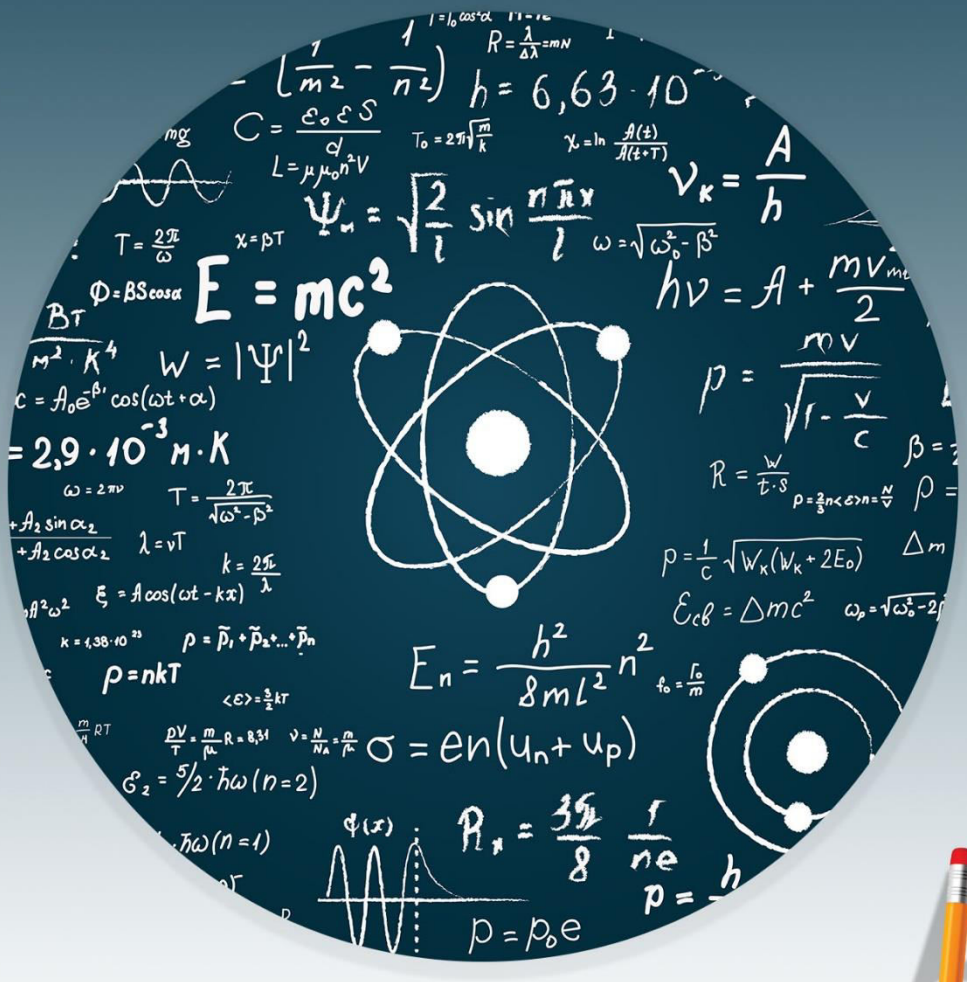
PHYSICS



WORKSHEET-14

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-14

Topics:- Work, Kinetic & Potential Energy, Gravitational P.E, Inter Conversion of K.E & P.E, Power, Implications of energy losses in practical devices

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.

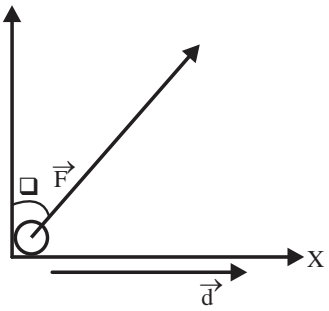
A) May increase C) Must increase

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) $20\ m\ s^{-1}$

USE THIS SPACE FOR SCRATCH WORK

Q.25 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

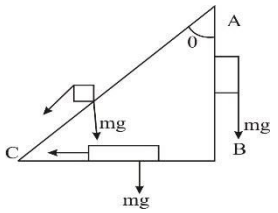
B) 15 W D) 45 W

Q.26 The engine of the car applies force of 2000 N by which it

moves with uniform velocity of 72 km h^{-1}. The power delivered by engine is:

A) 2 kW
B) 40 kW
C) 44 kW
D) 144 kW

Q.27 A body is displaced in a gravitational field as shown in the figure the work done from A to C is:

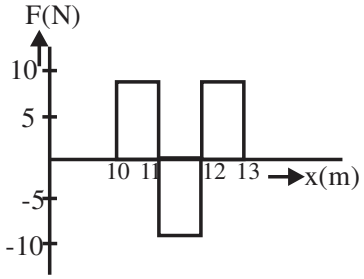


A) Greater than the work done from A to C via B
B) Equal to the work done from A to C via B
C) Less than the work done from A to C via B
D) Double of the work done from A to C via B

Q.28 A brick of mass 2 kg is dropped from rest position 12 m above the ground. At height 7 m above ground its velocity is:

A) 49 m s^{-1}
B) 7 m s^{-1}
C) 12 m s^{-1}
D) 10 m s^{-1}

Q.29 The figure shows the force distance curve of a body moving along a straight line. The work done by the forces:



A) 10 J
B) 20 J
C) 30 J
D) 40 J

Q.30 A force of $2\hat{i}+4\hat{j}+6\hat{k}$ N gives displacement of 10 $\hat{j}$ m. The work done is:

A) 20 J
B) 26 J
C) 40 J
D) Zero

Q.31 When the mass and speed of a body are doubled, K.E of body?

A) Becomes 4 times
B) Becomes 6 times
C) Becomes 8 times
D) Unchanged

Q.32 A stationary particle explodes into two particles of

masses m_1 and m_2 which move in opposite directions with velocities v_1 and v_2. The ratio of their kinetic energies is:

A) 1

C) $\frac{m_1 v_2}{m_2 v_1}$

B) $\frac{m_2}{m_1}$

D) $\frac{m_1}{m_2}$

Q.33 If the K.E of a particle is quadrupled its momentum will:

A) Remain same
C) Be quadrupled
B) Be doubled
D) Be half

Q.34 Which one is not a unit of power?

A) Horse power
C) Watt
B) Electron volt
D) kW

Q.35 1 horse power is equal to:

A) 746 J
C) 746 W
B) 746 kWh
D) 746 MWh

Q.36 Which one is the bigger unit of work?

A) 10 watt hour
C) electron volt
B) 10 electron volt
D) kilo watt hour

Q.37 A body falls freely under gravity. Its velocity is v when it has lost a potential energy of U. The mass of the body is:

A) $\frac{2U}{v^2}$

C) $\frac{U}{2v^2}$

B) $\frac{U}{v^2}$

D) $v \times U$

Q.38 A force of 10 N acts on the body and body moves 10 m distance perpendicular to it. Work done by the force on the body is:

A) 10 J
C) Zero
B) 100 J
D) Infinite

Q.39 A force of 1500 N is acting horizontally on a vehicle of mass 200 kg and the vehicle starts its motion from rest. What will be the speed of the vehicle when it covers a distance of 30 m?:

A) 17 m s^{-1}
C) 25 m s^{-1}
B) 21 m s^{-1}
D) 10 m s^{-1}

Q.40 A man pulling a bag with force of 15 N at angle 60^o with horizontal plane. If bag covers a distance of 10 m, then work done by the man is:

A) 50 J
C) 75 J
B) 100 J
D) 150 J

Q.41 The area under a curved shape in a force and displacement graph shows that:

A) Work under a constant force
B) Work under a variable force
C) Work under a maximum force
D) Work under a minimum force

Q.42 A bullet of mass 20 g is fired with velocity of 2000 m s^{-1}, the K.E of the bullet is:

A) 2000 J
B) 20000 J
C) 4000 J
D) 40000 J

Q.43 What is the power of an electric motor when it consumes energy of 9×10^3 J in 3 s?

A) 1 hp
B) 3 hp
C) 2 hp
D) 4 hp

Q.44 Absolute potential energy of a body at the surface of the earth is:

A) $\frac{Gm}{R}$
B) $-\frac{GmM}{R}$
C) $-\frac{Gm}{R}$
D) $-\frac{GmM}{R^2}$

Q.45 Which force is a non-conservative?

A) Gravitational force
B) Electrostatic
C) Friction force
D) Magnetic force

Q.46 One megawatt hour is equal to:

A) 3.6×10^7 J
B) 3.6×10^{12} J
C) 3.6×10^9 J
D) 3.6×10^{18} J

Q.47 The relation for the efficiency of a device is:

A) $\frac{Output\ Energy}{Input\ Energy}\times 100\%$

B) $\frac{Input\ Energy}{Output\ Energy}\times 100\%$

C) $\frac{Input\ Energy}{Energy\ wasted}\times 100\%$

D) $\frac{Wasted\ Energy}{Output\ Energy}\times 100\%$

Q.48 All practical machines and devices have efficiency:

A) Equal to 100%
B) Less than 100%
C) More than 100%
D) Equal to zero

Q.49 In case when friction force cannot be ignored, the work done on a system is equal to (where ΔE_{mech} is the change in energy of system and ΔE_{therm} is the energy wasted due to presence of friction):

A) $\Delta E_{mech}-\Delta E_{therm}$

B) ΔE_{mech}

C) $\Delta E_{mech}+\Delta E_{therm}$

D) $\Delta E_{mech} - \Delta E_{therm}^2$

Q.50 Work done against friction is definitely converted into:

A) Kinetic energy
B) Potential energy
C) Mechanical energy
D) Heat or thermal energy

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

SOLUTIONS

Unit – 2 (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 θ<90°
- W=-ve , if θ>90°
- W=0=minimum , if θ=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:- 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.26 Answer is "B"

Solution:-

$$P = Fv = (2000)\left(\frac{72\times1000}{3600}\right) = 40000W$$

Q.27 Answer is "B"

Solution:- Work done is independent of path followed in gravitational field

Q.28 Answer is "D"

Solution:-

$$v = \sqrt{2g(h_1 - h_2)} = \sqrt{2(10)(12-7)}$$

$$v = \sqrt{2\times10\times5} = 10ms^{-1}$$

Q.29 Answer is "A"

Solution:-

Work done = area under F-x graph

Work done = (11-10)(10)+(12-11)(-10)+(13-12)(10)

Work done = 10 J

Q.30 Answer is "C"

Solution:-

$$W = F_x d_x + F_y d_y + F_z d_z$$

$$W = (2)(0)+(4)(10)+(6)(0)$$

$$W = 40J$$

Q.31 Answer is "C"

Solution:-

$$K.E = \frac{1}{2}mv^2 \Rightarrow K.E \propto m, K.E \propto v^2$$

Q.32 Answer is "B"

Solution:-

By conservation of momentum, both particles must have same momentum i.e. $p_1=p_2=p$

$$K.E = \frac{p^2}{2m} \Rightarrow K.E \propto \frac{1}{m}(p = same)$$

$$\frac{K.E_1}{K.E_2} = \frac{m_2}{m_1}$$

Q.33 Answer is "B"

Solution:-

$$K.E = \frac{p^2}{2m} \Rightarrow p = \sqrt{2mK.E}$$

Q.34 Answer is "B"

Solution:-

- 1 horse power = 746 W
- 1 kilo watt = 1000 W
- 1 electron volt = 1.6×10^{-19} J

Q.35 Answer is "C"

Solution:-

- 1 horse power = 746 W
- 1 kilo watt = 1000 W
- 1 electron volt = 1.6×10^{-19} J

Q.36 Answer is "D"

Solution:-

- 10 Wh = 10×3600 Ws = 3.6×10^3 J
- 10 eV = $10\times1.6\times10^{-19}$ J = 1.6×10^{-18} J
- 1 kWh = 3.6×10^6 J

Clearly, kWh is bigger unit than other units given in options

Q.37 Answer is "A"

Solution:- Loss in P.E = Gain in K.E

$$U = \frac{1}{2}mv^2$$

$$m = \frac{2U}{v^2}$$

Q.38 Answer is "C"

Solution:-

$W = Fd\cos\theta = (10)(10)\cos90° = 0$

Q.39 Answer is "B"

Solution:-

$$W = K.E_f - K.E_i$$

$$W = \frac{1}{2}mv_f^2 - \frac{1}{2}m(0)^2$$

$$W = \frac{1}{2}mv_f^2$$

$$v_f = \sqrt{\frac{2W}{m}} = \sqrt{\frac{2Fd}{m}} = \sqrt{\frac{2\times(1500)(30)}{200}}$$

$$v_f = 21\ m\ s^{-1}$$

Q.40 Answer is "C"

Solution:-

$$W = Fd\cos\theta = (15)(10)\cos 60° = 75J$$

Q.41 Answer is "B"

Solution:- Area under a curved graph gives work done by variable force.

Q.42 Answer is "D"

Solution:-

$$K.E = \frac{1}{2}mv^2 = \frac{1}{2}\left(\frac{20}{1000}\right)(2000)^2$$

$$K.E = 40000J$$

Q.43 Answer is "D"

Solution:-

$$P = \frac{Energy}{time} = \frac{9\times10^3}{3} = 3000W$$

$$P = \frac{3000}{746}hp = 4hp$$

Q.44 Answer is "B"

Solution:- $U = -\frac{GmM}{R}$

Q.45 Answer is "C"

Solution:- Friction force is non-conservative.

Q.46 Answer is "C"

Solution:- 1 MWh = 3.6×10^9 J

Q.47 Answer is "A"

Solution:-

$$\eta = \frac{\text{output energy}}{\text{input energy}}\times100\%$$

Q.48 Answer is "B"

Solution:- All practical devices have efficiency less than 100% because of energy losses against frictional forces.

Q.49 Answer is "C"

Solution:- In Case of friction

$$W = \Delta E_{mech} + \Delta E_{therm}$$

Q.50 Answer is "D"

Solution:- Work done against friction is converted into heat or thermal energy.

STEP

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