TIME: 3 HOURS

General Instructions :

1. All questions are compulsory.
2. Q.1 to Q.5 are very short answer questions of 1 mark each.
3. Q.6 to Q.10 are short answer questions of 2 marks each.
4. Q.11 to Q.22 are long answer questions of 3 marks each.
5. Q.23 is a value based question of 4 marks.
6. Q.24 to Q.26 are long answer questions of 5 marks each.

Q1. Two equal balls having equal positive charge 'q' Coulomb are suspended by two insulating strings of equal lengths. What would be the effect on the force when a plastic sheet is inserted between the two? (1)

Q2. A circular coil of N turns and radius R carries a current I. It is unwound and rewound to make another coil of radius R/2, current I remaining the same. Calculate the ratio of the magnetic moments of the new coil and original coil. (1)

Q3. Twelve wires of equal lengths are connected in the form of a skeleton cube which is moving with a velocity $\vec{v}$ in the direction of a magnetic field $\vec{B}$. Find the e.m.f in each arm of the cube. (1)

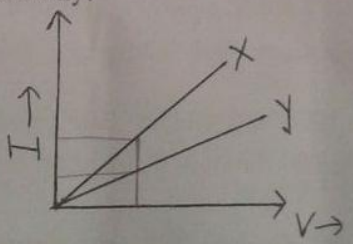
Q4. To which part of the electromagnetic spectrum does a wave of frequency 3×10^{13} Hz belong? (1)

Q5. A converging lens of refractive index 1.5 is kept in a liquid medium having the same refractive index. What would be the focal length of the lens in the medium? (1)

Q6. A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor but has a thickness 2d/3, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor. (2)

Q7. Explain what happens when a convex lens of refractive index 1.2 is immersed in a liquid of refractive index 1.3. (2)

Q8. The voltage current variation of two metallic wires X and Y at constant temperature are shown. Assuming that the wires have the same length and same diameter, explain which wire will have larger resistivity and why? (2)



Q9. A long straight wire of a circular cross section (radius a) carries steady current I. The current I is uniformly distributed across this cross section. Calculate the magnetic field in the region $r < a$ and $r > a$. Plot a graph between $\vec{B}$ Vs r.

Q10. Give two applications of eddy current & explain them briefly.

Q11. Derive lens makers formula.

Q12. a) Two charged spherical conductors of radii R_1 and R_2 respectively. Find the ratio of surface charge densities if they are connected by a wire. Are these surfaces equidistant from a point charge $q = 0$. Explain.

b) Draw equipotential surfaces due to a point charge $q > 0$. Are these surfaces equidistant from each other. Explain. (3)

Q13. a) Why are the connections between the resistors in a metre bridge made of thick copper strips?

b) Why is it generally preferred to obtain the balance point in the middle of the meter bridge wire.

c) Which material is used for the meter bridge wire and why? (3)

Q14. Compare the similarity between a solenoid and bar magnet. (3)

Q15. A rod of length l is moved horizontally with a uniform velocity 'V' in a direction perpendicular to its length through a region in which a uniform magnetic field is acting vertically downwards. Derive the expression for the e.m.f. induced across the ends of the rod. How can the motional emf, be explained using the concept of Lorentz force on free charge carriers of the conductor. (3)

Q16. a) Why are infrared waves often called heat waves? Give their one application.

b) Welders wear special glass goggles while working. Why?

c) Which part of electromagnetic spectrum is used in operating a RADAR & why? (3)

Q17. Two cells of e.m.f. 1.5 V and 2V and internal resistance 1Ω and 2Ω respectively are connected in parallel so as to send current in the same direction through a resistance of 5Ω. Draw the circuit diagram. (b) Using Kirchhoff's laws, find the current through each branch of the circuit and potential across the 5Ω resistance. (3)

Q18. State Gauss's law. Obtain an expression for the electric field due to an infinite plane sheet of charge. (3)

Q19. State the principle of potentiometer.

A cell of e.m.f. 1.08V is in series with a galvanometer. The series combination is placed across a resistor of resistance 108Ω which is in series with a potentiometer wire, a battery of emf 4V and zero internal resistance and another variable resistor. The resistance of the 1m long potentiometer wire is 2Ω. What should be the resistance of the variable resistor, so that the deflection in the galvanometer is to be zero? (3)

20. State Curie's law.

An iron rod of volume $10^{-4}\ m^3$ and relative permeability 1000 is placed inside a long solenoid wound with 5 turns cm^{-1}. If a current of 0.5 A is passed through the solenoid, find the magnetic moment of the rod. (3)

When a series combination of a coil of inductance L and a resistor of resistance R is connected across a 12V- 50Hz supply, a current 0.5 A flows through the circuit. The current differs in phase from applied voltage by $\frac{\pi}{3}$ radian. Calculate the value of L and R. (3)

Capacitor

A 28 μF is charged to 100V and another 2 μF capacitor to 200V. They are connected in parallel. Determine the total initial and final energies. Account for the difference in two values. (3)

Mrs. Sharma parked her car and forgot to switch off the car headlights. When she returned, she could not start the car. Rohit, a passerly came to her for help. After knowing about her problem, he went to a mechanic Ramu. Ramu noticed that the car battery was discharged. He replaced it with a new battery. He succeeded in starting the engine. (4)

battery charger which supplies 110V dc. How much resistance must be connected in series with the battery to limit the charging current to 5A? What will be the potential difference across the terminals of the battery during charging? What is the purpose of having a series resistor in the charging circuit?

Q24. (a) Describe a simple experiment or activity to show the polarity of emf induced in a coil is always such that it tends to produce a current which opposes the change of magnetic flux that produces it. (5)

(b) The current flowing through an inductor of self inductance L is continuously increasing. Plot a graph showing the variation of

(i) Magnetic Flux versus the current

(ii) Induced e.m.f. versus dI/dt

(iii) Magnetic Potential energy stored versus the current.

Q25. Draw a labeled ray diagram showing the formation of a final image by a compound microscope at least distance of distinct vision. Define angular magnification. (5)

The total magnification produced by a compound microscope is 20. The magnification produced by the eye piece is 5. The microscope is focused on a certain object. The distance between the objective and eye piece is 14cm. If least distance of distinct vision is 20cm, calculate the focal length of objective & eye piece.

Q26. With the help of a labeled diagram, explain the principle and working of a galvanometer.

The current sensitivity of a moving coil galvanometer increases by 20%, when its resistance is doubled. Calculate by what factor the voltage sensitivity changes.

********** THE END **********