Solved Paper 2018
Physics
Class-XII

Time : 3 Hours **Max. Marks : 70**

General Instructions :

(i) *All questions are compulsory. There are* ***26*** *questions in all.*
(ii) *This question paper has* ***five*** *sections : Section* ***A****, Section* ***B****, Section* ***C****, Section* ***D****, and Section* ***E****.*
(iii) *Section* ***A*** *contains* ***five*** *questions of* ***one*** *mark each, Section* ***B*** *contains* ***five*** *questions of* ***two*** *marks each, Section* ***C*** *contains* ***twelve*** *questions of* ***three*** *marks each, Section* ***D*** *contains one value based question of* ***four*** *marks and Section* ***E*** *contains* ***three*** *questions of* ***five*** *marks each.*
(iv) *There is no overall choice. However, an internal choice has been provided in* ***one*** *question of two marks,* ***one*** *question of* ***three*** *marks and all the* ***three*** *questions of* ***five*** *marks weightage. You have to attempt only* ***one*** *of the choices in such questions.*
(v) *You may use the following values of physical constants wherever necessary :*

$$c = 3 \times 10^8\ m/s$$
$$h = 6.63 \times 10^{-34}\ \text{Js}$$
$$e = 1.6 \times 10^{-19}\ \text{C}$$
$$\mu_0 = 4\pi \times 10^{-7}\ T\ m\ \text{A}^{-1}$$
$$\varepsilon_0 = 8.854 \times 10^{-12}\ \text{C}^2\ \text{N}^{-1}\ m^{-2}$$
$$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ \text{N m}^2\ \text{C}^{-2}$$

Mass of electron (m_e) = 9.1×10^{-31} kg
Mass of neutron = 1.675×10^{-27} kg
Mass of proton = 1.673×10^{-27} kg
Avogadro's number = 6.023×10^{23} per gram mole
Boltzmann constant = 1.38×10^{-23} JK^{-1}

SECTION -A

1. A proton and an electron travelling along parallel paths enter a region of uniform magnetic field, acting perpendicular to their paths. Which of them will move in a circular path with higher frequency? 1

Ans. Electron

(No explanation need to be given. If a student only writes the formula for frequency of charged particle (or $\nu_c \propto \frac{q}{m}$) award ½ mark)

[CBSE Marking Scheme, 2018] 1

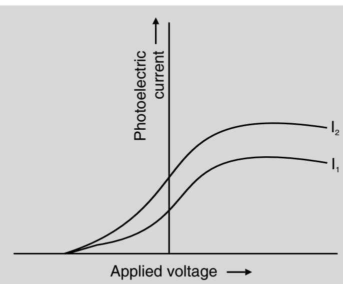
2. Name the electromagnetic radiations used for (a) water purification, and (b) eye surgery. 1

Ans. **(a)** Ultra violet rays ½
(b) Ultra violet rays / Laser ½

[CBSE Marking Scheme, 2018]

3. Draw graphs showing variation of photoelectric current with applied voltage for two incident radiations of equal frequency and different intensities. Mark the graph for the radiation of higher intensity. 1

Ans.



½

The graph I_2 corresponds to radiation of higher intensity [Note: Deduct this ½ mark if the student does not show the two graphs starting from the same point.] (Also accept if the student just puts some indicative marks, or words, (like tick, cross, higher intensity) on the graph itself. ½

[CBSE Marking Scheme, 2018]

At cylindrical part of the surface electric field $\vec{E}$ is normal to the surface at every point and its magnitude is constant. Therefore flux through the Gaussian surface.

= Flux through the curved cylindrical part of the surface.

$= E \times 2\pi r l$ ...(i) ½

Applying Gauss's Law

$$\text{Flux } \phi = \frac{q_{enclosed}}{\varepsilon_0}$$

Total charge enclosed = Linear charge density × l

$= \lambda l$

$$\phi = \frac{\lambda L}{\varepsilon_0} \quad \text{....(ii) ½}$$

Using Equations (i) & (ii)

$$E \times 2\pi r l = \frac{\lambda l}{\varepsilon_0}$$

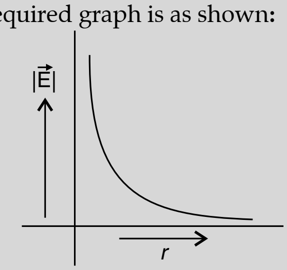
$$\therefore \quad E = \frac{\lambda}{2\pi\varepsilon_0 r} \quad ½$$

In vector notation

$$\vec{E} = \frac{\lambda}{2\pi\varepsilon_0 r}\hat{n} \quad ½$$

(where $\hat{n}$ is a unit vector normal to the line charge)

(b) The required graph is as shown: **1**



(c) Work done in moving the charge 'q' through a small displacement 'dr'

$$dW = \vec{F}.\vec{dr}$$

$$dW = q\vec{E}.\vec{dr}$$

$$= qEdr\cos 0°$$

$$dW = q \times \frac{\lambda}{2\pi\varepsilon_0 r} dr \quad ½$$

Work done in moving the given charge from r_1 to r_2 $(r_2 > r_1)$

$$W = \int_{r_1}^{r_2} dW = \int_{r_1}^{r_2} \frac{\lambda q dr}{2\pi\varepsilon_0 r}$$

$$W = \frac{\lambda q}{2\pi\varepsilon_0}[\log_e r_2 - \log_e r_1] \quad ½$$

$$W = \frac{\lambda q}{2\pi\varepsilon_0}\left[\log_e \frac{r_2}{r_1}\right]$$

[CBSE Marking Scheme, 2018]

25. (a) State the principle of an ac generator and explain its working with the help of a labelled diagram. Obtain the expression for the emf induced in a coil having N turns each of cross-sectional area *A*, rotating with a constant angular speed 'ω' in a magnetic field $\vec{B}$, directed perpendicular to the axis of rotation.

(b) An aeroplane is flying horizontally from west to east with a velocity of 900 km/hour. Calculate the potential difference developed between the ends of its wings having a span of 20 m. The horizontal component of the Earth's magnetic field is 5×10^{-4} T and the angle of dip is 30°. 5

OR

A device X is connected across an ac source of voltage $V = V_0 \sin \omega t$. The current through X is given as $I = I_0 \sin\left(\omega t + \frac{\pi}{2}\right)$.

(a) Identify the device X and write the expression for its reactance.

(b) Draw graphs showing variation of voltage and current with time over one cycle of ac, for X.

(c) How does the reactance of the device X vary with frequency of the ac? Show this variation graphically.

(d) Draw the phasor diagram for the device X. 5

Ans. (a) Principle of ac generator ½

working ½

Mark labelled diagram **1**

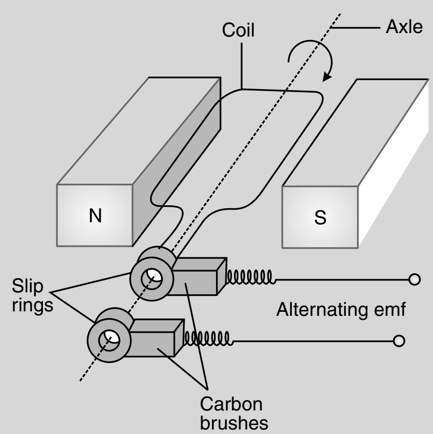
Derivation of the expression for induced emf **1½**

(b) Calculation of potential difference **1½**

(a) The AC Generator works on the principle of electromagnetic induction.

When the magnetic flux through a coil changes, an emf is induced in it. ½

As the coil rotates in magnetic field the effective area of the loop, (*i.e.* $A\cos\theta$) exposed to the magnetic field keeps on changing, hence magnetic flux changes and an emf is induced.½



When a coil is rotated with a constant angular speed 'ω ', the angle 'θ' between the magnetic field vector $\vec{B}$ and the area vector $\vec{A}$, of the coil at any instant 't' equals ωt; (assuming $\theta = 0^\circ$ at $t = 0$) As a result, the effective area of the coil exposed to the magnetic field changes with time ; The flux at any instant 't' is given by ½

$$\phi_B = NBA \cos\theta = NBA \cos\omega t$$

$\therefore$ The induced emf $e = -N \dfrac{d\phi}{dt}$ ½

$$= -NBA \frac{d\phi}{dt} (\cos \omega t)$$

$$e = NBA\omega \sin \omega t$$ ½

(b) Potential difference developed between the ends of the wings 'e' = Blv ½

Given Velocity v = 900km/hour

= 250 m/s

Wing span (l) = 20 m

Vertical component of Earth's magnetic field

$B_v = B_H \tan \delta$

$= 5\times10^{-4}$ (tan 30°) Tesla ½

$\therefore$ Potential difference

$= 5\times10^{-4}$ (tan 30°) × 20 × 250

$$= \frac{5\times20\times250\times10^{-4}}{\sqrt{3}}$$

= 1.44 volt ½

OR

(a) Identification of the device X ½

Expression for reactance ½

(b) Graphs of voltage and current with time **1+1**

(c) Variation of reactance with frequency ½

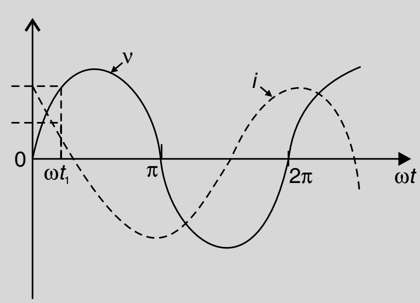
(Graphical variation) ½

(d) Phasor Diagram **1**

(a) **X :** capacitor ½

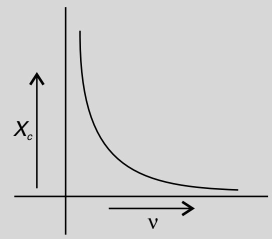
Reactance $X_c = \dfrac{1}{\omega C} = \dfrac{1}{2\pi\nu C}$ ½

(b)



½+½

(c) Reactance of the capacitor varies in inverse proportion to the frequency *i.e.*, $X_c \alpha \dfrac{1}{\nu}$ **1**



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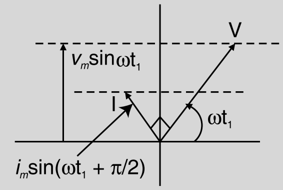

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[CBSE Marking Scheme, 2018]

26. (a) Draw a ray diagram to show image formation when the concave mirror produces a real, inverted and magnified image of the object.

(b) Obtain the mirror formula and write the expression for the linear magnification.

(c) Explain two advantages of a reflecting telescope over a refracting telescope. 5

OR

(a) Define a wavefront. Using Huygens' principle, verify the laws of reflection at a plane surface.

(b) In a single slit diffraction experiment, the width of the slit is made double the original width. How does this affect the size and intensity of the central diffraction band? Explain.

(c) When a tiny circular obstacle is placed in the path of light from a distant source, a bright spot is seen at the centre of the obstacle. Explain why. 5

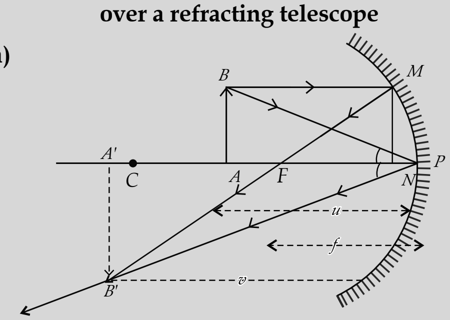
Ans. (a) Ray diagram to show the required image formation 1

(b) Derivation of mirror formula 2 ½

Expression for linear magnification ½

(c) Two advantages of a reflecting telescope over a refracting telescope ½+½

(a)



(b) In the above figure, Δ BAP and ΔB'A'P are similar

$$\Rightarrow \quad \frac{BA}{B'A'} = \frac{PA}{PA'}$$ ...(i) ½

Similarly, Δ MNF and ΔB'A'F are similar

$\Rightarrow \quad \frac{MN}{B'A'} = \frac{NF}{FA'}$ ...(ii)

As MN = BA

NF ≈ PF

FA' = PA' – PF ½

∴ equation (ii) takes the following form

$\frac{BA}{B'A'} = \frac{PF}{PA' - PF}$ ...(iii) ½

Using equation (i) and (iii)

$\frac{PA}{PA'} = \frac{PF}{PA' - PF}$ ½

For the given figure, as per the sign convention, PA = – u

PA' = – v

PF = – f

$\Rightarrow \quad \frac{-u}{-v} = \frac{-f}{-v-(-f)}$ ½

$\frac{u}{v} = \frac{f}{v-f}$

$uv - uf = vf$

Dividing each term by uvf, we get

$\frac{1}{f} - \frac{1}{v} = \frac{1}{u}$

$\Rightarrow \quad \frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ ½

Linear magnification = $-\frac{-v}{\mu}$, (alternatively m $= \frac{h_i}{h_o}$) ½

(c) Advantages of reflecting telescope over refracting telescope

(i) Mechanical support is easier. ½+½

(ii) Magnifying power is large.

(iii) Resolving power is large.

(iv) Spherical aberration is reduced.

(v) Free from chromatic aberration.

(Any two)

OR

(a) Definition of wave front ½

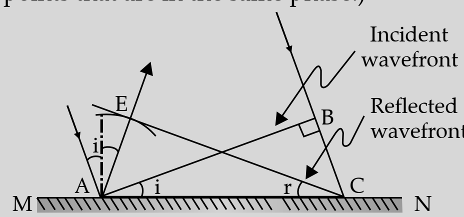
Verification of laws of reflection **2**

(b) Explanation of the effect on the size and intensity of central maxima **1+ 1**

(c) Explanation of the bright spot in the shadow of the obstacle ½

(a) The wave front may be defined as a surface of constant phase. ½

(Alternatively: The wave front is the loci of all points that are in the same phase.)



1

Let the speed of the wave in the medium be 'v'

Let the time taken by the wave front, to advance from point B to point ½

C is τ

Hence BC = $v\tau$

Let CE represent the reflected wave front

Distance AE = $v\tau = BC$

Δ AEC and Δ ABC are congruent

$BAC = \angle ECA$ ½

$\Rightarrow \quad \angle i = \angle r$ ½

(b) Size of central maxima reduces to half, ½

(∴ Size of central maxima = $2\frac{2\lambda D}{\alpha}$)

Intensity increases. ½

This is because the amount of light, entering the slit, has increased and the area, over which it falls, decreases. ½

(Also accept if the student just writes that the intensity becomes four fold.)

(c) This is because of diffraction of light.

[**Alternatively:** Light gets diffracted by the tiny circular obstacle and reaches the centre of the shadow of the obstacle.] ½

[**Alternatively:** There is a maxima, at the centre of the obstacle, in the diffraction pattern produced by it.]

[CBSE Marking Scheme, 2018]

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