



# Aakash

Medical | IIT-JEE | Foundations

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Sector- 18, Udyog Vihar, Gurugram, Haryana - 122015

## Mock Test Paper for Class-XII

Time: 3 hrs.

Max. Marks: 70

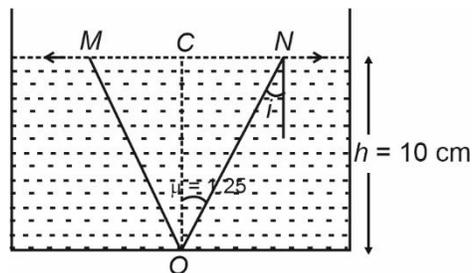
### PHYSICS (Code-A)

#### Answers & Solutions

1. Answer (a) [1]  
0.18 A  
$$I = \frac{\Delta Q}{\Delta t}$$
2. Answer (d) [1]  
$$B' = \frac{\lambda D}{d} = \frac{\lambda \times 2}{3d} = 2/3 B$$
3. Answer (b) [1]  
Current flow in the coil  
$$I\theta = NIAB$$
  
$$\frac{\theta}{I} = \frac{NAB}{I}$$
4. Answer (b) [1]  
45°  
$$\tan \phi = \frac{X_L}{R} = \frac{\omega L}{R} = 1$$
5. Answer (c) [1]  
$$\frac{\mu_0 I_1 I_2}{2\pi d}$$
 attractive  
$$F = Bil$$
6. Answer (a) [1]  
$$\frac{1}{F} = -\frac{1}{2f} + \frac{1}{f} = \frac{1}{2f}$$
  
$$\therefore F = 2f$$

7. Answer (c) [1]  
 +y-axis  $\frac{2\pi}{\lambda}$
8. Answer (c) [1]  
 $\frac{-13.6}{n^2} = -3.4 \text{ eV}$
9. Answer (c) [1]  
 $L = \frac{nh}{2\pi}$   
 $n = 3$   
 $\therefore L = \frac{3h}{2\pi}$
10. Answer (c) [1]  
 $20 \mu\text{F}$   
 $C = \frac{A\epsilon_0}{d}$
11. Answer (d) [1]  
 Zero as  $\phi = \frac{q}{\epsilon_0}$
12. Answer (b) [1]  
 $4 : 1$   
 $B = \frac{\mu_0 I}{2R}$
13. Answer (a) [1]  
 Both 'A' & 'R' are true and 'R' explains 'A'.
14. Answer (a) [1]  
 Both 'A' & 'R' are true and 'R' explains 'A'.
15. Answer (c) [1]  
 'A' is true, R is false.
16. Answer (d) [1]  
 Both 'A' and R are false.
17. When angle of incidence > critical angle light reflects back in the medium.  
 (a) So  $\mu = 1.25 = \frac{1}{\sin i_c}$   
 Or  $\frac{1}{\sin i_c} = \frac{1}{1.25} = \frac{4}{5} = 0.8$   
 $\therefore \angle i_c = 53^\circ$  [½]

So,  $\angle i_c = 53^\circ$  approx.



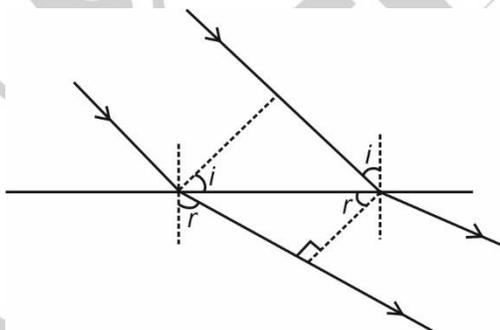
[1/2]

(b) From geometry fig.  $\tan i_c = \frac{\sin i_c}{\cos i_c} = \frac{CN}{OC} = \frac{r}{h} \rightarrow \text{radius}$

[1]

$$\frac{r}{h} = \frac{1}{\frac{\mu}{\sqrt{1-1/\mu^2}}} = \frac{1}{\sqrt{\mu^2-1}} \quad \text{or} \quad \boxed{r = \frac{h}{\sqrt{\mu^2-1}}} = \frac{10 \text{ cm}}{\sqrt{9}} = \frac{10 \times 4}{3} \text{ cm}$$

18. **Huygen's Principle** : Each point on a wave act as a source of secondary wavelets travelling in forward direction. [1+1]



19. (a) E.M. wave [1+1]

- (i) Suitable for RADAR system – Micro wave
  - (ii) Sometime referred as heat wave – Infra-red Rays
- Their wavelength range  $\rightarrow$  Microwave 1 mm to 10 cm  
 Their wavelength range  $\rightarrow$  Infrared 1 mm to 700 nm

OR

- (b) **Two characteristics of E.M. wave** [1+1]

- E.M. waves are transverse wave in nature.
- E.M. wave does not get deflected when passes through electric or magnetic field.

Radiation used to kill germs in water purifier  $\rightarrow$  Ultraviolet

Rays. (U.V. Rays) frequency range  $10^{15}$  Hz to  $10^{17}$  Hz

20.  $\phi = NBA$  [1+1]

$$\pi \times 10^{-5} = 1000 \times 1 \times \pi r^2$$

$$r = 10^{-4} \text{ m}$$

21. Crystalline solid contain large number of atoms and they are brought close and begin to attract each other consequently energy level of valance electros modified and collection of large number of closely spaced energy level is formed. [2]

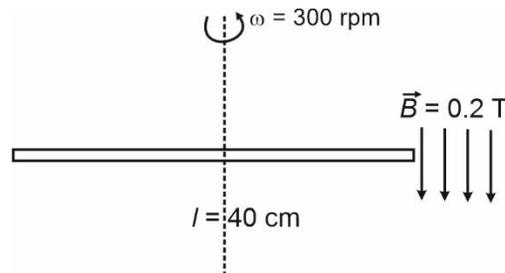
22. Given  $B = 0.2$  T directed vertically downward

[1+1+1]

$$l = 40 \text{ cm so radius of rotation } r = \frac{l}{2} = 20 \text{ cm} = 20 \times 10^{-2} \text{ m}$$

$$f = \frac{300}{60} = 5$$

$$\omega = 2\pi f = 10\pi$$



Potential between centre and one end

$$\begin{aligned} \text{We know induce emf develop } \varepsilon &= \frac{1}{2} B\omega r^2 \\ &= \frac{1}{2} \times 0.2 \times 10\pi \times 20 \times 20 \times 10^{-4} \\ &= 0.04\pi = 0.126 \text{ V} \end{aligned}$$

$\therefore$  Total potential between end is zero.

OR

Given side of coil  $a = 10$  cm

[1+1+1]

$$\therefore \text{Area} = a^2 = 100 \times 10^{-4} \text{ m}^2$$

$$N = 100, B = 100 \text{ mT} = 100 \times 10^{-3} \text{ T}$$

$$\theta = 90^\circ \text{ and } dt = 0.2 \text{ s}$$

$$\text{So, induced emf } \varepsilon = \frac{d\phi}{dt} = \frac{d}{dt} (B.A.)$$

$$\text{Or } N.B. \frac{dA}{dt} = \frac{100 \times 100 \times 10^{-3} \times 100 \times 10^{-4}}{0.2} = 0.5 \text{ volt}$$

23. (a) 1 atomic mass unit =  $1.66 \times 10^{-27}$  kg

[1½]

Using Einstein mass energy equivalence  $E = mc^2$

$$E = 1.66 \times 10^{-27} \times (3 \times 10^8)^2 = 1.66 \times 9 \times 10^{-11} \text{ joule}$$

Now, 1 eV =  $1.602 \times 10^{-19}$  joule

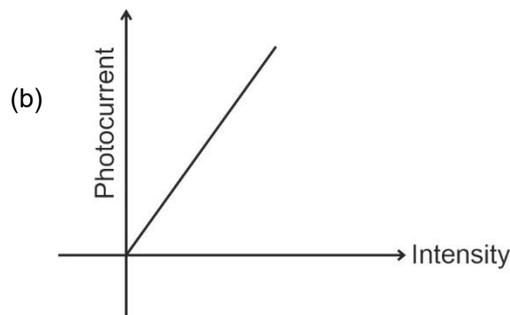
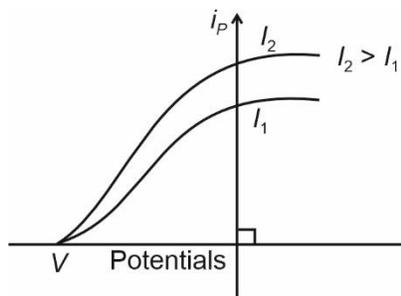
$$1u = \frac{1.66 \times 9 \times 10^{-11}}{1.602 \times 10^{-19}} = 9.315 \times 10^8 \text{ eV} = 931.5 \text{ MeV}/c^2$$

(b) Given mass of ball  $m = 0.5$  kg

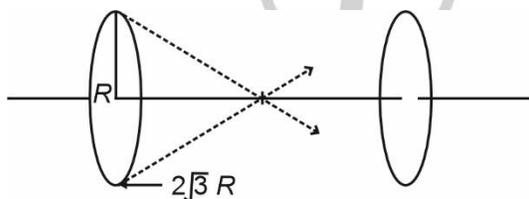
[1½]

$$\begin{aligned} \text{So, energy equivalent in eV} &= \frac{0.5 \times (3 \times 10^8)^2}{1.602 \times 10^{-19}} \\ &= \frac{4.5 \times 10^{35}}{1.602} \text{ eV} \\ &= 2.81 \times 10^{35} \text{ eV} \end{aligned}$$

24. (a) The two curves meet at axis of potential show that the kinetic energy of the photoelectrons is independent of the intensity of radiation as they have the same stopping potential. [2+1]



25. Given



[1+1+1]

The mid-point lies on the axis passing from the centre of each we know that magnetic field produce by current coil on its axis.

$$B = \frac{\mu_0 I R^2}{2(x^2 + R^2)^{3/2}}$$

So, field due to coil 1

$$x = \sqrt{3} R$$

$$B_1 = \frac{\mu_0 N I R^2}{2 \times 8 R^3}$$

$$B_1 = \frac{\mu_0 N I}{16 R}$$

Same is the magnetic field produced by other coil.

So, net magnetic field  $B = B_1 + B_2$

$$= \frac{\mu_0 N I}{8 R} \text{ (Along the axis of the coils)}$$

26. Given the charges are placed on x-axis having co-ordinate  $(-4, 0, 0)$  and  $(5, 0, 0)$ . Electric field  $E = \frac{A}{r^2}$ , where

$A = 2 \times 10^6 \text{ N/C}$  and  $\vec{r}$  is position vector. [1+1+1]

$\therefore$  Potential energy of system is sum of potential energy due to external field and P.E. due to two charges.

So, net potential energy  $U = U_1 + U_2 + U_3$

Potential due to external field :

$$V = \int_{\infty}^r \mathbf{E} \cdot d\mathbf{r}$$

$$V = \frac{A}{r}$$

$$U_1 + U_2 = \frac{A}{r_1} q_1 + \frac{A}{r_2} q_2$$

$$U_1 + U_2 = 1300 \text{ J}$$

$$\text{and } U_3 = \frac{1}{4\pi\epsilon_0} \frac{q_1 \times q_2}{(r_{12})} = \frac{9 \times 10^9 \times 10 \times 10^{-6} \times 20 \times 10^{-6}}{9 \times 10^{-2}} = 200 \times 10^{-1} = 2000 \times 10^{-2} \text{ J}$$

So, net P.E.  $U = 1320 \text{ J}$

27. When a charge particle moves in a magnetic field may act on it  $F = qB.v\sin\theta$ , where  $\theta$  is angle with direction of  $\vec{B}$  in which charges enters. [1+1+1]

Mathematically,  $\vec{F} = q(\vec{v} \times \vec{B})$

Direction of this force is perpendicular to velocity giving circular motion to charge particle.

- (a) If  $\theta = 0^\circ$ , then

$$F = Bqv\sin 0^\circ = 0$$

So, charge particle moves in straight line path.

- (b) If  $\theta = 90^\circ$ , then

$$F = Bqv\sin 90^\circ = \text{maximum force}$$

$$\text{Here, } Bqv = \frac{mv^2}{r} \text{ or } v = \left(\frac{Bq}{m}\right) \times r$$

As the force is always perpendicular to its velocity charge particle will acquire circular path of radius depending on  $v$  and  $(q/m)$ .

- (c) If  $\theta = 120^\circ$ , then

$$\begin{aligned} F &= Bqv\sin 120^\circ \\ &= \frac{\sqrt{3}}{2} Bqv = \frac{mv^2}{r_1} \end{aligned}$$

$$\text{or } r_1 = \frac{\sqrt{3}mv}{2.Bq}$$

One component of the velocity is making it move in circle and other in straight line. So the trajectory will be helical.

## 28. Einstein Photoelectric Equation

Energy of photon ( $E_\nu$ ) = work function ( $\phi_0$ ) + Maximum K.E. of photoelectron

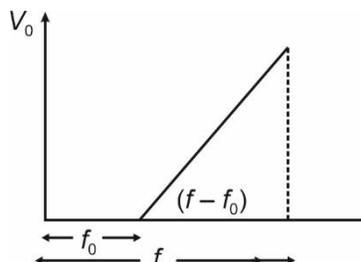
$$E = \phi_0 + \frac{1}{2} mV_{\max}^2$$

$$hf = hf_0 + \frac{1}{2} mV_{\max}^2 \text{ or } \boxed{h(f - f_0) = \frac{1}{2} mV_{\max}^2}$$

[1½]

- (i) From above equations, it is clear that if  $f = f_0$ , then K.E. will be zero. Hence photoelectric emission begins only if frequency of radiation is more than threshold frequency.
- (ii) Stopping potential ( $V_0$ ) provides stopping energy to electron emitted, i.e.,  $\frac{1}{2}mV_{\max}^2 = eV_0$

and  $\frac{1}{2}mV_{\max}^2 = h(f - f_0)$



[1½]

Hence,  $h(f - f_0) \propto V_0$

Graph varies linearly with slope =  $h/e = \text{constant}$

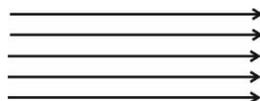
Planck's constant  $h = \frac{eV_0}{f - f_0}$

29. (i) → Answer (a) only B1 [1×4= 4]  
 (ii) → Answer (b) A, C (ii) OR → Answer (c) unidirectional with ripple but discontinuous.  
 (iii) → Answer (d) Holes, electrons  
 (iv) → Answer (c) 100 Hz

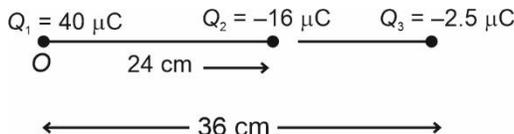
30. (i) → Answer (b)  $qd(\hat{i} + \hat{j})$  [1×4 = 4]  
 (ii) → Answer (c) 2  
 (iii) → Answer (a)  $2.5 \times 10^{-5}$  Nm  
 (iv) → Answer (c) ½ evr (iv) OR → Answer (b)  $5.0 \times 10^{-3}$  Am<sup>2</sup>

31. (i) Test charge (an arbitrary point charge) is used to consider the electrostatic force on this charge due to existing electric field  $F = q_0 \cdot E = \frac{1}{4\pi\epsilon_0} \frac{q_0q}{r^2}$ . We consider it small so that the actual charge will not move. [1+1+3]  
 (ii) When a small positive charge is free to move in an external electric field it will in the direction of electric field with acceleration  $a = \frac{q.E}{m}$ .

If the field is uniform then motion is uniformly accelerating. However if the field is nonuniform then motion will be non-uniform (acceleration not constant).



- (iii) According to the question,



Force on  $Q_3$  due to  $Q_1$   $F_{31} = \frac{1}{4\pi\epsilon_0} \frac{Q_1 \times Q_3}{(24+12)^2 \times 10^{-4}}$  attractive.

and on  $Q_3$  due to  $Q_2$  are  $F_{32} = \frac{1}{4\pi\epsilon_0} \frac{Q_2 \times Q_3}{(12 \times 10^{-2})^2}$  (repulsive)

$$\begin{aligned} \text{Net force } \vec{F}_{31} + \vec{F}_{32} &= \frac{1}{4\pi\epsilon_0} \left[ \frac{40 \times 2.5 \times 10^{-12}}{36 \times 36 \times 10^{-4}} - \frac{16 \times 2.5 \times 10^{-12}}{12 \times 12 \times 10^{-4}} \right] \\ &= \frac{9 \times 10^9 \times 10^{-12}}{10^{-4}} \left[ \frac{100}{12 \times 12 \times 9} - \frac{40}{12 \times 12} \right] \\ &= \frac{90}{12 \times 12} \left[ \frac{100}{9} - \frac{40}{1} \right] \\ &= \frac{10}{16} \times \left[ \frac{-360 + 100}{9} \right] = -\frac{260 \times 10}{16 \times 9} \text{ N, towards right repulsive} \end{aligned}$$

OR

(i) Capacitance of a parallel plate capacitor  $C = \frac{\epsilon_0 A}{d}$  [1½+1½+2]

(1) If plate area is doubled  $C' = \frac{\epsilon_0 \times 2A}{d} = 2C$

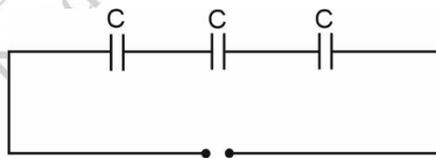
So, capacitance will be doubled

(2) When separation between plates ( $d$ ) is doubled  $C' = \frac{\epsilon_0 A}{(2d)} = C/2$  capacitance become half.

(ii) In series effective capacitance,

$$C_s = \frac{C}{3} = 1 \mu\text{F (given)}$$

So,  $C = 3 \mu\text{F}$  each



(1) When they are connected in parallel effective capacitance  $C_p = 3 \times C = 3 \times 3 \mu\text{F} = 9 \mu\text{F}$

(2) Energy stored in series  $U_1 = \frac{1}{2} C_s \times v^2$

Energy stored in Parallel  $U_2 = \frac{1}{2} C_p \times v^2$

$$\therefore \frac{U_1}{U_2} = \frac{C_s}{C_p} = \frac{1}{9} \Rightarrow \frac{U_p}{U_s} = 9$$

32. (a) A telescope has two main consideration while designing.

[1+1=2]

(i) Object lens should have larger focal length and aperture.

Eyepiece of lens should have smaller focal length, i.e., (large power)

For an objective of telescope,  $u = \infty$

$$\frac{1}{v_0} - \frac{1}{u_0} = \frac{1}{f_0} \Rightarrow v_0 = f_0$$

For eyepiece,  $v_e = \infty$

$$\frac{1}{v_e} - \frac{1}{u_e} = \frac{1}{f_e} \Rightarrow u_e = f_e$$

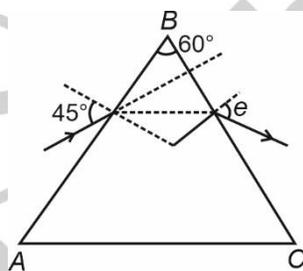
$$\therefore \text{Magnification} = \frac{v_0}{u_e} = \frac{f_0}{f_e}$$

$$m = \frac{f_0}{f_e}$$

(ii) Given  $\angle i = 45^\circ$  and  $\angle r = 30^\circ$

[3]

For symmetric passing,



$$\therefore \mu = \frac{\sin i}{\sin r} = \frac{1}{\sqrt{2} \times \frac{1}{2}} = \sqrt{2}$$

$$\text{Also, } \mu = \frac{\sin i}{\sin r} = \frac{\sin\left(\frac{A+\delta}{2}\right)}{\sin A/2}$$

$$\sqrt{2} = \frac{\sin\left(\frac{60+\delta}{2}\right)}{\sin A/2} = \sin\left(\frac{60+\delta}{2}\right) = \sqrt{2} \times \sin \frac{A}{2}$$

$$\sin\left(\frac{60+\delta}{2}\right) = \frac{1}{\sqrt{2}} \quad \therefore \sin 30 = \frac{1}{2}$$

$$\sin\left(\frac{A+\delta}{2}\right) = \sin 45^\circ \text{ giving } \frac{A+\delta}{2} = 45 \text{ or } \delta = 30^\circ$$

OR

(i) Using the space between two sharp razor blades we can observe diffraction pattern from large distance like bulb. [1]

(ii) Given when liquid is placed between lens and mirror a liquid lens also form which affects the focal length. The object should be at the centre of curvature of equivalent mirror. [4]

According to given condition when liquid is poured,

$$\frac{1}{45} - \frac{1}{f_1} + \frac{1}{f_2} \quad \dots(i), \text{ where } f_1 \rightarrow \text{focal length of original lens}$$

$f_2 \rightarrow$  focal length of liquid lens

And when liquid is random  $\frac{1}{30} = \frac{1}{f_1}$

$$\text{So, } \frac{1}{f_1} = (\mu_g - 1) \left[ \frac{2}{R_1} \right]$$

$$\frac{1}{30} = (1.5 - 1) \times \frac{2}{R_1} \Rightarrow R_1 = 30 \text{ cm}$$

As  $\frac{1}{R_2} = 0$  ( $\because$  plane of the significance surface influence)

$$\text{Now, } \frac{1}{f_2} = \left( \mu_2 - 1 \right) \times \frac{1}{-R_1}$$

$$\text{But } \frac{1}{f_2} = \frac{1}{45} - \frac{1}{30}$$

$$(\mu_2 - 1) \times \left( \frac{1}{R_1} \right) = \frac{1}{45} - \frac{1}{30}$$

$$= \frac{2-3}{90} = \frac{-1}{90}$$

$$(\mu_2 - 1) \times \left( -\frac{1}{30} \right) = \frac{-1}{90} \Rightarrow (\mu_2 - 1) = \frac{1}{3} \quad \therefore \mu_2 = \frac{4}{3}$$

33. (a) (i) Work done by magnetic field is zero on the charge particle. Therefore, the speed will be same. [1]

(ii) Given  $B = 6 \times 10^{-4} \text{ T}$  [4]

$$v = 3 \times 10^6 \text{ m/s}$$

$$\theta = 90^\circ$$

$$\text{So, force } Bqv \sin 90^\circ = \frac{mv^2}{r}$$

$$\therefore r = \frac{mv}{Bq}$$

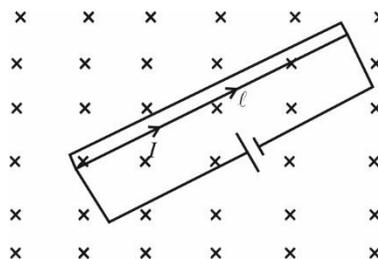
$$\therefore r = \frac{m}{Bq} \times v$$

$$r = 2.8 \text{ cm}$$

$$E = \frac{1}{2} mv^2 = 25.59 \text{ eV}$$

OR

(b) (i) Consider a conductor carrying  $I$  current kept in a magnetic field. Let number of electron flow/ $m^3$  in conductor be  $n$ . [3+2]



Imagine a small length ( $dx$ ) of conductor of cross sectional area  $A$ .

$\therefore$  Volume of element =  $A dx$

This charge flow in magnetic field  $B$  so a force.

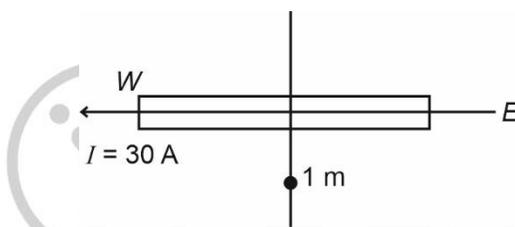
$$\int_0^l (nAdx) \times e \cdot v \cdot B \sin \theta$$

$$(neAv) \times \sin \theta \int_0^l dx$$

$$F = BI l \sin \theta$$

$\therefore I = (neAv)$ , here  $v$  is drift velocity of electrons

(ii) Field due to current wire



$$B = \frac{\mu_0 I}{2\pi r}$$

$$= \frac{4\pi^2 \times 10^{-7} \times 30}{2\pi \times 1 \text{ m}} = 6.0 \times 10^{-6} \text{ T directed outward}$$

