



DELHI PUBLIC SCHOOL

SAIL TOWNSHIP, RANCHI

HALF YEARLY EXAMINATION (2017-18)

Class:-XII

Time- 3 Hrs.

Subject:-Physics

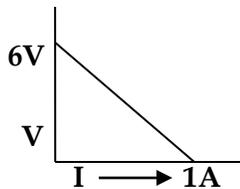
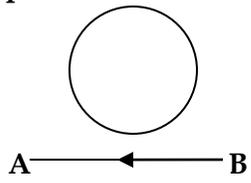
M.M-70

General Instructions:-

- All questions are compulsory .
- This question paper has five sections.
- 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.

Section- A

[1x5=5]

1. Two charges of magnitude $-2Q$ and $+Q$ are located at points $(a,0)$ and $(4a, 0)$ respectively. What is the electric flux due to these charges through a sphere of radius $3a$ with its centre at the origin?
2. The plot of the variation of potential difference across a combination of three identical cells in series, versus current is as shown in Fig. What is the emf of each cell?

3. Show the variation of resistivity of copper as a function of temperature in a graph.
4. The electric current flowing in a wire in the direction from B to A is decreasing. Find out the direction of the induced current in the metallic loop kept above the wire as shown in fig.

5. The susceptibility of a magnetic material is -4.2×10^{-6} . Name the type of magnetic material it represent.

Section- B

[2x5=10]

6. A narrow beam of protons and deuterons , each having the same momentum enters a region of uniform magnetic field directed perpendicular to their direction of momentum. What would be the ratio of the radii of the circular paths described by them?
7. Derive an expression for the torque on an electric dipole placed in a uniform electric field.

OR

How much work is required in turning an electric dipole of dipole momentum \vec{p} from its position of stable equilibrium to its position of unstable equilibrium in a uniform electrostatic field \vec{E} ?

8. The focal length of an equiconvex lens is equal to the radius of curvature of either face. What is the value of refractive index of the material of the lens?
9. A ray of light passes through an equilateral glass prism such that the angle of incidence is equal to angle of emergence and each of these angles is equal to $\frac{3}{4}$ of angle prism. What is the value of angle of deviation?

10. (a) An em wave is travelling in a medium with a velocity $\vec{v} = v \hat{i}$. Draw a sketch showing the propagation of the em wave, indicating the direction of the oscillating electric and magnetic fields .
- (b) How are the magnitude of electric and magnetic fields related to the velocity of the em wave?

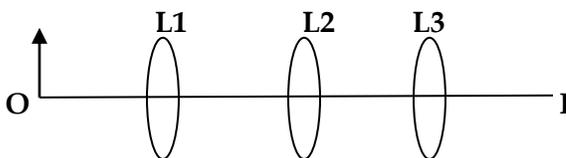
Section- C

[3x12=36]

11. Deduce the expression for capacitance of a parallel plate capacitor when a dielectric slab of thickness t , is inserted between its plates (Assume $t < d$, where d is plate separation).
12. Use Kirchhoff's rules to determine the potential difference between the points A and D when no current flows in the arm BE of the electric networks shown in figure.
13. A capacitor, mad of two parallel plates each of plate area A separation d , is being charged by an external ac source. Show that the displacement current inside the capacitor is the same as the current charging the capacitor.
14. Derive an expression for the mutual inductance of two long coaxial solenoids. How does the mutual inductance of a pair of coils changes when (i) distance between the coil is increased (ii) a thin iron sheet is placed between the two coils.
15. A convex lens of focal length 20 cm, is place Co-axially with a convex mirror of radius of curvature 20 cm. The two are kept 15 cm apart from each other. A point object is placed 60 cm in front of the convex lens. Find the position of the image formed by this combination. Draw the ray diagram for the image formation.

OR

You are given three lenses $L_1, L_2,$ and L_3 each of focal length 10 cm. An object is kept at 15 cm infront of L_1 as shown. The final real image is formed at the focus I of L_3 . Find the separation between L_1, L_2 and L_3 .



16. State Gauss' Law. Using this law, obtain the expression for the electric field due to an infinitely long straight conductor of linear charge density λ .
17. A wheel with 8 metallic spokes each 50 cm long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the Earth's magnetic field. The Earth's magnetic field at the plane is 0.4 G and the angle of dip is 60° . Calculate the emf induced between axle and the rim of the wheel. How will the value of emf be affected if the number of spokes were increase?
18. When a circuit element 'X' is connected across an a.c source , a current of $\sqrt{2}$ A flows through it and this current is in phase with applied voltage. When another element "Y" is connected across the same a.c source, the same current flows in the circuit but it leads the voltage by $\pi/2$ radians.
- (i) Name the circuit element X and Y.
- (ii) Find the current that flows in the circuit when the series combination of X and Y is connected across the same a.c voltage .
- (iii) Plot a graph showing variation of the net impedance of this series combination of X and Y as a function of the angular of frequency ω of the applied voltage.

19. Use Huygens's principle to show how a plane wavefront propagates from a rarer to denser medium. Hence, verify Snell's law of refraction.
20. (i) Using Ampere's circuital law obtain the expression for the magnetic field due to a long solenoid at a point inside the solenoid on its axis.
(ii) In what respect, is a toroid different from a solenoid?
(iii) How is the magnetic field inside a given solenoid made strong?
21. A network of four $15 \mu\text{F}$ capacitors is connected to a 500V supply as shown in figure. Determine
(i) The equivalent capacitance of the network.
(ii) The charge on each capacitor.
22. In the given circuit, a metre bridge is shown in the balanced state. The metre bridge wire has a resistance of $1 \Omega \text{ cm}^{-1}$. Calculate the unknown resistance X and the current drawn from the battery of a negligible internal resistance if the magnitude of Y is 6Ω . If at the balancing point, we interchange the position of galvanometer and the cell, how it will affect the position of the galvanometer?

Section- D

[4]

23. Anita went to the market with her mother and decided to come back home by metro. At the metro station they were made to pass through a gateway for security check. Anita passed through it and was waiting for her mother to come. She heard a long beep when her mother passed through the metal detector gateway. Anita was curious to know as to why metal detector beeped in the case of her mother. She asked the duty staff, who explained her in detail. Both were satisfied with the security system.
(i) On what principle does a metal detector work? What causes production of a beep in this case?
(ii) Which values are reflected in Anita's behaviour?

Section- E

[5x3=15]

24. (i) Define the term drift velocity.
(ii) On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of electrons and relaxation time.
(iii) Why alloys like constantan and manganin are used for making standard resistors?

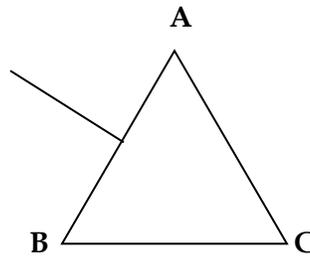
OR

- (i) Two cells of different emfs and internal resistances are connected in parallel with one another. Find the expression for the equivalent emf and equivalent internal resistance of the combination.
(ii) Two primary cells of emfs e_1 and e_2 ($e_1 > e_2$) are connected to a potentiometer wire AB as shown in figure. If the balancing length for two combinations of the cells are 250 cm and 400 cm , find the ratio of e_1 and e_2 .

25. (i) Draw a labelled diagram of AC generator. Derive the expression for the instantaneous value of the emf induced in the coil.
- (ii) A horizontal straight wire 10 m long extending from east to west is falling with a speed of 5m/sec at right angle to the horizontal component of earth's magnetic field equal to 0.30×10^{-4} wb m⁻²
- (a) What is the instantaneous value of the emf induced in the wire?
- (b) What is the direction of induced current?

OR

- (i) What is a transformer ? On what principle it works? Draw a labelled diagram of step-down transformer. Obtain the ratio of secondary to primary voltage in terms of number of turns and current in the two coils.
- (ii) A power transmission line feeds input power at 2200 V to a step-down transformer with its primary windings having 3000 turns . Find the number of turns in the secondary to get the power output at 220 V.
26. (i) Draw a ray diagram for formation of image of a point object by a thin double convex lens having radii of curvature R_1 and R_2 .Hence derive lens maker's formula for a double convex lens.
- (ii) As show in figure, PQ is the ray incident on a prism ABC. Show the corresponding refracted and emergent rays. The critical angle for the material of the prism is 45° . Also find the refractive index of the material of the prism.



OR

- (i) Draw a ray diagram of a compound microscope. Write an expression for the total magnification when the final image is formed at the near point.
- (ii) Why must both the objective and the eye piece of a compound microscope have short focal length?
- (iii) Three rays of light- red (R) green (G) and blue (B) are incident on the face PQ of right-angled prism. The refractive indices of the material of the prism for red , green and blue wave lengths are 1.39 , 1.44 and 1.47 respectively. Out of the three which colour ray will emerge out of face PS? Justify your answer. Trace the path of these rays after passing through face PS.

