HALF YEARLY EXAMINATION: 2011-12

PHYSICS {042}

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

General Instructions

- All questions are compulsory.
- There is no overall choice. However, some internal choices have been provided in some questions.
- Question number 1 to 8, carrying one mark each, 9 to 18 carrying two marks each, 19 to 27 carrying three marks each, 28 to 30 carrying five marks each
- Use of calculator is not permitted. However you may use log tables if necessary. You may use the following values of physical constants wherever necessary:

  $c = 3 \times 10^{8} ms^{-1}$; $h = 6.6 \times 10^{-34} Js$; $e = 1.6 \times 10^{-19}$ C

  $\mu_o = 4\pi \times 10^{-7} T\ m\ A^{-1}$; Boltzmann constant $k = 1.38 \times 10^{23} JK^{-1}$

  Avogadro's number $NA = 6.023 \times 10^{23}$/mole Mass of neutron $M_n = 1.6 \times 10^{-27}$ kg

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1. Consider the situation as shown in fig (i) given below. What are the signs of q_1 and q_2?

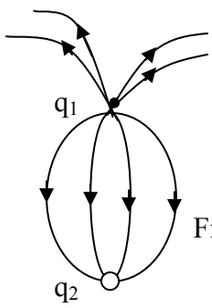


Fig.(i)

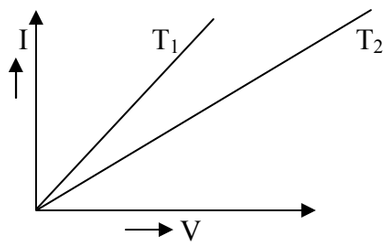


Fig.(ii)

2. I-V graph for a given metallic wire at two temperatures (T_1 & T_2) are shown in fig.(ii), which of these is for a higher temperature?

3. Why is Wheatstone bridge method suitable for comparing the resistances of the same order of magnitudes?

4. The fig. (iii) shows a circular loop carrying current I. Show the direction of magnetic field with the help of line of force.

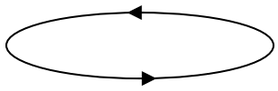


Fig.(iii)

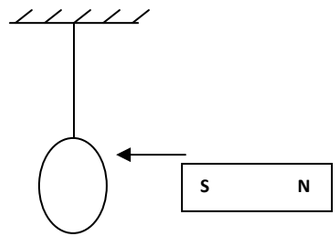


Fig.(iv)

5. Under what condition is the force acting on a charge moving through a uniform magnetic field minimum?

6. Give the direction in which the induced current flows in the wire loop when the magnet moves towards it as shown in fig. (iv).

7. Write the expression for the energy stored in a capacitor and an inductor.

8. Name two phenomena, which establish the wave nature of light?

9. A wire of 10 Ω resistance is stretched to thrice of its original length. What will be its (i) new resistivity and (ii) new resistance?

10. Two charges of 2μC and -2μC are placed at points A and B 6cm apart.

    (a) Identify an equipotential surface of the system.

    (b) What is the direction of the electric field at every point on the surface?

11. Two fixed point charge +4e and +e units are separated by a distance 'a'. Where should the third point charge be placed for it to in equilibrium?

OR

A system has electric charge $q_A = 2.5 \times 10^{-7}$C and $q_B = -2.5 \times 10^{-7}$C located at the point A(0, 0, 15cm) and (0, 0, +15cm) respectively. Calculate the electric dipole moment of the system, what is its direction?

12. Magnet field lines can be entirely confined within the core of a toroid, but not within a straight solenoid. Why?

13. State Lenz's law. Show that it is in accordance with the law of conservation of energy.

14. A light bulb and an open coil inductor are connected to an ac source as shown in fig (v). The switch is closed and after some time, an iron rod is inserted into the interior of the inductor. The glow of light bulb (a) increases, (b) decreases (c) is unchanged as the iron rod is inserted; Give your answer with reasons.

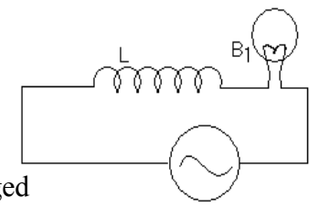


Fig (v)

15. Give any two characteristics of electromagnetic waves. Write the expression for the velocity of electromagnetic waves in terms of the permittivity and permeability of the medium.

16. What is the focal length of a convex lens of focal length 20 cm in contact with a concave lens of focal length 15 cm? Is the system is converging or diverging lens? Ignore the thickness of the lenses.

17. Calculate the refractive index of the material of an equilateral prism for which the angle of minimum deviation is 60^o.

18. The refractive index of the material of a convex lens is μ_1. It is immersed in a medium of refractive index μ_2. A parallel beam of light is incident on the lens. Trace the path of emergent rays when $\mu_2 > \mu_1$.

19. A small candle, 2.5 cm in size is placed at 27 cm from in front of a concave mirror of radius of curvature 36 cm. At what distance from the mirror should a screen be placed in order to obtain a sharp image? Describe the nature and size of the image. If the candle is moved closer to the mirror, how would the screen have to be moved?

20. A plane electromagnetic wave of frequency 25 MHz travel in free space along the x-direction. At a particular point in space and time the electric vector is $\vec{E} = 6.3$ V/m $\hat{j}$. Calculate $\vec{B}$ at this point.

21. What is dipole moment of an electric dipole? Derive an expression for the electric field on the axial line of an electric dipole.

22. If $C_1 = 3$pF and $C_2 = 2$pF, calculate the equivalent capacitance of the given network between points A & B?

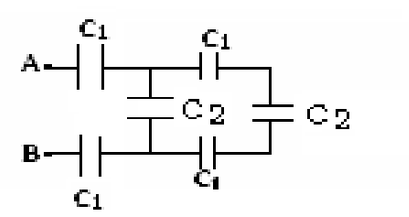
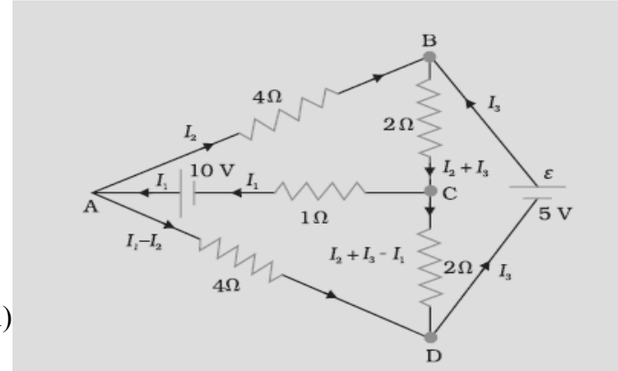


Fig (vi)



Fig(vii)

23. Determine the currents I_1, I_2 , I_3 in the network using Kirchhoff's laws.

OR

State Kirchhoff's laws of an electrical network and draw the network diagram.

24. What is meant by radial magnetic field? A moving coil galvanometer consisting of a rectangular coil of n turn, each of area A is suspended in a radial magnetic field of flux density B. With the help of a labeled diagram, derive the expression for the torque on the coil when the current passes through it.

25. Show that in an inductor, voltage leads to current by $\pi/2$.

OR

What is the phase difference between the emf and current when a capacitor is connected across an ac source?

26. A capacitor and a resistor are connected in series with an ac source. If the potential difference across the C, R are 120V and 90V respectively and if rms current of the circuit is 3 A, calculate the (i) impedance and (ii) power factor of the circuit.

27. Give reasons for the following: (i) Rainbow is not formed on the surface of the moon. (ii) The sun looks radish at sunrise and sunset as viewed from the surface of the earth.

28. (a) Using Gauss's law, derive an expression for electric field intensity at any point outside a uniformly charged thin spherical shell of radius R and charge density σ C/m^2. Draw the field lines when the charge density of the sphere (i) positive, (ii) negative. (b) A uniformly charged conducting sphere of 2.5 m in diameter has a surface charge density of 100μC/m^2. Calculate the (i) charge on the sphere, (ii) Total electric flux passing through the sphere.

OR

(a) Derive an expression the torque experienced by an electric dipole kept in a uniform electric field.

(b) Calculate the work done to dissociate the system of three charges placed on the vertices of a triangle as shown in fig (viii): Here $q = 1.6 \times 10^{-10}$C.

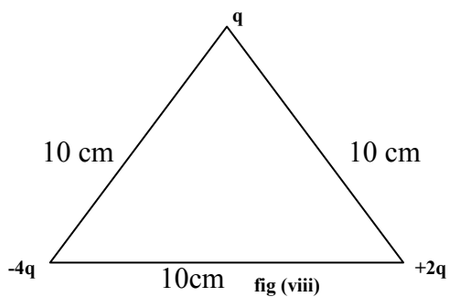


fig (viii)

29. (a) State Biot-Savart's law. Using this law, derive the expression for magnetic field due to a current carrying circular loop of radius 'R', at a point which is at a distance 'x' from its centre along the axis of the loop. (b) Two small identical circular loops, marked (i) and (ii), carrying equal currents, are placed with the geometrical axes perpendicular to each other as shown in fig. Find the magnitude and direction of the net magnetic field produced at point O.

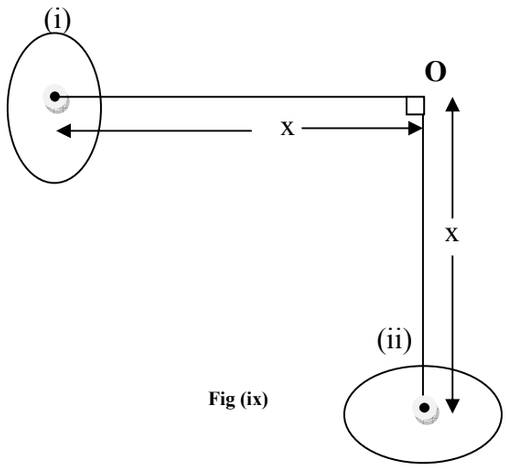


Fig (ix)

OR

(a) Draw a schematic diagram of a cyclotron. Explain its underlying principle.
(b) A cyclotron oscillator frequency is 10 MHz what should be the operating magnetic field for accelerating proton? If the radius of its Dees is 60 cm, what is the kinetic energy of the proton beam produced by the accelerator?
Express your answer in units of MeV, $m_p = 1.67 \times 10^{-27}$kg.

30. With the help of ray diagram, explain the formation of image in an astronomical telescope for a distant object. Define the term magnifying power of a telescope. Derive an expression for its magnifying power when it is in practical adjustment.

OR

With the help of ray diagram, illustrate the formation of final image of an object in a compound microscope. Derive an expression for its magnifying power. How can be magnifying power be increased?

****Best of luck****