INDIAN SCHOOL SOHAR No. of printed pages: 6
TERM I EXAMINATION 2018-19
PHYSICS (THEORY)

CLASS: XII **Max Marks: 70**
DATE: 27/9/2018 **Duration: 3 Hours**

General Instructions:

(i) All questions are compulsory. There are 27 questions in all.

(ii) This question paper has four sections: Section A, Section B, Section C and Section D.

(iii) Section A contains five questions of **one mark** each, Section B contains seven questions of **two marks** each; Section C contains twelve questions of **three marks** each and Section D 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:

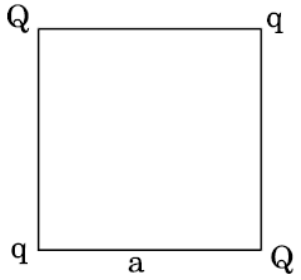
$c = 3 \times 10^{8}$ m/s
$h = 6.6 \times 10^{-34}$ J s
$e = 1.6 \times 10^{-19}$ C
$\mu_0 = 4\pi \times 10^{-7}$ Tm A^{-1}
$\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}
$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^{9}\ Nm^2C^{-2}$
Mass of electron = 9.1×10^{-31} kg
Mass of neutron = 1.675×10^{-27} 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. An electron is accelerated through a potential difference V. Write the expression for its final speed, if it was initially at rest.
2. Define the term magnetic susceptibility and write its relation in terms of relative magnetic permeability.
3. Two magnetic materials A and B have relative magnetic permeabilities of 0.96 and 500. Identify the magnetic materials A and B.
4. Give one example each to illustrate the situation where there is (i) displacement current but no conduction current and (ii) only conduction current but no displacement current.
5. Draw the phasor diagram for a series RC circuit connected to an ac source

Section B

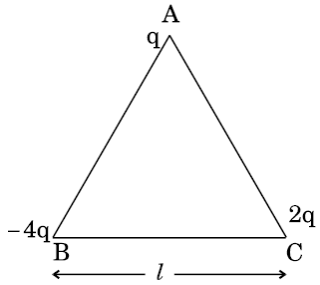
6. Two protons of equal kinetic energies enter a region of uniform magnetic field. The first proton enters normal to the field direction while the second enters at 30^0 to the field direction. Draw the trajectories followed by them.
7. Two point charges +4 μC and +1 μC are separated by a distance of 2 m in air. Find the point on the line joining charges at which the net electric field of the system is zero.
8. An infinitely large thin plane sheet has a uniform surface charge density +σ. Obtain the expression for the amount of work done in bringing a point charge q from infinity to a point, distant r, in front of the charged plane sheet
9. Two electric bulbs P and Q have their resistances in the ratio of 1: 2. They are connected in series across a battery. Find the ratio of the power dissipation in these bulbs.
10. Four point charges Q, q, Q and q are placed at the corners of a square of side 'a' as shown in the figure.



Find the potential energy of the system.

OR

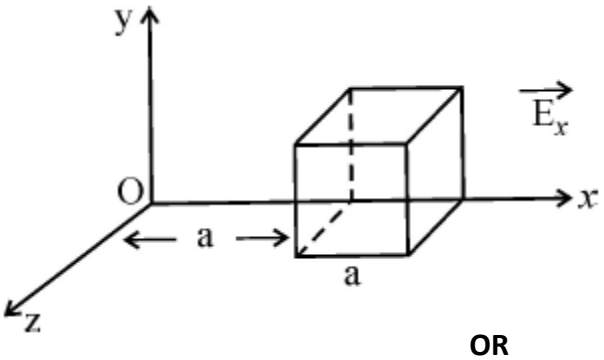
Three point charges q, – 4q and 2q are placed at the vertices of an equilateral triangle ABC of side *'l'* as shown in the figure. Obtain the expression for the magnitude of the resultant electric force acting on the charge q.



11. Use Ampere's Circuital theorem to find the magnetic field due to a long straight wire carrying a current **I**.
12. Define self-inductance of a coil. Obtain the expression for the self-inductance L of a coil of N turns.

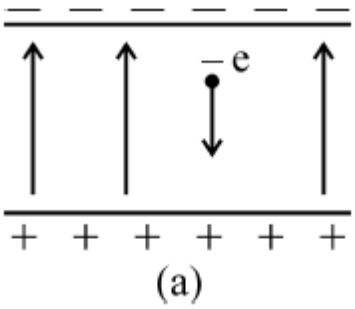
Section C

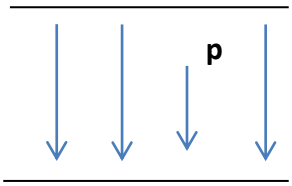
13. Define electric flux and write its SI unit. The electric field components in the figure shown are : $E_x = \alpha x$, $E_y = 0$, $E_z = 0$ where $\alpha = 100\ NC^{-1}\ m^{-1}$. Calculate the charge within the cube, assuming a = 0.1m.



OR

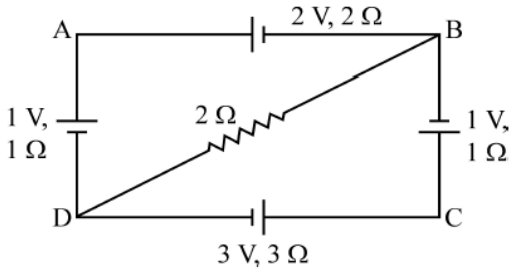
An electron falls through a distance of 1.5 cm in a uniform electric field of magnitude 2.0×10^4 N/C (Fig. a) Calculate the time it takes to fall through this distance starting from rest.





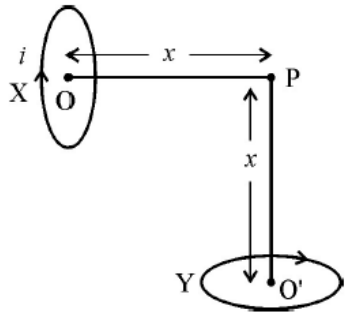
If the direction of the field is reversed (fig. b) keeping its magnitude unchanged, calculate the time taken by a proton to fall through this distance starting from rest.

14. A parallel plate capacitor of capacitance C is charged to a potential V by a battery. Without disconnecting the battery, the distance between the plates is tripled and a dielectric medium of k =10 is introduced between the plates of the capacitor. Explain giving reasons, how will the following be affected: (i) capacitance of the capacitor (ii) charge on the capacitor, and (iii) energy density of the capacitor.
15. State Kirchhoff's loop rule. Using Kirchhoff's rules, calculate the potential difference between B and D in the circuit diagram as shown in the figure.

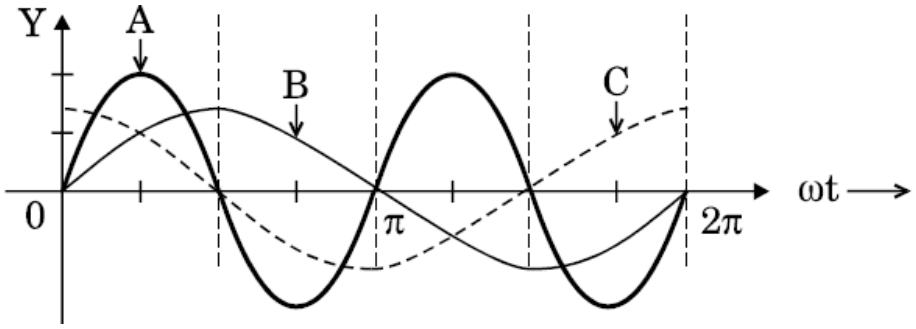


16. Derive the expression for the current density of a conductor in terms of the conductivity and applied electric field. Explain, with reason how the mobility of electrons in a conductor changes when the potential difference applied is doubled, keeping the temperature of the conductor constant.
17. (a) Draw the pattern of magnetic field lines for a circular coil carrying current. (b) Two identical circular loops X and Y of radius R and carrying the same current are kept in perpendicular planes

such that they have a common centre at P as shown in the figure. Find the magnitude and direction of the net magnetic field at the point P due to the loops.



18. Define mutual inductance between a pair of coils. Derive an expression for the mutual inductance of two long coaxial solenoids of same length wound one over the other.
19. What are the elements of Earth's magnetic field? Briefly explain each with help of diagrams.
20. An Iron rod of 0.5 cm^2 area of cross section is subjected to a magnetising field of 1200 Am^{-1}. If susceptibility of iron is 599, calculate (i) Permeability (μ) (ii) **B**, and (iii) magnetic flux produced.
21. (a) The reading on a high resistance voltmeter when a cell is connected across it is 2.2 V. When a 5Ω resistance is connected across the terminals of the cell in parallel with the voltmeter the reading drops to 1.8 V. Determine the internal resistance of the cell. (b) Write two factors on which internal resistance of a cell depend.
22. A device 'X' is connected to an ac source $V = V_0 \sin \omega t$. The variation of voltage, current and power in one cycle is shown in the following graph :

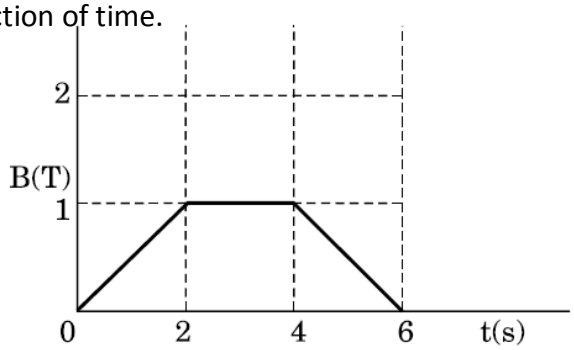


(a) Identify the device 'X'. (b) Which of the curves A, B and C represent the voltage, current and the power consumed in the circuit? Justify your answer. (c) How does its impedance vary with frequency of the ac source? Show graphically.

23. In a series LCR circuit, define the quality factor, Q, at resonance. Show that the power dissipated at resonance in LCR is maximum. Explain briefly how the phenomenon of resonance in the circuit can be used in the tuning mechanism of a radio or a TV set.
24. When an ideal capacitor is charged by a dc battery, no current flows. However, when an ac source is used, the current flows continuously. How does one explain this? Derive the expression for displacement current. What is the S.I. unit of displacement current?

Section D

25. (a) State Faraday's law of electromagnetic induction.(b) The magnetic field through a circular loop of wire 12 cm in radius and 8·5 Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Calculate the induced current in the loop and plot it as a function of time.



(c) Show that Lenz's law is a consequence of conservation of energy.

OR

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 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 30^0.

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

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.

OR

Describe, with the help of a suitable diagram, the working principle of a step-up transformer. Obtain the relation between input and output voltages in terms of the number of turns of primary and secondary windings and the currents in the input and output circuits.
Given the input current 15 A and the input voltage of 100 V for a step-up Given the input current 15 A and the input voltage of 100 V for a step-up transformer having 90% efficiency, find the output power and the voltage in the secondary if the output current is 3 A.

27. (a) State Biot – Savart law and express it in the vector form.(b) Using Biot – Savart law, obtain the expression for the magnetic field due to a circular coil of radius r, carrying a current I at a point on its axis distant x from the centre of the coil.

OR

(a) With the help of a diagram, explain the principle and working of a moving coil galvanometer.

(b) What is the importance of the radial magnetic field and how is it produced?

(c) Why is it that while using a moving coil galvanometer as a voltmeter a high resistance in series is required whereas in an ammeter a shunt resistance is used?