B.K. BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL

NABET

INDIAN PUBLIC SCHOOLS' CONFERENCE

PREBOARD-III EXAMINATION (2025-26)

PHYSICS (042) (SET-II) **MARKING SCHEME**

Class: XII **Max Marks70** **Time: 3hrs**

SECTION A

1.	(a)	1
2.	(c) 5:27	1
3.	(b) hc/2λ.	1
4.	(b) 20cm away from the +4q charge	1
5.	(a) planes parallel to y-z plane	1
6.	(c) 6 : 5	1
7.	(a) $5 \times 10^2\ Am^2$	1
8.	(c) 32μC	1
9.	(a) larger in case (i)	1
10.	(a) The frequency of the microwaves must match the resonant frequency of the water molecules.	1
11.	(d) r/(√k)	1
12.	(d) $1/2\pi f(2\pi f_L + R)$	1
13.	(a) Both A and R are true and R is the correct explanation of A	1
14.	(a) Both A and R are true and R is the correct explanation of A	1
15.	(c) A is true but R is false	1
16.	(a) Both A and R are true and R is the correct explanation of A	1

SECTION B

17.

a sin θ = path difference = λ

sin θxθ for small angles

$$\theta = \frac{n\lambda}{a}$$

$$\frac{y}{D} = \tan\theta \equiv \theta$$

$$y = D\theta = \frac{n\lambda D}{d}$$

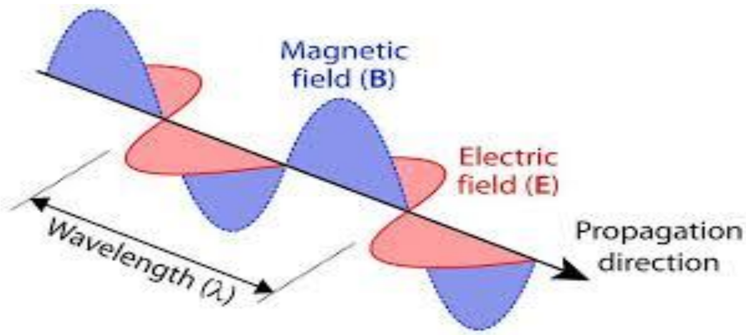
y is position of maxima

fring width = difference between maxima

$$= \frac{\lambda D}{d}$$

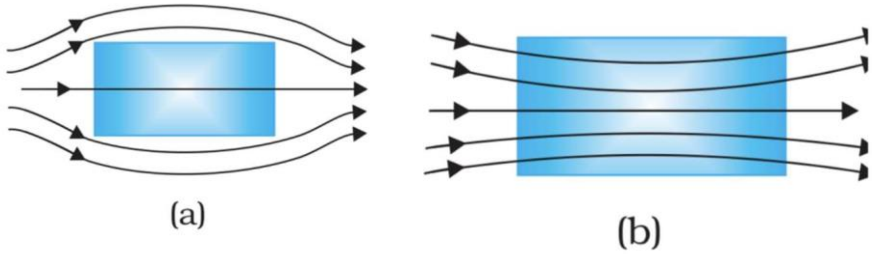
OR

18. 2



2

19.



a - diamagnetic ½

b- paramagnetic ½

The magnetic susceptibility of A is small negative and that of B is small positive. (½+½)

20.

$$p = \frac{h}{\lambda} = \frac{6 \cdot 63 \times 10^{-34}}{1 \cdot 00 \times 10^{-9}} = \mathbf{6 \cdot 63 \times 10^{-25}\ kg\ ms^{-1}}$$

(ii) Energy of photon, $E = h\nu = h \cdot \frac{c}{\lambda} = \frac{h}{\lambda} c$

$$= pc = 6 \cdot 63 \times 10^{-25} \times 3 \times 10^{8}\ \text{J} = 19 \cdot 89 \times 10^{-17}\ \text{J}$$

$$= \frac{19 \cdot 89 \times 10^{-17}}{1 \cdot 6 \times 10^{-19}}\ \text{eV} = 1 \cdot 24 \times 10^{3}\ \text{eV} = \mathbf{1 \cdot 24\ keV}$$

(iii) Kinetic energy of electron $E_k = \frac{1}{2} m_e v^2 = \frac{p^2}{2m_e}$

$$= \frac{(6 \cdot 63 \times 10^{-25})^2}{2 \times 9 \cdot 1 \times 10^{-31}}\ \text{J}$$

$$= 2 \cdot 42 \times 10^{-19}\ \text{J} = \frac{2 \cdot 42 \times 10^{-19}}{1 \cdot 6 \times 10^{-19}}\ \text{eV} = \mathbf{1 \cdot 51\ eV}$$

Ep/Ee= 1240/1.51=825

2

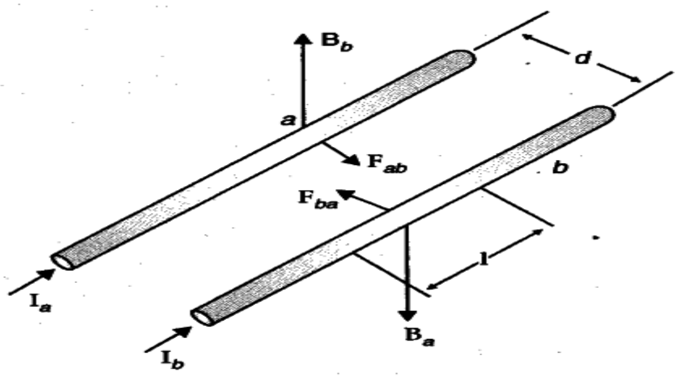
21. **(i) Existence of Threshold Frequency:** Wave theory suggests any frequency of light, if intense enough, should eventually provide enough energy for electron emission, but experimentally, if the light's frequency is below a specific minimum (threshold frequency), no electrons are emitted, no matter how bright the light.
(ii) **Kinetic Energy vs. Intensity:** Wave theory predicts that increasing light intensity (amplitude of the wave) should increase the energy of the emitted electrons, but in reality, the maximum kinetic energy of photoelectrons depends only on the light's frequency, not its intensity; intensity only changes the *number* (rate) of emitted electrons. 2

SECTION- C

22.

Similarly,

$$F_{ab} = I_1 . l \frac{\mu_0 I_2}{2\pi d}$$



$$B_a = \frac{\mu_0 I_a}{2\pi d}$$

since $$\vec{F} = i(\vec{l} \times \vec{B})$$

$$F_{ba} = I_1 . l \frac{\mu_0 I_2}{2\pi d}$$

Similarly,

$$F_{ab} = I_1 . l \frac{\mu_0 I_2}{2\pi d}$$

2

The ampere is the value of that steady current which, when maintained in each of the two very long, straight, parallel conductors of negligible cross-section, and placed one metre apart in vacuum, would exert on each of these conductors a force equal to 2×10^{-7}newtons per metre of length. 1

23. (a) 2

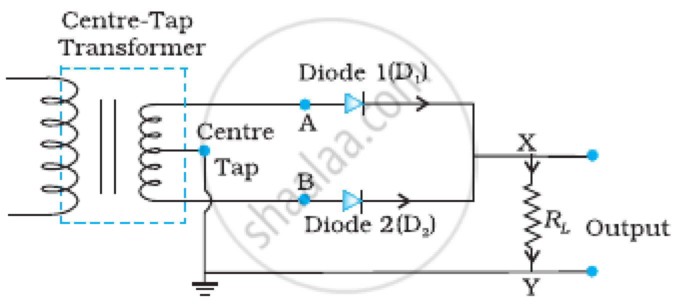
$= mvr$ is an integral multiple of $\frac{h}{2\pi}$ i.e.

$$L = mvr = \frac{nh}{2\pi} \text{ or } 2\pi r = \frac{nh}{mv} = \frac{nh}{p}$$

or $2\pi r = n\lambda$, where $\lambda = \frac{h}{p}$, from de–Broglie's relation.

(b) For a hydrogen atom starting in the third excited state (n=4) and transitioning to the ground state (n=1), the maximum number of spectral lines emitted is 1

24.



2

A full-wave rectifier converts both halves of an AC cycle into pulsating DC using two diodes and a center-tapped transformer, ensuring current flows in the same direction through the load resistor (RL) for both positive and negative input halves, resulting in a smoother DC output than a half-wave rectifier, with its output frequency being **twice** the input frequency $f_{out}=2f_{in}$, because it utilizes both positive and negative cycles to create full-wave pulsations. 1

25.

$$\therefore \frac{2q^2}{4\pi\varepsilon_0 x^2} = \frac{6q^2}{4\pi\varepsilon_0 (d+x)^2}$$

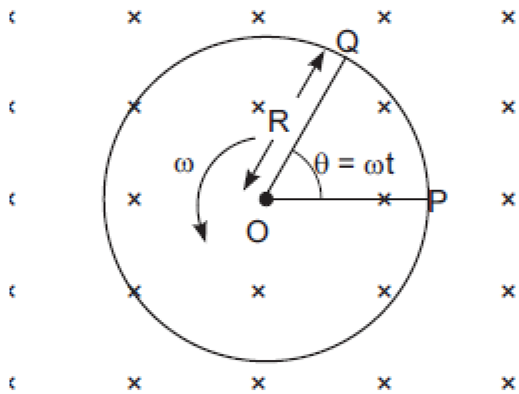
$$\therefore (d + x)^2 = 3x^2$$

$$\therefore 2x^2 - 2dx - d^2 = 0$$

$$x = \frac{d}{2} \pm \frac{\sqrt{3}d}{2}$$

3

26.



1

The area of the sector $OPQ = \pi R^2 \times \frac{\theta}{2\pi} = \frac{1}{2}R^2\theta$

where R = Radius of the circle.

Hence $\varepsilon = B \times \frac{d}{dt}\left(\frac{1}{2}R^2\theta\right) = \frac{1}{2}BR^2\frac{d\theta}{dt} = \frac{B\omega R^2}{2}$

2

27.

(*i*) Given : $\nu = 6.0 \times 10^{14}$ Hz, $P = 2.0 \times 10^{-3}$ W

Energy of one photon = $h\nu$

$= (6.6 \times 10^{-34}) \times (6.0 \times 10^{14})$

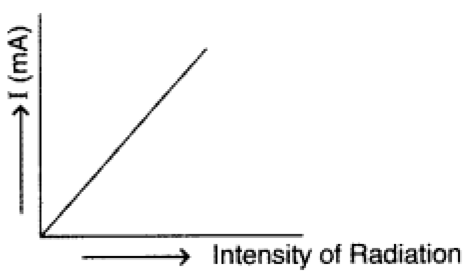
Number of photons emitted per sec

$= \frac{\text{Power}}{\text{Energy of one photon}}$

$n = \frac{2\times10^{-3}}{(6.6\times10^{-34})\times(6.0\times10^{14})}$ $\therefore$ $\mathbf{n = 5 \times 10^{15}}$

2

(ii)



1

OR

Given : $\lambda = 5460 \text{ nm} = 5460 \times 10^{-9} \text{ m} \qquad \lambda_B = ?$

Energy of the photon (K) $= \dfrac{hc}{\lambda}$ ...(*i*)

de-Broglie wavelength, $(\lambda_B) = \dfrac{h}{p} = \dfrac{h}{\sqrt{2mk}}$ ...(*ii*)

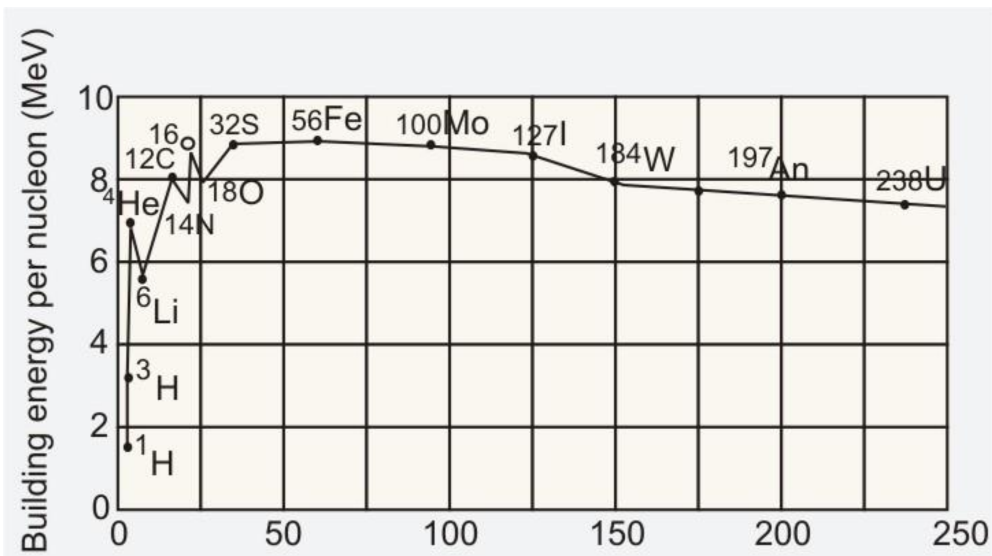
$$\therefore \quad \lambda_B = \frac{h}{\sqrt{2m.\frac{hc}{\lambda}}} = \sqrt{\frac{h\lambda}{2mc}}$$

$$= \left[\frac{(6.63 \times 10^{-34}) \times (5460 \times 10^{-9})}{2 \times (9.1 \times 10^{-31}) \times (3 \times 10^{8})}\right]^{\frac{1}{2}}$$

$$= \mathbf{25.75 \times 10^{-10} \ m}$$

3

28.



2

The binding energy per nucleon graph rises from light nuclei to a peak around Iron (Fe-56), then gradually falls, explaining why light nuclei undergo fusion (moving toward stability/peak) and heavy nuclei undergo fission (also moving toward stability/peak) to release energy. The constancy in the middle range (A=30-170) is due to the short-range nature of the nuclear force, where each nucleon only strongly interacts with its immediate neighbors, making binding energy per nucleon plateau. 1

SECTION D

29. (i) (b) 5 cm 1

(ii) (b) 2.5 cm 1

(iii) (a) 20 1

(iv) (a) real, inverted and magnified 1

OR

(iv) the focal length of both objective lens and of eye lens is decreased

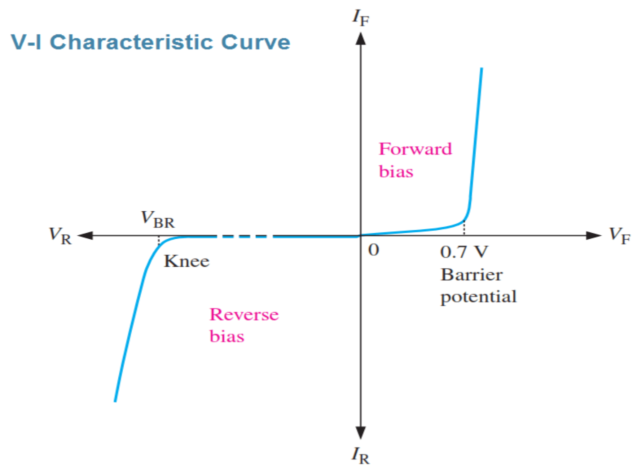
30. (i) The energy band gap in insulators is typically large, usually **greater than** 3 eV 1

(ii) **Forward biasing** lowers the energy barrier, allowing carriers to cross the junction more easily, while **reverse biasing** increases the barrier and the width of the depletion region, which hinders carrier flow. 1

(iii) Germanium > Silicon > Carbon 2

OR

(iii) V-I Characteristic curves of pn junction diode in forward biasing and reverse biasing.

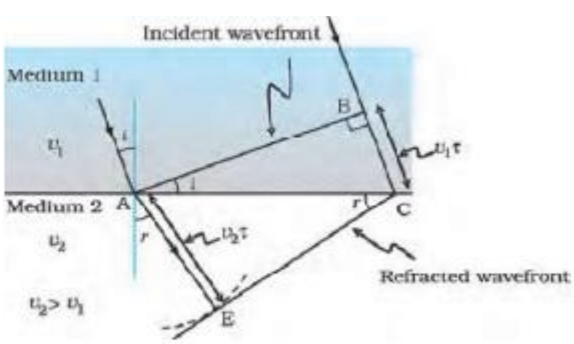


2

SECTION-E

31. (a) Each point of the wavefront is the source of secondary disturbance and the wavelets emanating from these points spread out in all directions with the speed of the wave. These wavelets emanating from the wavefront are usually referred to as secondary wavelets and if we draw a common tangent to all these spheres, we obtain the new position of the wavefront at a later time. 1

(b)



$\sin i = BC/AC = v_1t / AC$

$\sin r = AE/AC = v_2t / AC$

$\sin i/\sin r = v_1/v_2$

since, $n_1 = c/v_1$ and $n_2 = c/v_2$

thus

$n_1 \sin i = n_2 \sin r$ (Snell's law)

2

c) λ_1 be the wavelength in medium1

λ_2 be the wavelength in medium 2

λ_1 and λ_2 are respectively proportional to BC and AE.

$\lambda_1 / \lambda_2 = BC/AE = v_1/v_2$

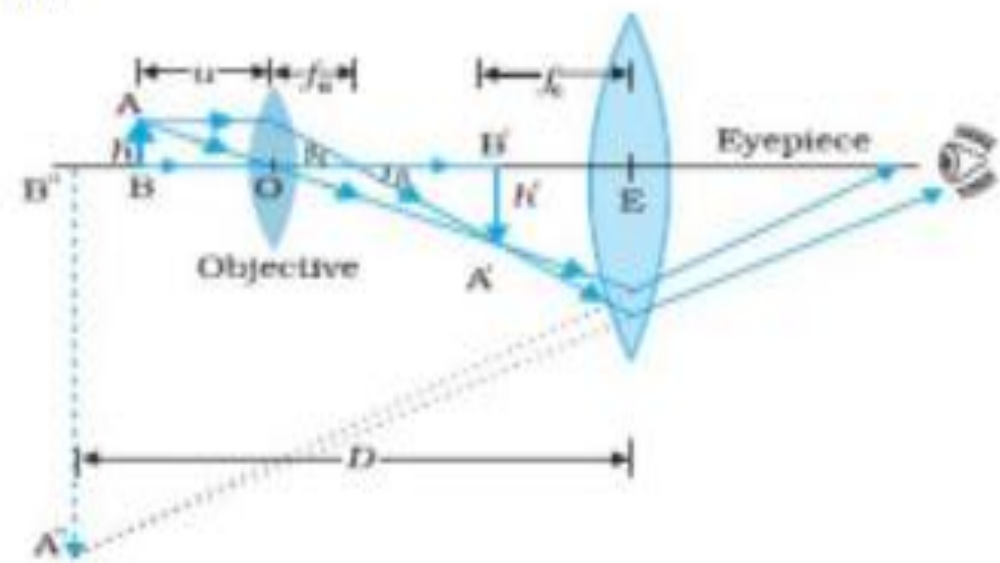
$\Rightarrow v_1/\lambda_1 = v_2/\lambda_2$

$\Rightarrow \nu_1 = \nu_2$ **[1]**

2

OR

(a)



2

Ans. Here $f_0 = 2.0\,\text{cm}$, $f_e = 6.25\,\text{cm}$, $u_0 = ?$

(i) *When the final image is obtained at the least distance of distinct vision :*

$$v_e = -25\,\text{cm}$$

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

$$\therefore \quad \frac{1}{u_e} = \frac{1}{v_e} - \frac{1}{f_e} = \frac{1}{-25} - \frac{1}{6.25}$$

$$= \frac{-1-4}{25} = \frac{-5}{25} = -\frac{1}{5}$$

or $$u_e = -5\,\text{cm}$$

Now distance between objective and eyepiece

$$= 15\text{ cm}$$

$\therefore$ Distance of the image from objective is

$$v_0 = 15 - 5 = 10\,\text{cm}$$

$$\therefore \quad \frac{1}{u_0} = \frac{1}{v_0} - \frac{1}{f_0} = \frac{1}{10} - \frac{1}{2} = \frac{1-5}{10} = -\frac{2}{5}$$

or $$u_0 = -\frac{5}{2} = -2.5\,\text{cm}$$

$\therefore$ Distance of object from objective = **2.5 cm**

1.5

Magnifying power,

$$m = m_0 \times m_e = \frac{v_0}{u_0}\left(1+\frac{D}{f_e}\right) = \frac{10}{2.5}\left(1+\frac{25}{6.25}\right) = 20.$$

(ii) When the final image is formed at infinity :

Here $v_e = \infty$, $f_e = 6.25$ cm

As $\frac{1}{v_e} - \frac{1}{u_e} = \frac{1}{f_e}$ $\therefore$ $\frac{1}{\infty} - \frac{1}{u_e} = \frac{1}{f_e}$

or $u_e = -f_e = -6.25$ cm

Distance between objective and eyepiece = 15 cm

$\therefore$ Distance of the objective from the image formed by itself,

$$v_0 = 15 - 6.25 = 8.75 \text{ cm}$$

Also $f_0 = +2.0$ cm

$$\therefore \quad \frac{1}{u_0} = \frac{1}{v_0} - \frac{1}{f_0} = \frac{1}{8.75} - \frac{1}{2} = \frac{2-8.75}{17.5} = \frac{-6.75}{17.5}$$

or $$u_0 = -\frac{17.5}{6.75} = -2.59 \text{ cm}$$

$\therefore$ The distance of the object from objective = **2.59 cm**

Magnifying power,

$$m = m_0 \times m_e = \frac{v_0}{u_0} \times \frac{25}{6.25} = \frac{27}{8} \times 4 = 13.46 = 13.5.$$

1.5

32.

$$V = -\int_{\infty}^{R} \vec{E}\, \vec{dr}$$

But $$\vec{E} = \frac{1}{4\pi\varepsilon_0} \frac{q}{r^2} \hat{r}$$

$\therefore$ $$V = -\int_{\infty}^{R} \frac{1}{4\pi\varepsilon_0} \frac{q}{r^2} \hat{r}\, \vec{dr}$$

$$= -\int_{\infty}^{R} \frac{1}{4\pi\varepsilon_0} \frac{q}{r^2}\, dr$$

because $\hat{r}\, \vec{dr} = dr$

$$= -\frac{q}{4\pi\varepsilon_0} \int_{\infty}^{R} \frac{1}{r^2}\, dr$$

$$= -\frac{q}{4\pi\varepsilon_0} \left[-\frac{1}{r}\right]_{\infty}^{R} = \frac{q}{4\pi\varepsilon_0} \left[\frac{1}{R} - \frac{1}{\infty}\right]$$

or $$V = \frac{1}{4\pi\varepsilon_0} \frac{q}{R}$$

3

(i) Inside the shell potential will be constant and same as at the surface V=kq/R 1

(ii) Outside the shell V= kq/r 1

Or

(a) C_{13}= 12μF 3
C_{213}= 4 μF
C_{4213}= 10 μF
(b) q_{C4} = C x V= 6 x10^{-6} X10= 6 X 10^{-5} C 2
q_{C1}= 4 X 10^{-5}/2= 2x 10^{-5} C

33. (a) In metals, resistivity increases with temperature because more vigorous atomic vibrations cause frequent collisions, scattering free electrons; in semiconductors, resistivity decreases because higher temperatures provide energy for more electrons to break covalent bonds and jump to the conduction band, dramatically increasing the number of charge carriers available for conduction. The dominant factor in metals is electron scattering, while in semiconductors, the increase in charge carriers is the key 2
(b) The effective internal resistance is **0.067 Ω** , and the effective emf is **2.67 V**. 3

OR

(a) Correct explanation with graph 2

(b). $I = \frac{\varepsilon}{R_0 + r}$ $Where\ R_0\ is\ resistance\ at\ room\ temperature\ 20^0$

$\Rightarrow R_0 = \frac{\varepsilon}{I}$-1

OR $R_0 = \frac{100}{10}$-1 = $R_0 = 9\Omega$

3

Now Final temperature is 320^0C

So, $R = R_0\ (1 + \alpha\Delta T)$

= 9 ($(1 + 3.7\ \times 10^{-4}\ \times 300)$

= 10 Ohm

Power Consumed by cell $(P) = i^2 r$

= $(\frac{\varepsilon}{R + r})^2\ \times r \quad Watt$

= $(\frac{100}{11})^2$ = 82.64 W

________________________________END OF MARKING KEY____________________________