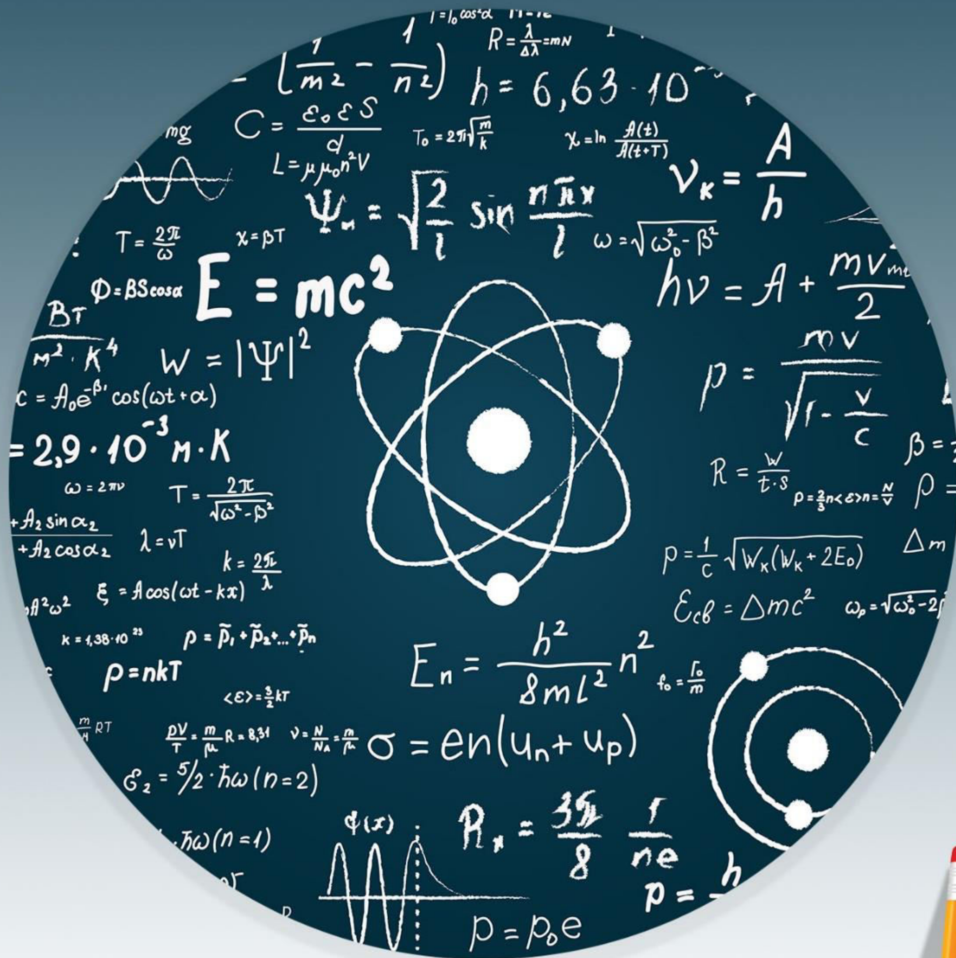
PHYSICS



WORKSHEET-5

A PROJECT BY PUNJAB GROUP

Worksheet-05

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

USE THIS SPACE FOR SCRATCH WORK

Q.1 The value of permeability of free space in S.I unit is:

A) $4\pi\times10^{7}\,Wb\,A^{-1}\,m^{-1}$
C) $4\pi\times10^{-10}\,Wb\,A^{-1}\,m^{-1}$
B) $4\pi\times10^{-7}\,Wb\,A^{-1}\,m^{-1}$
D) $4\pi\times10^{10}\,Wb\,A^{-1}\,m^{-1}$

Q.2 The magnetic field along the axis of solenoid with N turns carrying a current I is given by:

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

Q.3 In case of solenoid if it is cut into equal parts then "n" becomes:

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

Q.4 Generalized form of Ampere's law is given by:

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

Q.5 The magnetic induction at a distance r from an infinitely long straight wire, carrying current I, is given by:

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

Q.6 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.7 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

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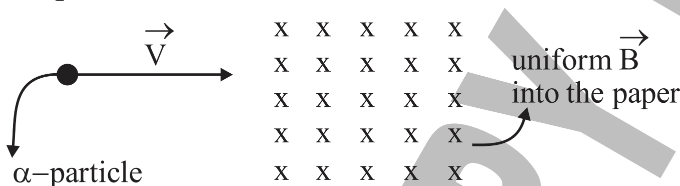
Q.8 A magnetic field is applied on an electron at rest then it will:

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

Q.9 A charge particle is projected perpendicular into a region of $\vec{B}$ such that before entering it's $K.E = 6\text{ eV}$, 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.10 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
B) Anti-clock wise
C) Along axis of rotation
D) It has no torque

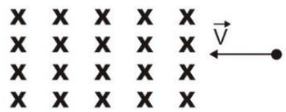
Q.11 An electron is injected into a uniform magnetic field with components of velocity parallel to and normal to the field direction. The path of the electron is a:

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

Q.12 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) $\frac{B}{E}$
B) EB
C) $\frac{E}{B}$
D) $\frac{E^2}{B}$

Q.13 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.14 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.15 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.16 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) $B = 4\mu_\circ nI$

Q.17 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.18 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

USE THIS SPACE FOR SCRATCH WORK

Q.19 If electron passes through axis of solenoid then electromagnetic force on electron will be:

A) Towards the outward
B) Parallel to its motion
C) Towards the inward
D) No force acts on it

Q.20 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
B) 1:2
C) 2:1
D) 4:1

Q.21 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
B) 25 A
C) 10 A
D) 14.5 A

Q.22 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}
B) 3.3×10^{4} m s^{-1}
C) 2.3×10^{4} m s^{-1}
D) 4.6×10^{5} m s^{-1}

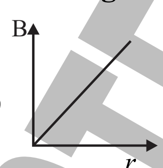
Q.23 The magnetic field lines in the middle of a solenoid are:

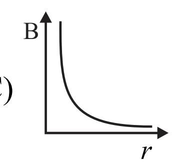
A) Circles
B) Parallel to axis
C) Spiral
D) Perpendicular to axis

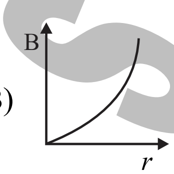
Q.24 If some current is passed in a spring, then the spring:

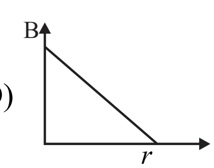
A) Gets expanded
B) Gets compressed
C) Oscillates
D) Remains unchanged

Q.25 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) 

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Q.26 **Magnetic flux passing through a surface area will be half of maximum value when:**

A) $\vec{A}$ makes 60° with $\vec{B}$
B) $\vec{A}$ makes 30° with $\vec{B}$
C) $\vec{A}$ makes 45° with $\vec{B}$
D) $\vec{A}$ makes 0° with $\vec{B}$

Q.27 **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°
B) 45°
C) 60°
D) 75°

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

SOLUTIONS

Unit – 8 (WS-05)

Q.1 Answer is "B"

Solution:- Permeability of free space is given as:

$\mu_\circ = 4\pi\times10^{-7}\,Wb\,A^{-1}\,m^{-1}$

Q.2 Answer is "A"

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

Q.3 Answer is "B"

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

Q.4 Answer is "B"

Solution:-

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

Q.5 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.6 Answer is "B"

Solution:- Magnetic field inside solenoid is given as:

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

Q.7 Answer is "A"

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

Q.8 Answer is "C"

Solution:- When electron is at rest, v=0 then, $F=evB\sin\theta=0$

Q.9 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.10 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.11 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.12 Answer is "C"

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

Q.13 Answer is "A"

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

Q.14 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.15 Answer is "C"

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

Q.16 Answer is "C"

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

Q.17 Answer is "B"

Solution:- For straight wire;

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

Q.18 Answer is "D"

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

$$F = qvB\sin 90° = qvB = \max$$

Q.19 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.20 Answer is "A"

Solution:-

$$q\cancel{v}B = \frac{mv^{\cancel{2}}}{r}$$

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

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

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.21 Answer is "A"

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

Q.22 Answer is "B"

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

Q.23 Answer is "B"

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

Q.24 Answer is "B"

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

Q.25 Answer is "C"

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

Q.26 Answer is "A"

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

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

Q.27 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

$$\alpha = 90° - \theta$$

STEP

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