CAMBRIDGE SCHOOL SRINIVASPURI, NEW DELHI
HALF YEARLY EXAMINATION 2017 - 2018
PHYSICS
CLASS XII
SET - B

Time Allowed: 3 hours | Max Marks: 70

General Instructions:

(i) All questions are compulsory.
(ii) There are 26 questions in total.
(iii) Question Nos. 1 to 5 are very short answer type questions and carry **one** mark each.
(iv) Question Nos. 6 to 10 short answer type questions and carry **two** marks each.
(v) Question Nos. 11 to 22 carry **three** marks each.
(vi) Question no. 23 is a value-based question and carries **four marks**.
(vii) Question Nos. 24 to 26 are long answer questions and carry **five** marks each.
(viii) There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and in each question of 5 marks weightage. A student has to attempt only one of the alternatives in such questions.

Q1. Write the expression for the torque $\vec{\tau}$ acting on a dipole of dipole moment $\vec{p}$ placed in an electric field $\vec{E}$.

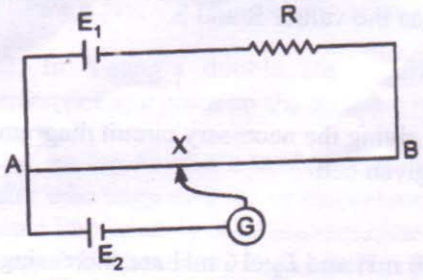
Q2. Why must electrostatic field at the surface of a charged conductor be normal to the surface at every point? Give reasons.

Q3. A wire of resistance 8R is bent in the form of a circle. What is the effective resistance between the ends of a diameter AB?

Q4. Plot a graph showing the variation of resistivity of a conductor with temperature.

Q5. A long straight wire carries a steady current I along the positive y-axis in a coordinate system. A particle of charge +Q is moving with a velocity $\vec{v}$ along the x-axis. In which direction will the particle experience a force?

Q6. In the circuit diagram shown, AB is a uniform wire of resistance 15Ω and length 1m. It is connected to a cell E_1 of emf 2V and negligible internal resistance and a resistance R. The balance point with another cell E_2 of emf 75 mV is found at 30 cm from end A. Calculate the value of the resistance R.

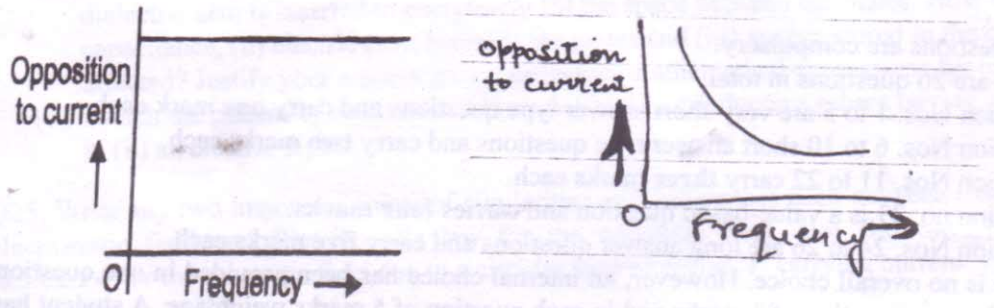


Q7. Define self-inductance of a coil. Show that the magnetic energy required to build up the current I in a coil of self inductance L, is given by $\frac{1}{2}LI^2$.

Q8. Two identical loops, one of copper and the other of aluminum, are rotated with the same angular speed in the same magnetic field. Compare (i) the induced emf and (ii) the current produced in the two

coils. Justify your answer.

OR



(a) The graphs (i) and (ii) represent the variation of the opposition offered by the circuit element to the flow of alternating current with frequency of the applied emf. Identify the circuit element corresponding to each graph.

(b) Write the expression for the impedance offered by the series combination of the above two elements connected across the a.c. Which will be ahead in phase in this circuit, voltage or current?

Q9. Write the important characteristic features by which the interference can be distinguished from the observed diffraction pattern?

Q10. What is Rayleigh criteria of LOR? How would you increase resolving power of optical telescope using light of different colours?

Q11. Four charges +q, -q, +q and –q are to be arranged respectively at the four corners of a square ABCD of side a.
(a) Find the work required to put together this arrangement.
(b) A charge q_0 is bought to the center of the square, the four charges being held fixed. How much extra work is needed to do this?

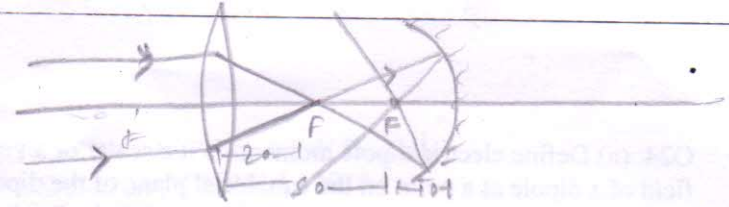
Q12. In a meter bridge, the null point is found at a distance of 60.0 cm from A. If a resistance of 5Ω is connected in series with S, the null point occurs at 50.0cm. Determine the values R and S.

OR

State the underlying principle of a potentiometer. Describe briefly, giving the necessary circuit diagram, how a potentiometer is used to measure the internal resistance of a given cell.

Q13. The currents flowing in the two coils of self-inductance L_1=20 mH and L_2=16 mH are increasing at the same rate. If the power supplied to the two coils are equal, find the ratio of (i) induced voltages, (ii) the currents and (iii) the energies stored in the two coils at a given instant.

Q14. 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 place is 0.4 G and the angle of dip is 60°. Calculate the emf induced between the axle and the rim of the wheel.



How will the value of emf be affected if the number of spokes were increased?

Q15. A convex lens of focal length 20 cm is placed coaxially with a concave mirror of focal length 10 cm at a distance of 50 cm apart from each other. A beam of light coming parallel to the principal axis is incident on the convex lens. Find the position of the final image formed by this combination. Draw the ray diagram showing the formation of the image.

Q16. Draw a schematic ray diagram of reflecting type telescope showing how rays coming from a distant object are received at the eye piece. Write its two important advantages over a refracting telescope.

Q17. A plane wave front propagating in a medium of refractive index μ_1 is incident on a plane surface making the angle of incidence. It enters into a medium of refractive index μ_2 ($\mu_2 > \mu_1$). Use Huygens' construction of secondary wavelets to trace the propagation of the refracted wave front. Hence verify Snell's law of refraction.

Q18. A parallel beam of monochromatic light of wavelength 500 nm falls normally on a narrow slit and the resulting diffraction pattern is obtained on a screen 1 m away. It is observed that the first minimum is at a distance of 2.5 mm from the center of the screen. Find
(a) the width of the slit.
(b) the distance of the second maximum from the center of the screen,
(c) the width of the central maximum.

Q19. In a series LCR circuit with an ac source of effective voltage 50 V, frequency $\nu = 50/\pi$ Hz, R = 300 Ω, C = 20 μF and L = 1.0 H. Find the rms current in the circuit.

Q20. State working principle of a galvanometer.

A galvanometer of resistance G is converted into a voltmeter to measure up to V volts by connecting a resistance R_1 in series with the coil. If the resistance R_2 is connected in series with it then it can measure up to V/2 volts. Find the resistance in terms R_1 and R_2 required to be connected to convert it in to a voltmeter that can read up to 2V. Also find the resistance G of the galvanometer in terms of R_1 and R_2.

Q21. (a) State the condition for resonance to occur in series LCR ac circuit and derive an expression for resonant frequency.

(b) Draw a plot showing the variation of the peak current with frequency of the ac source used.

Q22. In Young's double slit experiment, deduce the conditions for constructive and destructive interference at a point on the screen with the help of a suitable diagram.

Q23. One day Chetan's mother developed a severe stomach ache all of a sudden. She was rushed to the doctor who suggested for an immediate endoscopy test and gave an estimate of expenditure for the same. Chetan immediately contacted his class teacher and shred the information with her. The class teacher arranged for the money and rushed to the hospital. On realizing that Chetan belonged to a below average income group family, even the doctor offered concession for the test fee. The test was conducted successfully.
Answer the following questions based on the above information:
(a) which principle in optics is made use of in endoscopy?
(b) Briefly explain the values reflected in the action taken by the teacher.
(c) In what way do you appreciate the response of the doctor on the given situation?

Q24. (a) Define electric dipole moment. Is it a scalar or a vector? Derive the expression for the electric field of a dipole at a point on the equatorial plane of the dipole.
(b) Draw the equipotential surfaces due to an electric dipole. Locate the points where the potential due to the dipole is zero.

OR

(a) A parallel plate capacitor is charged by a battery to a potential. The battery is disconnected and a dielectric slab is inserted to completely fill the space between the plates. How will (i) its capacitance, (ii) electric field between the plates and (iii) energy stored in the capacitor be affected? Justify your answer giving necessary mathematical expressions for each case.
(b) Sketch the pattern of electric field lines due to (i) a conducting sphere having negative charge in it, (ii) an electric dipole.

Q25. Write any two important points of similarities and differences each between Coulomb's law for the electrostatic field and Biot-Savart's law for the magnetic field. Use Biot-Savart's law to find the expression for the magnetic field due to a circular loop of radius 'r' carrying current 'I' at the center.

OR

Two infinitely long straight parallel wires, '1' and '2', carrying steady currents I_1 and I_2 in the same direction are separated by a distance d. Obtain the expression for the magnetic field $\vec{B}$ due to the wire '1' acting on wire '2'. Hence, find out with the help of a suitable diagram, the magnitude and direction of this force per unit length on wire '2' due to wire 'I'. How does the nature of this force change if the currents are in opposite direction? Use this expression to define the S.I. unit of current.

Q26. (a) A resistor of 400 Ω, and inductor of $\frac{5}{\pi}$ H and a capacitor of $\frac{50}{\pi}$ μF are connected in series across a source of alternating voltage of 140 sin 100 πt volts. Find the voltage (rms) across the resistor, the inductor and the capacitor. Is the algebraic ~~sum~~ of these voltages more than the source voltage? If yes, resolve the paradox. (Given $\sqrt{2}$=1.4).

(b) An ideal capacitor having a ~~change~~ charge q=q_0 cos ωt is connected across an ideal inductor 'I' through a switch 'S'. On closing the switch, show that the sum of the energies in the capacitor and inductor is constant in time in the free oscillations of the LC circuit.

OR

(a) What are eddy currents? How are these currents reduced in the metallic cores of transformers?
(b) A step down transformer operates on a 2.5 kV line. It supplies a load with 20 A. The ratio of the primary winding to the secondary is 10:1. If the transformer is 90% efficient, calculate
(i) the power output, (ii) the voltage, and
(iii) the current in the secondary.