विद्या सर्वार्थि साधिका

ANANDALAYA

PREBOARD EXAM 2023

Class : XII

Subject: Physics MM : 70

Date : 10-01-2023 Time: 3 hours

General Instructions:

(1) There are 35 questions in all. All questions are compulsory.

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.

(3) Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.

(4) There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.

(5) Use of calculators is not allowed.

SECTION A

1. The electric flux through a closed Gaussian surface depends on _____. (1)
   (A) net charge enclosed and permittivity of the medium
   (B) net charge enclosed, permittivity of the medium and the size of the charge
   (C) net charge enclosed only
   (D) permittivity of the medium only

2. Equipotential surface at a great distance from a collection of charges whose total sum is not zero are approximately (1)
   (A) spheres (B) planes (C) paraboloids (D) ellipsoids

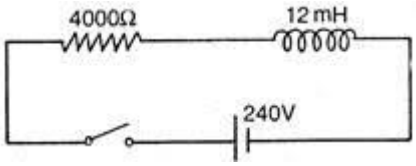
3. Three charges Q, +q and +q are placed at the vertices of an equilateral triangle of side l. If the net electrostatic energy of the system is zero, then Q is equal to _____. (1)
   (A) – q (B) + q (C) zero (D) – (q/2)

4. A charge moving in a uniform magnetic field does not experience any force. This is possible when the angle between its velocity and the magnetic field is _____ (1)
   (A) 0° (B) 30° (C) 45° (D) 90°

5. Find the magnetic flux linked to a rectangular coil of dimension 6 cm × 8 cm placed at right angle to a magnetic field of 0.5 T. (1)
   (A) 4×10^{-3}Wb (B) 2.4×10^{-3}Wb (C) 24 Wb (D) 3 Wb

6. A galvanometer of resistance G is converted into an ammeter. The current flowing through the galvanometer is 10% of main current. What is the shunt resistance used? (1)
   (A) 9G (B) $\frac{G}{9}$ (C) 90G (D) $\frac{G}{90}$

7. In the inductive circuit given in the figure, the current rises after the switch is closed. At the instant, when the current is 25 mA, the potential difference across the inductor will be _____. (1)



   (A) 60 V (B) 140 V (C) 180 V (D) zero

8. What is the dimensions of $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$? (1)

(A) $\left[L^{\frac{1}{2}} T^{-\frac{1}{2}}\right]$ (B) $[L^{-1}T]$ (C) $[LT^{-1}]$ (D) $\left[L^{-\frac{1}{2}} T^{\frac{1}{2}}\right]$

9. A beam of light converges at a point P. Now a convex lens of focal length 20 cm is placed in the path of the convergent beam 12cm from P. At what point does the beam converge? (1)
(A) 30 cm (B) -30 cm (C) 7.5 cm (D) -7.5 cm

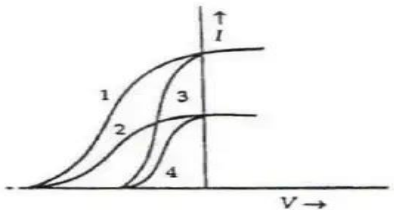
10. Two slits are made one millimetre apart and the screen is placed one metre away. What is the fringe separation in the interference pattern obtained when blue-green light of wavelength 500 nm is used? (1)
(A) 0.2 mm (B) 0.05 mm (C) 0.2 m (D) 0.5 mm

11. Which of the following has the least wavelength? (1)
(A) Alpha rays (B) Beta rays (C) Gamma rays (D) X - rays

12. In Bohr atom model, which of the following is an integral multiple of $\frac{h}{2\pi}$? (1)
(A) Kinetic energy (B) Potential energy (C) Radius of an atom (D) Angular momentum

13. In Bohr atom model of hydrogen, the radius of the first orbit is 0.53 °A. What will be the radius of the 3rd orbit? (1)
(A) 4.77 °A (B) 47.7 °A (C) 9 °A (D) 0.09 °A

14. In a photoelectric experiment the anode potential is plotted against the photo current. (1)
(A)1 and 2 will have same intensities
(B)2 and 3 have different frequencies
(C)2 and 4 have same frequencies
(D)1 and 3 have different intensities



15. Ratio of the radii of the nuclei with mass numbers 8 and 27 would be _____ (1)
(A) $\frac{27}{8}$ (B) $\frac{8}{27}$ (C) $\frac{2}{3}$ (D) $\frac{3}{2}$

16. In an n-type silicon, which of the following statement is true: (1)
(A) Electrons are majority carriers and trivalent atoms are the dopants.
(B) Electrons are minority carriers and pentavalent atoms are the dopants.
(C) Holes are minority carriers and pentavalent atoms are the dopants.
(D) Holes are majority carriers and trivalent atoms are the dopants.

For question numbers 17 and 18, two statements are given-one labelled Assertion and the other labelled Reason. Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.
A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
B) Both Assertion and Reason are true but Reason is NOT the correct explanation of Assertion.
C) Assertion is true but Reason is false
D) Assertion is false and Reason is also false.

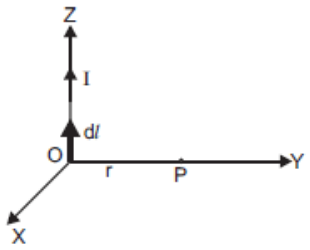
17. Assertion: Number of electrons emitted in one second in photoelectric emission is directly proportional to the intensity of incident radiation. (1)
Reason: Higher number of photons can target higher number of electrons in the metal surface.

18. Assertion: Conductivity of n-type semiconductor is greater than that of p-type semiconductor. (1)
Reason: Electrons have greater mobility than holes

SECTION B

19. A cell of emf E and internal resistance r is connected across a variable resistor R. Plot a graph showing the variation of terminal potential V with resistance R. Predict from the graph the condition under which V becomes equal to E. (2)

20. State Biot-Savart law. (2)
A current I flows in a conductor perpendicular to the plane of the paper. Indicate the direction of the magnetic field due to a small element $d\vec{l}$ at point P situated at a distance $\vec{r}$ from the element as shown in the figure.



21. Use the mirror equation to show that an object placed between f and 2f of a concave mirror produces a real image beyond 2f. (2)

22. In the study of Geiger- Marsdon experiment on scattering of alpha particles by a thin foil of gold, draw the trajectory of alpha particles in the coulomb field of target nucleus. Explain briefly how one gets the information on the size of the nucleus from this study. (2)

23. What is Lorentz force? A straight wire of mass 200 g and length 1.5 m carries a current of 2 ampere. It is suspended in mid-air by a uniform horizontal magnetic field B. What is the magnitude of the magnetic field? (2)

24. Give two points of difference between interference pattern and diffraction pattern. (2)

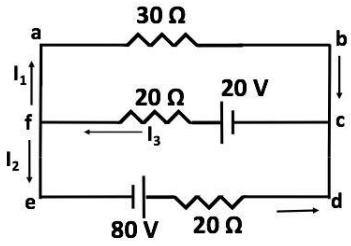
25. An atom absorbs a photon of wavelength λ and then reemits the energy in two steps. If one of the emitted wavelengths is 3λ, what will be the other wavelength? (2)

SECTION C

26. State Huygen's wave theory. Using Huygen's wave theory, prove Snell's law. (3)

27. A thin conducting spherical shell of radius R has charge Q spread uniformly over its surface. Using Gauss' law, derive an expression for electric field at a point outside the shell. Draw a graph of electric field E(r) with distance r from the centre of the shell for $0 \leq r \leq \infty$. (3)

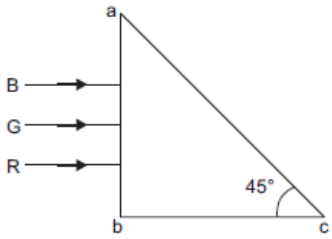
28. In the network shown here, find the currents I_1, I_2 and I_3. (3)



OR

Net capacitance of three identical capacitors in series is 3 pF. What will be their net capacitance if connected in parallel? Find the ratio of energy stored in the two configurations if they are both connected to the same source.

29. Three light rays red (R), green (G) and blue (B) are incident on a right angled prism abc at face ab. The refractive indices of the material of the prism for red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. Out of the three which colour ray will emerge out of the face ac? Justify your answer. Trace the path of these rays after passing through face ab. (3)



OR

Draw the ray diagram of a refracting type telescope in normal adjustment. Give the expression of the magnifying power of the telescope? Give two advantages of reflecting type telescope over refracting type telescope.

30. A proton and an alpha particle are accelerated through the same potential. Which one of the two has (i) greater value of de Broglie wavelength associated with it and (ii) less kinetic energy? Justify your answer. (3)

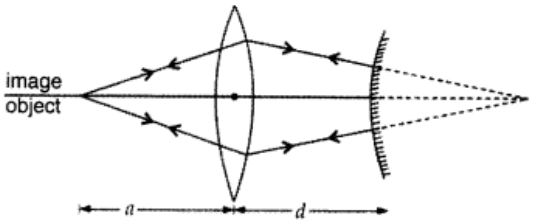
SECTION D

31. What are coherent sources? Give the condition for positions of bright and dark fringes in a Young's double slit experiment. (5)

In Young's double-slit experiment using monochromatic light of wavelength l, the intensity of light at a point on the screen where path difference is λ, is *K* units. What is the intensity of light at a point where path difference is λ/3?

OR

The image of an object, formed by a combination of a convex lens (of focal length *f*) and a convex mirror (of radius of curvature R), set up, as shown is observed to coincide with the object. Redraw this diagram to mark on it the position of the centre of curvature of the mirror. Obtain the expression for R in terms of the distances, marked as *a* and *d*, and the focal length, *f*, of the convex lens.



The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. If focal length of the lens is 12 cm, find the refractive index of the material of the lens.

32. Derive the expression for potential due to a small electric dipole at a point on its axial line. Two point charges, $q_1 = 10 \times 10^{-8}$C, $q_2 = -2 \times 10^{-8}$C are separated by a distance of 60 cm in air. (5)

(i) Find at what distance from the 1st charge q_1, would the electric potential be zero.

(ii) Also calculate the electrostatic potential energy of the system.

OR

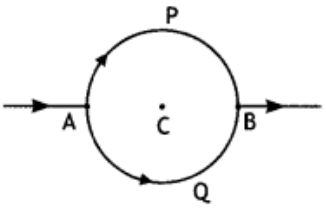
(i) What is drift velocity? Give the expression for drift velocity.

(ii) Derive an expression for the resistivity of a good conductor, in terms of the relaxation time of electrons.

(iii) Two metallic wires of the same material have the same length but cross-sectional area is in the ratio 1:2. They are connected (A) in series and (B) in parallel. Compare the drift velocities of electrons in the two wires in both the cases (A) and (B).

33. (i) A straight wire of length L is bent into a semi-circular loop. Use Biot-Savart's law to deduce an expression for the magnetic field at its centre due to the current passing through it. (5)

(ii) A current 'I' enters a circular wire at the point A as shown in the figure. What is the magnetic field at the centre 'c' of the circular wire?



(iii) A solenoid of length 1.0 m has a radius of 1 cm and has a total of 1000 turns wound on it. It carries a current of 5 A. Calculate the magnitude of the axial magnetic field inside the solenoid.

OR

Two wires carrying currents I_1 and I_2 are placed parallel to each other. Deduce an expression for the force acting between the two wires. Hence, define 1A. What will be direction of force if the currents are antiparallel?

SECTION E

Questions 34 and 35 are Case Study Based questions and are compulsory. Each question carries 1 mark.

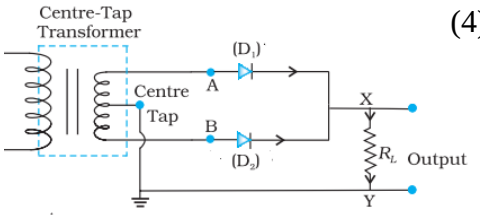
34. Materials are classified as diamagnetic, paramagnetic or ferromagnetic. Diamagnetic substances are those which have tendency to move from stronger to the weaker part of the external magnetic field. Paramagnetic substances are those which get weakly magnetised when placed in an external magnetic field. They have tendency to move from a region of weak magnetic field to strong magnetic field, i.e., they get weakly attracted to a magnet. Experimentally, one finds that the magnetisation of a paramagnetic material is inversely proportional to the absolute temperature T. Ferromagnetic substances are those which gets strongly magnetised when placed in an external magnetic field. They have strong tendency to move from a region of weak magnetic field to strong magnetic field, i.e., they get strongly attracted to a magnet. The individual atoms (or ions or molecules) in a ferromagnetic material possess a dipole moment as in a paramagnetic material. However, they interact with one another in such a way that they spontaneously align themselves in a common direction over a macroscopic volume called domain. (4)

(i) What is 'domain' in ferromagnetic substance?
(ii) Out of - mercury, Alnico, copper, aluminium and calcium - which are paramagnetic?
(iii) The susceptibility of a material is negative. What type of magnetic material is this?
(iv) What is Curie temperature?

OR

(iv) What are the factors on which the magnetisation of paramagnetic materials depends?

35. Given a circuit diagram used commonly in our day to day life. Observe the circuit diagram and answer the following questions. (4)



(i) What is the name of the circuit?

(ii) Identify the component labelled as D_1 and D_2.

(iii) Out of X and Y, which one terminal would be at high potential?
(iv) Draw the output waveform of the circuit.

OR

(iv) What will be the frequency of the output wave if the input wave has the frequency 60Hz?