

STEP

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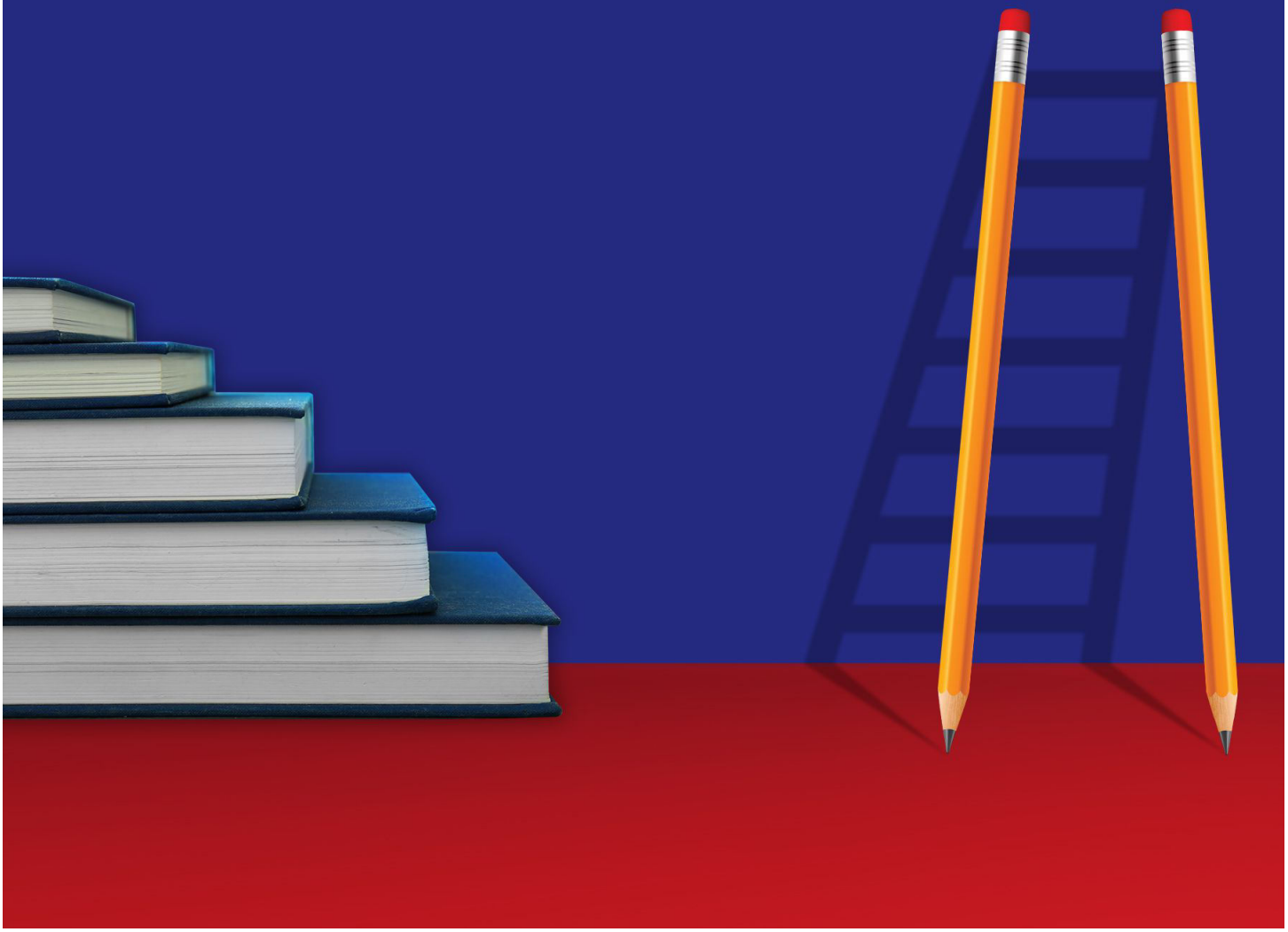

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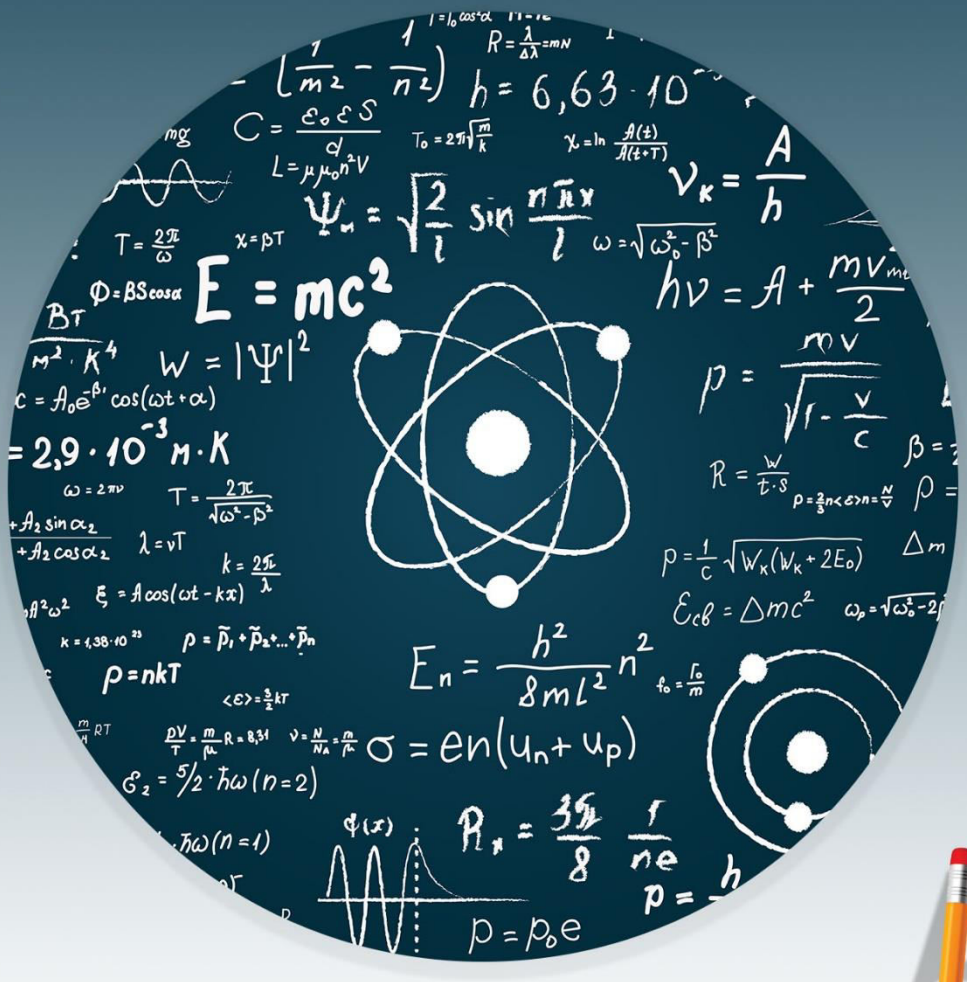

WORKSHEET-18

STEP

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Worksheet-18

Topics:- KMT, Pressure of Gas, Interpretation of Temperature, Internal Energy, Specific Heat Capacity

USE THIS SPACE FOR SCRATCH WORK

Q.1 PV = RT Represent:

A) Gas equation for n moles

B) Gas equation for one mole

C) Gas equation for 10 moles

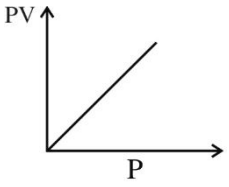
D) Gas constant for one molecule

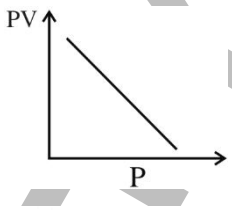
Q.2 The value of Boltzmann constant is:

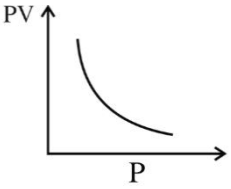
A) 13.8×10^{-23} J K^{-1} C) 13.8×10^{25} J K^{-1}

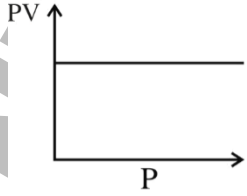
B) 1.38×10^{-23} J K^{-1} D) 1.38×10^{-25} J K^{-1}

Q.3 In an experiment to investigate the relationship between the volume *V* of a fixed mass of an ideal gas and its pressure *P*, a graph of PV against P is plotted. Which graph shows the correct relationship at constant temperature?

A) 

C) 

B) 

D) 

Q.4 Which of the following parameters does not characterize the thermodynamic state of matter?

A) Work C) Temperature

B) Pressure D) Volume

Q.5 Boyle's law is a relation between _____ thermodynamic parameters keeping temperature constant.

A) 1 C) 3

B) 2 D) ∞

Q.6 During an adiabatic expansion the increase in volume is

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associated with:

A) Decrease in pressure and decrease in temperature

B) Increase in pressure and decrease in temperature

C) Increase in pressure and increase in temperature

D) Decrease in pressure and increase in temperature

Q.7 In the expressions below, *R* is the molar gas constant, *P* is pressure, *T* is thermodynamic temperature, N_A is the Avogadro's number, *n* is the number of moles, *k* is the Boltzmann constant, and *m* is the mass one molecule of gas. Which one of the expressions is correct for the molar volume V of an ideal gas?

A) $\frac{RT}{P}$ C) $\frac{nRT}{P}$

B) $\frac{N_A RT}{P}$ D) $\frac{nkT}{P}$

Q.8 The internal energy of 1 mole of an ideal gas depends on:

A) Only volume

B) Only temperature

C) Only pressure

D) Temperature and pressure

Q.9 The mass of O_2 molecules is 16 times that of H_2 molecules. The rms velocity of O_2 molecules at room temperature is v_{rms}. The rms velocity of H_2 molecules at the same temperature will be:

A) 16 v_{rms} C) $\frac{v_{rms}}{4}$

B) 4 v_{rms} D) $\frac{v_{rms}}{16}$

Q.10 The internal energy of a monoatomic ideal gas is:

A) Translational K.E C) Rotational K.E

B) Vibrational K.E D) All of these

Q.11 The rms velocity for monoatomic gas is:

A) $\sqrt{\frac{3kT}{m}}$ C) $\sqrt{\frac{2kT}{m}}$

B) $\sqrt{\frac{8kT}{\pi m}}$ D) Zero

Q.12 **Internal energy is a unique function of state because change in internal energy.**

A) Does not depend upon path

B) Depends upon path

C) Corresponds to an adiabatic process

D) Corresponds to an isothermal process

Q.13 **How will it effect the pressure "P" of a gas such that average velocity of gas molecules is doubled?**

A) $P' = 4P$ C) $P' = P$

B) $P' = 2P$ D) Not possible

Q.14 **When we provide heat to a system then it's temperature?**

A) May rise C) May not change

B) May fall D) All of these

Q.15 **For which of the following process work done comes out to be maximum?**

A) Isothermal C) Adiabatic

B) Isochoric D) Isobaric

Q.16 **When heat is neither given nor taken from a system then it's temperature?**

A) May remain same C) May fall

B) May rise D) All of these

Q.17 **If temperature is increased from 200 K to 800 K then what would be the change in pressure at constant volume**?

A) Increases by factor 4 C) Decrease by factor 4

B) Increases by factor 2 D) Decreases by factor 2

Q.18 **The average translational K.E of molecules in a gas at temperature 27 °C is:**

A) 5.71×10^{-21} J C) 4.79×10^{-21} J

B) 7.54×10^{-21} J D) 6.21×10^{-21} J

Q.19 **The average speed of oxygen molecule in the air at STP is 461 m s^{-1}. For calculation of this speed the temperature is taken:**

A) 298 K C) 327 K

B) 273 K D) 25 °C

Q.20 **The direction of flow of heat between two bodies is determined by:**

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A) Internal energy C) Total energy

B) Kinetic energy D) None of these

Q.21 Universal gas constant of a gas is equal to:

A) C_p-C_v C) $C_p \times C_v$

B) C_p+C_v D) None of these

Q.22 20 °C will be equal to:

A) 50 °F C) 68 °F

B) 98 °F D) 100 °F

Q.23 If a gas is heated against a pressure, keeping the volume constant, then workdone will be:

A) Positive C) Zero

B) Negative D) Any of these

Q.24 Which of the following is the property of a system?

A) Pressure and temperature

B) Internal energy and entropy

C) Volume and density

D) All of these

Q.25 Which of the following quantity is not the property of a system?

A) Pressure C) Internal energy

B) Temperature D) Heat

Q.26 Work done in a free expansion (expansion in vacuum) process is:

A) Positive C) Zero

B) Negative D) Maximum

Q.27 Kinetic theory of gases assumes that the collisions between the molecules are:

A) Perfectly inelastic C) Partially inelastic

B) Partially elastic D) Perfectly elastic

Q.28 Temperature of a gas is due to:

A) Its heating value

B) Attraction of molecules

C) Kinetic energy of molecules

D) Potential energy of molecules

Q.29 An ideal gas as compared to a real gas at very high

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pressure occupies:

A) More volume C) Same volume

B) Less volume D) Unpredictable

Q.30 Which of the following variable/variables control the physical properties of an ideal gas?

A) Pressure C) Temperature

B) Volume D) All of these

Q.31 Heat and work are:

A) State functions C) Point functions

B) System properties D) Path functions

Q.32 A perfect gas at 30 °C is heated at constant pressure till its volume is double. The final temperature is:

A) 60 °C C) 606 °C

B) 333 °C D) 120 °C

Q.33 A piston cylinder contains air at 600 kPa, 290 K and a volume of 0.01 m^3. A constant pressure process gives 54 kJ of work out. The final volume of the air is:

A) 0.05 m^3 C) 0.15 m^3

B) 0.10 m^3 D) 0.20 m^3

Q.34 A gas is enclosed in a container fitted with a piston of cross sectional area 0.10 m^2. The pressure of the gas is maintained at 8000 Nm^{-2}. When heat is slowly transferred, the piston is pushed up through a distance of 4.0 cm. If 42 J heat is transferred to the system during the expansion, the work done by the gas is:

A) 52 J C) 48 J

B) 38 J D) 32 J

Q.35 Referring to previous question, the change in internal energy of the system is:

A) 4 J C) 6 J

B) 10 J D) 5 J

Q.36 Evidence in favour of kinetic theory of gases is exhibited in:

A) Diffusion of gases

B) Brownian motion of smoke particles

C) Both A & B

D) Macroscopic approach of gases

Q.37 Kinetic theory of gases is based on:

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A) Microscopic approach C) Molecular approach

B) Macroscopic approach D) Both A and C

Q.38 "Molecules do not exert force on each other" this postulate implies:

A) Gas molecules do not have K.E

B) Gas molecules have P.E

C) Gas molecules have very small mass

D) Gas molecules do not have P.E

Q.39 The momentum transferred to the walls of the container per second per unit area due to continuous collisions of molecules of the gas gives:

A) Force per unit area C) Pressure of gas

B) K.E of gas D) Both A and C

Q.40 The collision frequency of gas molecules in a cubical container is:

A) $\frac{2\ell}{v}$ C) $\frac{3v}{2\ell}$

B) $\frac{2\ell}{3v}$ D) $\frac{v}{2\ell}$

Q.41 If there are "N" no. of molecules each of mass "m" in a cubical container of volume "ℓ^3", then density of gas is given by:

A) $\frac{m}{\ell^3}$ C) $\frac{m}{N\ell^3}$

B) $\frac{M}{\ell^3}$ D) $\frac{mN}{\ell^3}$

Q.42 Referring to previous question, the no. of particles colliding with any face of cube are:

A) $\frac{N}{3}$ C) $\frac{N}{6}$

B) $\frac{N}{2}$ D) $\frac{N}{4}$

Q.43 A gas in a cubical container contains three molecules each having speed of 2 m s^{-1}, 4 m s^{-1} and 4 m s^{-1}.What is the root mean square speed?

A) $\frac{36}{3}\ m\ s^{-1}$ C) $6\ m\ s^{-1}$

B) $12\ m\ s^{-1}$ D) $\sqrt{12}\ m\ s^{-1}$

Q.44 Two gases A and B having the same temperature T,

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same pressure P, and same volume V are mixed, If the mixture is at the same temperature and occupies a volume V, the pressure of the mixture is:

A) P C) 2P

B) 4P D) 6P

Q.45 If P is the pressure of the gas, then the kinetic energy per unit volume of the gas is:

A) P/2 C) P

B) (3/2)P D) 2P

Q.46 H_2 and O_2 both are at thermal equilibrium at 600 K. Oxygen is 16 times heavier than H_2. Root mean square speed of Hydrogen is:

A) 4 times the root mean square speed of O_2.

B) $^1/_{16}$ times the root mean square speed of O_2.

C) $^1/_4$ times the root mean square speed of O_2.

D) 16 times the root mean square speed of O_2.

Q.47 The r.m.s speed of gas molecules having molar mass 'M' at a temperature 'T' is proportional to:

A) $\sqrt{M}$ C) $\frac{1}{\sqrt{M}}$

B) $\frac{1}{M}$ D) None of these

Q.48 The pressure of gas is directly proportional to

A) Mean velocity of the molecules

B) Root mean square velocity of the molecules

C) Velocities of individual molecule

D) Mean square velocity of the molecules

Q.49 The temperature of a gas is 0°C. Its root mean square velocity will be doubled at:

A) 273 °C C) 1092 °C

B) 819 °C D) 103 °C

Q.50 The r.m.s velocity of the molecules of an ideal gas at S.T.P is 'v'. The gas is heated at constant volume till the pressure becomes double. The final r.m.s velocity is

A) v C) $\sqrt{2}$v

B) 2v D) $\frac{v}{2}$

Q.51 The mean square velocity of the molecules of an ideal gas at S.T.P is 'v'. The gas is heated at constant volume

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till the pressure becomes double. The final mean square velocity is:

A) v C) $\sqrt{2}$v

B) 2v D) $\frac{v}{2}$

Q.52 The temperature of a gas is increased from 27 ^{o}C to 127 ^{o}C. The ratio of mean K.E at initial to final temperature is:

A) $\frac{10}{9}$ C) $\frac{4}{3}$

B) $\frac{3}{4}$ D) $\frac{9}{16}$

Q.53 The mean kinetic energy of gas molecules at t ^{o}C is directly proportional to:

A) $\sqrt{t}$ C) $\sqrt{t+273}$

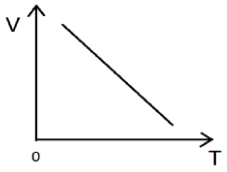
B) $(t+273)$ D) t

Q.54 The density of gas A is four times that of gas B. If the molar mass of gas A is M, then molar mass of gas B is:

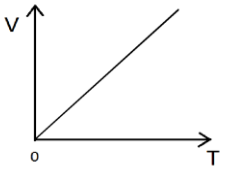
A) 2M C) 4M

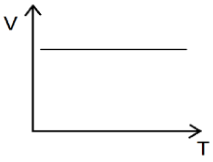
B) $\frac{M}{4}$ D) $\frac{M}{2}$

Q.55 Which one of the following represents correctly the variation of the volume (V) of an ideal gas with temperature (T) under constant pressure conditions?

A) 

C) 

B) 

D) 

Q.56 Which one is correct relation between "°F " and " °C "?

A) $^{\circ}F=\frac{9}{5}{}^{\circ}C+32$ C) $^{\circ}F=\frac{9}{5}(^{\circ}C+32)$

B) $^{\circ}C=(^{\circ}F-32)\frac{5}{9}$ D) Both A and B

Q.57 The temperature at which " °C" and " °F" have same

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values:

A) +40° C) -40°

B) 160° D) -160°

Q.58 The temperature at which " °F" and "kelvin" have same values:

A) 460 C) 340

B) 574 D) 525

Q.59 At constant temperature if the pressure of gas is doubled then its volume becomes:

A) Half C) Remains same

B) Double D) Four times

Q.60 In the general gas equation $PV = nRT$, how many state variable are there?

A) 2 C) 4

B) 3 D) 5

Q.61 Which one of following is not true about the ratio "$\frac{R}{N_A}$"?

A) It is called Boltzmann constant

B) It is called gas constant per mole

C) It is called gas constant per molecule

D) None of these

Q.62 Which one of following is true about ideal gas?

A) Mean K.E is directly proportional to absolute temperature

B) Average speed of gas molecules is not zero

C) Average velocity of gas molecules is zero

D) All of these

Q.63 The average speed of oxygen at STP is:

A) 473 m s^{-1} C) 437 m s^{-1}

B) 493 m s^{-1} D) 461 m s^{-1}

Q.64 Which of following expression is not true?

A) $v_{rms} = \sqrt{\frac{3RT}{M}}$ C) $v_{rms} = \sqrt{\frac{3RT}{N_A m}}$

B) $v_{rms} = \sqrt{\frac{3kT}{m}}$ D) None of these

Q.65 Which one is true expression of mean K.E of a molecule

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of ideal gas?

A) $\frac{3P}{2N_o}$ C) $\frac{3kT}{2}$

B) $\frac{3PV}{2N}$ D) All of these

Q.66 Which of following is correct about internal energy of ideal gas?

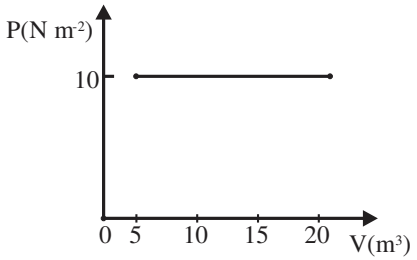
A) It is measure of average translational K.E

B) It is directly proportional to absolute temperature

C) It is a state function

D) All of these

Q.67 The work done during following expansion of:



A) 150 J C) 75 J

B) 100 J D) 200 J

Q.68 First law of thermodynamics is restatement of conservation of:

A) Energy C) Charge

B) Momentum D) Mass

Q.69 Which is correct expression of 1st law of thermodynamics for bicycle pump?

A) $Q=\Delta U+W$ C) $-W=+\Delta U$

B) $Q-\Delta U=W$ D) $\Delta U=Q-W$

Q.70 Which is correct expression of 1st law of thermodynamics for Human metabolism?

A) $\Delta U=Q-W$ C) $+\Delta U=-W$

B) $-\Delta U=+W$ D) None of these

Q.71 The process that occurs at constant temperature is:

A) Isothermal process C) Isochoric process

B) Adiabatic process D) Isobaric process

Q.72 The PV-equation for isothermal process is:

A) $P_1V_1 = P_2V_2$ C) $P = \text{constant}$

B) $P_1V_1^{\gamma} = P_2V_2^{\gamma}$ D) $V = \text{constant}$

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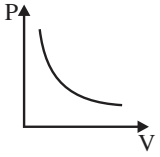
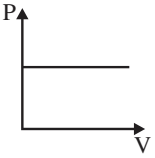
Q.73 **1st law of thermodynamics in case of Adiabatic process is:**

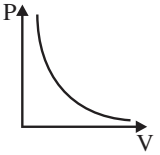
A) $W = -\Delta U$ C) $-Q = +W - \Delta U$

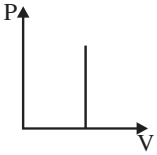
B) $Q = W - \Delta U$ D) $Q - \Delta U = W$

Q.74 **Which one represent Adiabat?**

A) 

C) 

B) 

D) 

Q.75 **The ratio of slope of Adiabat to Isotherm is:**

A) γ C) $\frac{1}{\gamma}$

B) γ^2 D) $\frac{1}{\gamma^2}$

Q.76 **During which process work done is minimum?**

A) Isothermal C) Adiabatic

B) Isochoric D) Isobaric

Q.77 **Which is correct expression?**

A) $C_P - C_V = R, \frac{C_P}{C_V} = \gamma$ C) $C_V = \frac{R}{(\gamma - 1)}$

B) $C_P = \frac{\gamma R}{(\gamma - 1)}$ D) All of these

Q.78 **1st law of thermodynamics in case of Isobaric process is:**

A) $C_P \Delta T = P \Delta V$ C) $C_P \Delta T = C_V \Delta T + P \Delta V$

B) $C_V \Delta T = C_P \Delta T + P \Delta V$ D) None of these

ANSWER KEY (Worksheet-18)							
1	B	21	A	41	D	61	B
2	B	22	C	42	C	62	D
3	D	23	C	43	D	63	D
4	A	24	D	44	C	64	D
5	B	25	D	45	B	65	D
6	A	26	C	46	A	66	D
7	A	27	D	47	C	67	A
8	B	28	C	48	D	68	A
9	B	29	A	49	B	69	C
10	A	30	D	50	C	70	A
11	A	31	D	51	B	71	A
12	A	32	B	52	B	72	A
13	D	33	B	53	B	73	A
14	D	34	D	54	B	74	B
15	D	35	B	55	B	75	A
16	D	36	C	56	D	76	B
17	A	37	D	57	C	77	D
18	D	38	D	58	B	78	C
19	B	39	D	59	A		
20	D	40	D	60	B		

SOLUTIONS

Unit – 6 (WS-18)

Q.1 Answer is "B"

Solution:- General gas equation for n moles is

$PV = nRT$

For one mole of a gas it can be written as:

$PV = RT$

Q.2 Answer is "B"

Solution:- Boltzman constant or gas constant per molecule is given as:

$$K = \frac{R}{N_A} = 1.38 \times 10^{-23}\, J\, K^{-1}$$

Q.3 Answer is "D"

Solution:- At constant temperature,

PV = constant, so graph will be a straight line parallel to P-axis.

Q.4 Answer is "A"

Solution:- Work is not a property of the system or surrounding. Work is a path variable. So work can not characterize the state of matter.

Q.5 Answer is "B"

Solution:- Boyle's law states:

"At constant temperature, the pressure of gas is inversely proportional to its volume."

Q.6 Answer is "A"

Solution:- Expansion causes cooling, when temperature decreases, pressure also decreases.

Q.7 Answer is "A"

Solution:- Put n=1 in general gas equation.

Q.8 Answer is "B"

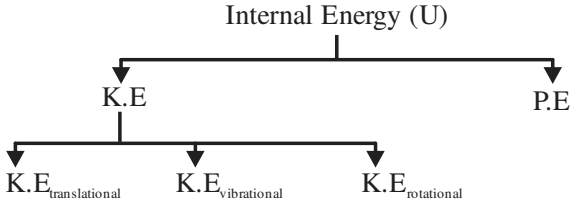
Solution:- $U \propto T$

Q.9 Answer is "B"

Solution:- $$\frac{v_{rms,H_2}}{v_{rms,O_2}} = \sqrt{\frac{\rho_{O_2}}{\rho_{H_2}}}$$

Q.10 Answer is "A"

Solution:- Internal energy of a gas can be described as:



- For ideal gases

$P.E = K.E_{vib} = K.E_{rot} = 0$

So,

$U = K.E_{trans}$

Q.11 Answer is "A"

Solution:- The rms velocity of a gas is:

$$v_{rms} = \sqrt{\frac{3KT}{m}}$$

or it can also be written as:

$$v_{rms} = \sqrt{\frac{3RT}{mN_A}} = \sqrt{\frac{3RT}{M}}$$

$$\left(\therefore M = mN_A\right)$$

Q.12 Answer is "A"

Solution:- Basic property of internal energy

Q.13 Answer is "D"

Solution:- Average velocity = 0

Q.14 Answer is "D"

Solution:- It may be a general process so temperature may rise but it may be an isothermal process as well in which T=constant

Q.15 Answer is "D"

Solution:- Work done is calculated by area under PV graph which is maximum for isobaric process.

Q.16 Answer is "D"

Solution:-

- If system is kept at same state temperature remains same.
- If system undergoes adiabatic process its temperature may rise or fall.

Q.17 Answer is "A"

Solution:- $PV = nRT \Rightarrow P \propto T$

Q.18 Answer is "D"

Solution: The average translational K.E is given as:

$$< K.E >= \frac{3kT}{2} = \frac{3\times 1.38\times 10^{-23}\times 300}{2}$$

$$< K.E >= \frac{3\times 1.38\times 3\times 10^{-21}}{2}\left(\therefore \frac{1.38}{2}\approx 0.7\right)$$

$$< K.E >= 9\times 0.7\times 10^{-21}$$

$$< K.E >= 6.3\times 10^{-21} J$$

Just to simplify calculations we assumed $\frac{1.38}{2} = 0.7$ so, now we'll choose the answer that is closest to 6.3×10^{-21} and smaller than this value. We'll use this technique to simplify calculations.

Q.19 Answer is "B"

Solution:- Usually average speed of gas molecules is found at STP and for gases STP means;

$T = 0\ ^\circ C = 273.16\ K$ and $P = 1\ atm.$

Q.20 Answer is "D"

Solution:- It is determined by temperature

Q.21 Answer is "A"

Solution:- Universal gas constant is related with specific heats as:

$$C_p - C_v = R$$

Q.22 Answer is "C"

Solution:- Use relation; $T_F = \frac{9}{5}T_C + 32$

Q.23 Answer is "C"

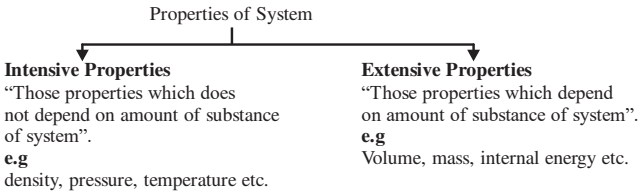
Solution:- Since the volume of gas is kept constant, so;

$$\Delta V = 0$$

$$W = P\Delta V = 0$$

Q.24 Answer is "D"

Solution:-



Note:

Work and heat are neither intensive properties nor extensive properties of system.

Q.25 Answer is "D"

Solution:- Work and heat are not properties of a system. Work and heat are forms of energy in transit. They appear only when there occurs any change in the state of a system or surrounding. They don't exist before and after the change of the state, so they are not system properties.

Q.26 Answer is "C"

Solution:- When we talk about free expansion, it is understood that it is happening in vacuum, where the pressure on the system is zero, so,

$$W = P\Delta V = (0)\Delta V = 0$$

Note:-

Rapid expansion of air from a burst tyre (adiabatic expansion) happens in air, in this case pressure on the system is not zero, so work is done by system on surrounding on the cost of internal energy.

Q.27 Answer is "D"

Solution:- According to kinetic theory of gases, the collisions between the molecules of gas are PERFECTLY ELASTIC not partially elastic.

Q.28 Answer is "C"

Solution:- According to the relation

$$T = \frac{2}{3k} < K.E >$$

$$T \propto < K.E >$$

Temperature of a gas is directly proportional to average K.E.

Q.29 Answer is "A"

Solution:- At very high pressure the forces of attraction starts dominating in real gases and these forces tend to liquify the gas, so volume gets decreased, while in ideal gases no forces of attraction or repulsion are present so their volume at high pressure is more than real gases.

Q.30 Answer is "D"

Solution:- In the ideal gas equation;

$$PV = nRT$$

n=no.of moles, once selected they remain same

R=general gas constant.

P,V,T=describe physical state of gas.

Q.31 Answer is "D"

Solution:- Both heat and work are path variable as their value depends on the path which system follows.

Q.32 Answer is "B"

Solution:- As P=constant, Charles law can be applied which states;

$$V \propto T$$

Where T is in kelvin.

Also;

$$\frac{V_1}{T_1}=\frac{V_2}{T_2} \qquad \left[\begin{array}{l}\therefore T_1=30\ ^\circ C=303\ K\\ V_1=V\\ T_2=?\\ V_2=2V\end{array}\right]$$

$$\frac{V}{303}=\frac{2V}{T_2}$$

$$T_2=606\ K=333\ ^\circ C$$

Q.33 Answer is "B"

Solution:- Data

$$P=600\times10^3\ Pa, V_1=0.01\ \text{m}^3$$

$$W=54\times10^3\ J, \text{V}_2=?$$

$$\text{T}=290\ K$$

Sol:-

$$W=P\Delta V=P\left(V_2-V_1\right)$$

$$54\times10^3=600\times10^3\left(V_2-0.01\right)$$

$$\frac{54}{600}=V_2-0.01$$

$$\frac{54}{6}\times10^{-2}=V_2-0.01$$

$$9\times10^{-2}=V_2-0.01$$

$$V_2=0.09+0.01=0.10\ m^3$$

Q.34 Answer is "D"

Solution:- Data:-

$$A=0.1\ m^2, P=8000\ N\ m^{-2}$$

$$\Delta y=4\ cm=4\times10^{-2}\ m, \text{Q}=42\ \text{J}$$

Sol:-

$$W=P\Delta V=P\left(A\Delta y\right)$$

$$W=8000\times0.1\times4\times10^{-2}$$

$$W=8\times10^3\times1\times10^{-1}\times4\times10^{-2}$$

$$W=32\ J$$

Q.35 Answer is "B"

Solution:- Data

$$A=0.1\ m^2, P=8000\ N\ m^{-2}$$

$$\Delta y=4\ cm=4\times10^{-2}\ m, \text{Q}=42\ \text{J}$$

Sol:-

$$W=P\Delta V=P\left(A\Delta y\right)=32\ J$$

By 1st-law of thermodynamics

$$Q=W+\Delta U$$

$$\Delta U=Q-W=42-32=10$$

$$\Delta U=10\ \text{J}$$

Q.36 Answer is "C"

Solution:- Evidence in favour of kinetic theory of gases is exhibited in diffusion of gases and Brownian motion of smoke particles.

Q.37 Answer is "D"

Solution:- Kinetic theory of gases is based on microscopic approach in which the assumption is that gases are composed of molecules.

Q.38 Answer is "D"

Solution:- P.E is because of attractive or repulsive forces, so for ideal gas it is zero because of no attractive or repulsive force.

Q.39 Answer is "D"

Solution:- Pressure of gas is defined as;

$$P=\frac{F}{A}=\frac{\frac{\Delta P}{\Delta t}}{A}=\frac{\text{Momentum per second}}{Area}$$

Q.40 Answer is "D"

Solution:- See derivation of pressure of Gas

Q.41 Answer is "D"

Solution:-

$$density=\frac{Total\ mass}{Total\ volume}=\frac{mN}{\ell^3}$$

Q.42 Answer is "C"

Solution:- No. of particles colliding with total 6 faces of cube =N

$$\begin{pmatrix} No.\ of\ particles \\ colliding\ with\ one\ face \end{pmatrix} = \frac{N}{6}$$

Q.43 Answer is "D"

Solution:- $v_{rms} = \sqrt{\frac{v_1^2 + v_2^2 + v_3^2}{3}}$

Q.44 Answer is "C"

Solution:- Dalton's law of partial pressure states $P_{mixture} = P_1 + P_2 + ...$

Q.45 Answer is "B"

Solution:- $P = \frac{2}{3}\frac{N}{V} < K.E >$

Here

N < K.E >= average K.E of gas.

<K.E> = average K.E of one molecule of gas

Q.46 Answer is "A"

Solution:- $\frac{v_{rms,1}}{v_{rms,2}} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{M_2}{M_1}}$

Where ρ = density of gas

and M = molar mass of gas

Q.47 Answer is "C"

Solution:- $v_{rms} = \sqrt{\frac{3RT}{M}}$

Q.48 Answer is "D"

Solution:- $P = \frac{2}{3}\frac{N}{V} < \frac{1}{2}mv^2 >$

$P \propto < v^2 >$

Q.49 Answer is "B"

Solution:- $\frac{v_{rms,2}}{v_{rms,1}} = \sqrt{\frac{T_2}{T_1}}$ where T_2 and T_1 are temperatures in kelvin

Alternative shortcut to solve this type of problem is:

$T_2 = n^2 T_1$

Where n = the number / factor to which speed at T_2 is greater or smaller than at T_1 for example in this question n=2.

Q.50 Answer is "C"

Solution:- As the pressure of gas is given as:

$$P = \frac{2}{3}\frac{N}{V} < \frac{1}{2}mv^2 >$$

$$P = \frac{2}{3}\frac{N}{V}\frac{1}{2}m < v^2 >$$

$P = \text{Constant} < v^2 >$

Taking square root on both sides

$\sqrt{P} = \text{Constant}\sqrt{< v^2 >}$

$\sqrt{P} = \text{Constant}\ v_{rms}$

$\sqrt{P} \propto v_{rms}$

Q.51 Answer is "B"

Solution:- As the pressure of gas is given as:

$$P = \frac{2}{3}\frac{N}{V} < \frac{1}{2}mv^2 >$$

$P \propto < v^2 >$

$< v^2 >$ = mean square velocity = v_{ms}

$P \propto v_{ms}$

Q.52 Answer is "B"

Solution:- $\frac{< K.E >_1}{< K.E >_2} = \frac{T_1}{T_2}$

Q.53 Answer is "B"

Solution:- $T = \frac{2}{3k} < K.E >$

$(t + 273) = \frac{2}{3k} < K.E >$

Q.54 Answer is "B"

Solution:- $\frac{\rho_A}{\rho_B} = \frac{M_A}{M_B}$

Q.55 Answer is "B"

Solution:- $V \propto T$

Q.56 Answer is "D"

Solution:- Temperature conversion formulae

Q.57 Answer is "C"

Solution:- $\frac{^{\circ}C - 0^{\circ}}{100} = \frac{^{\circ}F - 32}{180} = \frac{K - 273}{100}$

Q.58 Answer is "B"

Solution:- $\frac{^{\circ}C - 0^{\circ}}{100} = \frac{^{\circ}F - 32}{180} = \frac{K - 273}{100}$

Q.59 Answer is "A"

Solution:- $P \propto \frac{1}{V}$

Q.60 Answer is "B"

Solution:- P, V and T are state variable

Q.61 Answer is "B"

Solution:- Boltzmann constant /gas constant per molecule is defined as;

$K = \frac{R}{N_A} = 1.38 \times 10^{-23} \text{ J K}^{-1}$

Q.62 Answer is "D"

Solution:- Average velocity of gas molecules is zero but average speed/rms velocity is not zero. Also,

$T = \frac{2}{3k} < K.E >$

$T \propto < K.E >$

Q.63 Answer is "D"

Solution:- Average speed of oxygen at STP is:

$V = 461 \text{ m s}^{-1}$

Average speed of nitrogen at STP is

$V = 493 \text{ m s}^{-1}$

Q.64 Answer is "D"

Solution:- Rms velocity of gas molecules is given as

$v_{rms} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3RT}{mN_A}} = \sqrt{\frac{3RT}{M}}$

Q.65 Answer is "D"

Solution:- $P = \frac{2}{3}\frac{N}{V} < K.E >$

Q.66 Answer is "D"

Solution:- For ideal gas internal energy is equal to average K.E of gas molecules which is directly proportional to absolute temperature.

Q.67 Answer is "A"

Solution:- Find area under graph i.e

$W = \text{Area} = (10)(20 - 5)$

$W = (10)(15) = 150 \text{ J}$

Q.68 Answer is "A"

Solution:- 1st Law of thermodynamics is another statement of law of conservation of energy.

Q.69 Answer is "C"

Solution:- For a bicycle pump Q=0, so,

$Q = W + \Delta U$

$0 = W + \Delta U$

$-W = +\Delta U$

(-W) $\Rightarrow$ Workdone on the system

(ΔU) $\Rightarrow$ Increase in internal energy

Q.70 Answer is "A"

Solution:- Rearrange 1st law of thermodynamics

i.e

$Q = W + \Delta U$

$\Delta U = Q - W$

$(\Delta U) \Rightarrow$ Change in internal energy

(Q) $\Rightarrow$ Energy gained from food

(-W) $\Rightarrow$ Energy dissipated in different process by body

Q.71 Answer is "A"

Solution:-

- Process at constant temperature is called isothermal process
- Process at constant volume is called isochoric/isometric process
- Process at constant pressure is called isobaric process
- Process in which Q=0 is called adiabatic / isentropic process

Q.72 Answer is "A"

Solution:- For isothermal process:

T = constant

So, Boyle's law is applicable i.e

$P_1V_1 = P_2V_2$

Q.73 Answer is "A"

Solution:- As $Q = W + \Delta U$ putting Q=0

$0 = W + \Delta U$

$W = -\Delta U \Rightarrow$ Adiabatic Expansion

$-W = \Delta U \Rightarrow$ Adiabatic Compression

$-\Delta U \Rightarrow$Adiabatic expansion

$\Delta U \Rightarrow$Adiabatic compression

Q.74 Answer is "B"

Solution:- Among "A" and "B" the curve in option B is steeper, so it is adiabat.

Q.75 Answer is "A"

Solution:-

$$(\text{Slope})_{\text{Isotherm}} = \frac{-P}{V}$$

$$(\text{Slope})_{\text{Adiabat}} = -\frac{\gamma P}{V}$$

Taking ratio:

$$\frac{(Slope)_{adiabat}}{(Slope)_{isotherm}} = \gamma$$

Q.76 Answer is "B"

Solution:- For isochoric process $\Delta V = 0$ and $W = P\Delta V = 0$.

Q.77 Answer is "D"

Solution:- $C_P - C_V = R \longrightarrow (1)$

$$\gamma = \frac{C_p}{C_v}$$

$$C_p = \gamma C_v \qquad C_v = \frac{C_p}{\gamma}$$

Put these values after other in (1) and solve.

Q.78 Answer is "C"

Solution:- For isobaric process

$Q_P = W + \Delta U$

$C_P \Delta T = P\Delta V + \Delta U$

$C_P \Delta T = P\Delta V + C_V \Delta T$

STEP

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