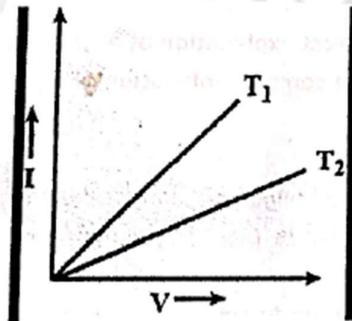


CLASS - XII**General Instructions**

1. All the questions are compulsory there are 33 questions in all. Total 10 pages are there.
2. The question paper has five sections: Section A, Section B, Section C, Section D and Section E.
3. Section A contains 10 very short answer questions and four assertion reasoning MCQ of 1 Mark each. Section B has two case based questions of 4 marks each. Section C contains 9 short answer questions of 2 marks each and Section C contains 5 short answer questions of 3 marks each and section E contains 3 long answer questions of 5 marks each.
4. Black is no overall choice however internal choice is provided you have to attempt only one of the choices in such question.

Section A

1. Sketch the electric field lines for two point charges q_1 and q_2 for $q_1=q_2$ and $q_1>q_2$ separated by a distance d .
2. A conducting sphere of radius R is given a charge Q . What is the electric potential and electric field and the centre of the sphere.
3. I-V graph for the two metallic wires at two different temperatures is as shown in the figure. Which of the two temperature is lower and why?



4. In a certain region a static electric field and magnetic field exists. The magnetic field is given by $B = B_0(\hat{i}+2\hat{j}-4\hat{k})$. If a test charge moving with a velocity, $v=v_0(3\hat{i}-\hat{j}+2\hat{k})$ experiences no force in that region. Calculate the electric field in SI units.
5. A bar magnet AB with the magnetic moment M is cut into two equal Parts perpendicular to its axis. One part is kept over the other so that B is exactly over A What will be the net magnetic moment of the combination formed? Why?

6. Which of the following substances are diamagnetic: Material P having magnetic susceptibility of -0.00015 or Material Q having magnetic susceptibility 10^{-5} Why?
7. There are two coils A and B as shown in the fig. The current starts flowing in B as shown, when A is moved towards B, and stops when A stops moving. The current in A is counterclockwise. B is kept stationary A moves. What change would you observe in A in terms of the current and Why?
8. A pair of adjacent coils has a mutual inductance of 1.5 H . If the current in one coil changes from 0 to 20 A in 0.5 s . What is the change in the flux linkage with the other coil.
9. A light bulb and a solenoid are connected series across an a.c. source of voltage. Explain what will happen to the glow of the light bulb when an iron rod is inserted in the solenoid.
10. Write the dimensional formula for the Q-factor.

Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

- (a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false and R is also false.

11. **Assertion:** A metallic shield in form of a hollow shell may be built to block an electric field.

Reason: In a hollow spherical shield, the electric field inside it is zero at every point.

Or

Assertion: The tyres of aircraft are slightly conducting.

Reason: If a conductor is connected to ground, the extra charge induced on the conductor will flow to ground.

12. **Assertion:** The electric bulbs glow immediately when the switch is on.

Reason: The drift velocity of electrons in a metallic wire is very high.

13. **Assertion:** To protect any instrument from external magnetic field, it is put inside an iron body.

Reason: Iron is a magnetic substance.

14. **Assertion:** When ac circuit contain resistor only, its power is minimum.

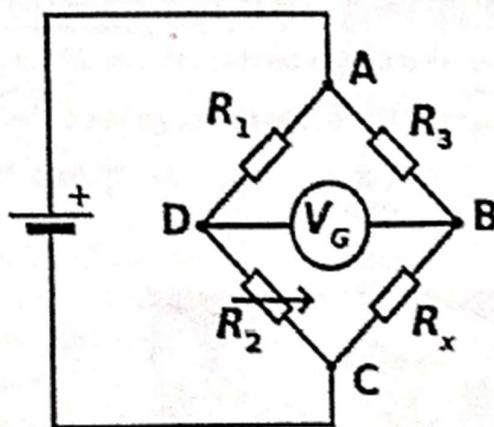
Reason: Power of a circuit is independent of phase angle.

SECTION B

Case Based questions

(Attempt any four parts of each question out of 5)

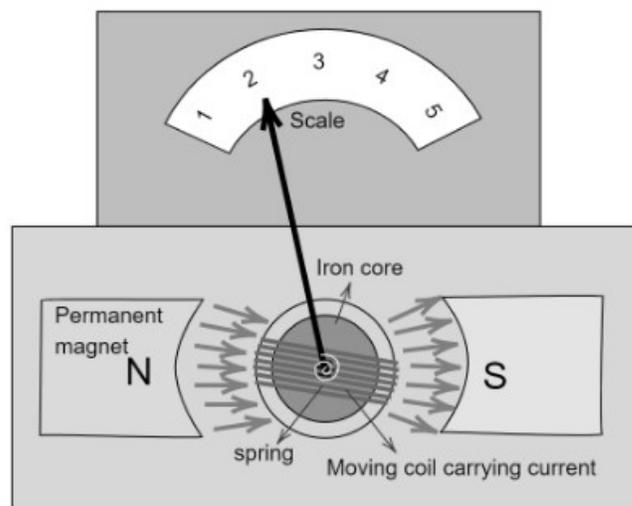
15. A Wheatstone bridge is an electrical circuit used to measure an unknown electrical resistance by balancing two legs of a bridge circuit, one leg of which includes the unknown component. The primary benefit of the circuit is its ability to provide extremely accurate measurements. The resistance is adjusted until the bridge is "balanced" and no current flows through the galvanometer.



At this point the voltage between the two mid point B and D will be zero. Therefore the ratio of the two resistances in the known leg is equal to the ratio of the two resistances in the unknown leg

- (i) In balanced Wheat Stone bridge
- Potential at points B and D remain same
 - Large current flows through the circuit
 - Battery becomes over heated
 - Resistances become small
- (ii) Wheat bridge is used to measure unknown
- unknown current
 - unknown charge
 - unknown voltage
 - unknown resistance

- (iii) Wheat Stone Bridge is implemented in lab using
- Ammeter
 - Voltmeter
 - Meter Bridge
 - Potentiometer
- (iv) Condition for balanced Wheat stone bridge
- $R_1 / R_2 = R_3 / R_x$
 - $R_3 = R_1 * R_x$
 - $R_1 = R_3 * R_x$
 - None of the Above
- (v) Three resistance R_1, R_2, R_3 each of 2 ohms and an unknown resistance R_x forms the four arms of the wheatstone bridge. A resistance of 6 ohms is connected parallel to R_x . If the bridge is balanced what will be the value of R_x
- 2.5 ohms
 - 2 ohms
 - 3 ohms
 - 3.5 ohms
16. Moving coil galvanometer operates on Permanent Magnet Moving Coil (PMMC) mechanism and was designed by the scientist Darsonval.
- Moving coil galvanometers are of two types (i) Suspended coil (ii) Pivoted coil type or tangent galvanometer. Its working is based on the fact that when a current carrying coil is placed in a magnetic field, it experiences a torque. This torque tends to rotate the coil about its axis of suspension in such a way that the magnetic flux passing through the coil is maximum.



Front view of a Moving Coil Galvanometer

- (i) A moving coil galvanometer is an instrument which
- (a) is used to measure emf
 - (b) is used to measure potential difference
 - (c) is used to measure resistance
 - (d) is a deflection instrument which gives a deflection when a current flows through its coil
- (ii) To make the field radial in a moving coil galvanometer:
- (a) number of turns of coil is kept small
 - (b) magnet is taken in the form of horse-shoe
 - (c) poles are of very strong magnets
 - (d) poles are cylindrically cut
- (iii) The deflection in a moving coil galvanometer is
- (a) directly proportional to torsional constant of spring
 - (b) directly proportional to the number of turns in the coil
 - (c) inversely proportional to the area of the coil
 - (d) inversely proportional to the current in the coil
- (iv) In a moving coil galvanometer, having a coil of N -turns of area A and carrying current is placed in a radial field of strength B . The torque acting on the coil is
- (a) NA^2B^2I (b) $NABI^2$ (c) N^2ABI (d) $NABI$
- (v) To increase the current sensitivity of a moving coil galvanometer, we should decrease
- (a) strength of magnet
 - (b) torsional constant of spring
 - (c) number of turns in coil
 - (d) area of coil

SECTION C

17. A point charge causes an electric flux of $-1.0 \times 10^3 \text{ Nm}^2/\text{C}$ to pass through a spherical Gaussian surface of 10.0 cm radius centred on the charge.
- (a) If the radius of the Gaussian surface were doubled, how much flux would pass through the surface? Explain.
 - (b) What is the value of the point charge?
18. The two graphs are drawn below, show the variation of electrostatic potential V with $1/r$ (r being the distance of field point from the point from the point charge) for two point charges q_1 and q_2 .
- (a) What are the signs of the two charges. Justify
 - (b) Which of the two charges has the larger magnitude and why ?

19. (a) Two wires of equal length, one of copper and the other of manganin have the same resistance. Which wire is thicker? Why?
- (b) Nichrome and copper wire of same length and same radius are connected in series. Current, I , is passed through them. Which wire gets heated up more? Justify your answer.

OR

Find the equivalent capacitance between A and B in the given figure. Take $C_2 = 10\mu\text{f}$ and C_1, C_2, C_3 each equal to $4\mu\text{f}$.



20. A potential difference V is applied across a conductor of length L and diameter D . How are the electric field E and the resistance R of conductor affected, when
- (a) V is halved
- (b) L is halved. Justify your answers.
21. Two long straight wires A and B carrying the current of 8.0 A and 5.0 A in same direction are separated by a distance of 4 cm . Estimate the force on 10 cm section of the wire. Also mention its nature.
22. A straight horizontal conducting rod of length 0.45 m and mass 60 g is suspended by two vertical wires at its ends. A current of 5.0 A is set up in the rod through the wires.
- (a) What magnetic field should be set up normal to the conductor in order that the tension in the wires is zero?
- (b) What will be the total tension in the wires if the direction of current is reversed keeping the magnetic field same as before? (ignore the mass of the wires.) $g = 9.8\text{ ms}^{-2}$
23. Differentiate between permanent magnets and electromagnets in terms of their retentivity, coercivity and permeability.

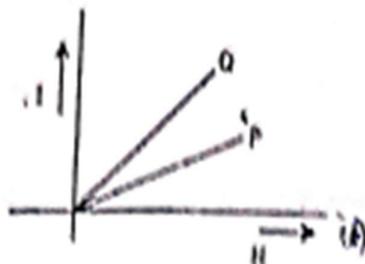
OR

Draw the magnetic field lines for a current carrying solenoid is made of

(a) copper

(b) Aluminium

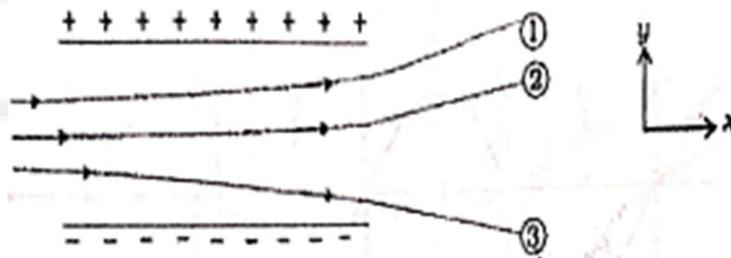
The given graph shows the variation of Intensity of magnetisation, I with strength of applied magnetic field H for two magnetic materials P and Q.



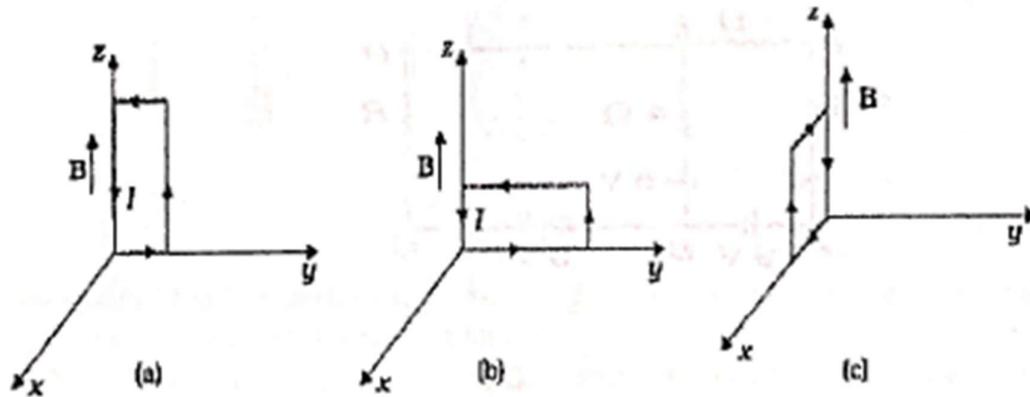
- 1) Identify the material P and Q. Justify your answer.
 - 2) For the material P, plot the variation of the Intensity of magnification with temperature?
25. Two concentric circular coils one of small radius r_1 and the other of large radius r_2 such that $r_1 \ll r_2$ are placed coaxially with centres coinciding. Obtain the mutual inductance of the arrangement.

SECTION D

26. Figure below shows tracks of three charged particles in a uniform electrostatic field. Give the signs of the three charges. Also derive the relation between the deflection experienced by the particle and the charge to mass ratio, if the length of the plates is L and Initially the charged particles are moving in x -direction?



27. A $200 \mu\text{F}$ parallel plate capacitor having the plate separation of 5 mm is charged by a 100 V dc source. It remains connected to the source. Using an insulated handle, the distance between the plates is doubled and a dielectric slab of thickness 5 mm and dielectric constant 10 is introduced between the plates. Explain with reason, how the
- (i) capacitance,
 - (ii) electric field between the plates,
 - (iii) energy density of the capacitor will change?
28. A uniform magnetic field of 3000 G is established along the positive z -direction. A rectangular loop of sides 10 cm and 5 cm carries a current of 12 A .
What is the torque on the loop in the different cases shown in Fig. below ?

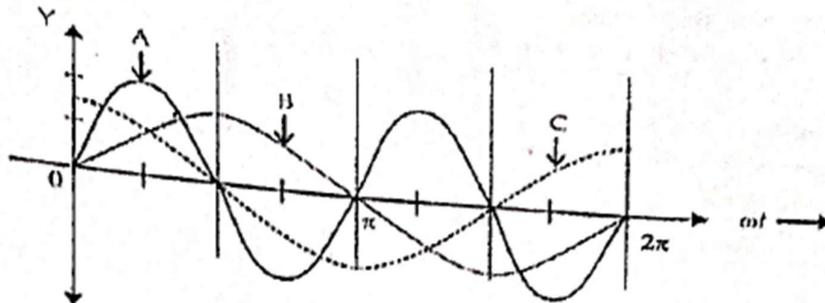


What is the force in each case? Justify your answers

29. A conducting rod of length l , with one end pivoted is rotated with a uniform angular speed ω' in a vertical plane, normal to a uniform magnetic field B' . Deduce an expression for the emf induced in this rod. If the resistance of the rod is R , what is the current induced in it?
30. Draw a labeled diagram of an a.c. generator. On what principle does it work? Discuss its working. Write the expression for the emf generated in the coil in terms of its speed of rotation.

OR

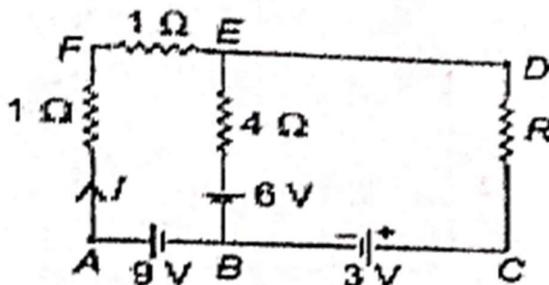
A device X is connected to an a.c. source $V = V_0 \sin \omega t$. The variation of voltage, current and power in one cycle is shown in the following graph.



- (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

SECTION E

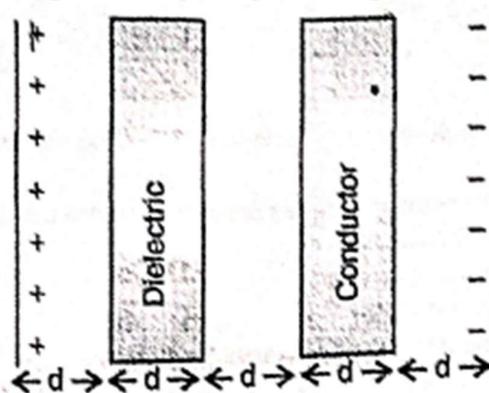
31. State Kirchhoff's rules. Using Kirchhoff's rules determine the value of unknown resistance R in the circuit so that no current flows through $4\ \Omega$ resistance. Also find the potential difference between A and D



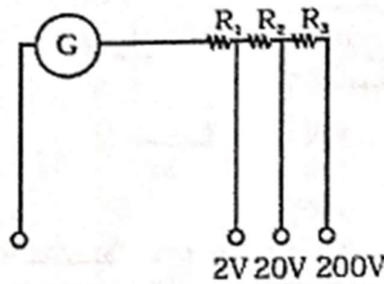
OR

Compare the individual dipole moment and the specimen dipole moment for H_2O molecule and O_2 molecule when placed in

- (I) Absence of external electric field.
 - (ii) Presence of external electric field. Justify your answer.
- (b) Given two parallel conducting plates of area A and charge densities $+\sigma$ and $-\sigma$. A dielectric slab of constant K and a conducting slab of thickness d each are inserted in between them as shown.
- (i) Find the potential difference between the plates.
 - (ii) Plot E versus x graph, taking $x = 0$ at positive plate and $x = 5d$ at negative plate.

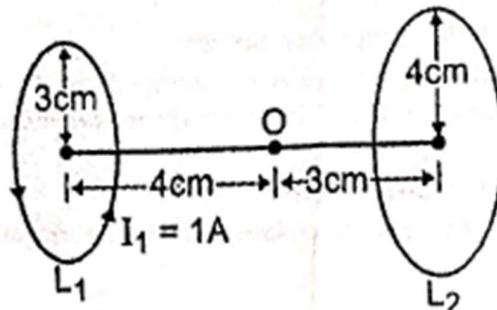


32. Briefly explain how a galvanometer can be converted to a voltmeter. A multi range voltmeter can be constructed by using a galvanometer circuit as shown in Fig. We want to construct a voltmeter that can measure 2V, 20V and 200V using a galvanometer of resistance $10\ \Omega$ and that produces maximum deflection for current of 1 mA. Find R_1 , R_2 and R_3 that have to be used.



OR

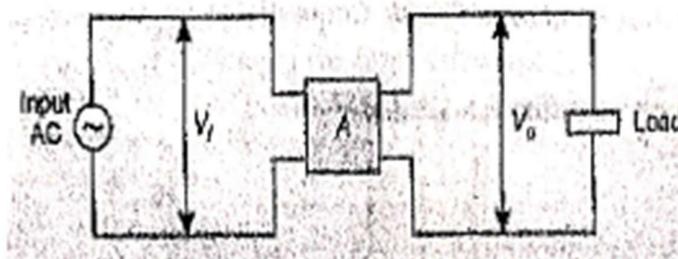
- Using Biot-Savart law derive the expression for magnetic field in the vector form at a point on the axis of a circular current loop.
- Two coaxial circular loops L_1 and L_2 of radii 3cm and 4cm are placed as shown in figure. What should be the magnitude and direction of the current in the loop L_2 so that the net magnetic field at the point O be zero?



33. (a) Define the term Self Inductance of a solenoid. Derive the expression for the same for a solenoid.
- (b) The current flowing through an inductor of self inductance L is continuously increasing plot a graph showing the variation of
- Magnetic flux versus the current
 - Induced emf versus di/dt
 - Magnetic potential energy stored versus the current.

OR

- (a) Box A, in the set up shown in the figure, represents an electric device often used to supply electric power from the (ac) mains to a load. It is known that $V_o < V_i$. Identify the device A and draw its symbol. Also define the transformer ratio. What will be its value in this case ?



- (b) A small town with a demand of 800kW of electric power at 220V is situated 15 km away from an electric plant generating power at 440 V. The resistance of the two wire line carrying power is 0.5Ω per km. The town gets power from the line through a 4000- 220 V step-down transformer at a sub-station in the town.
- Estimate the line power loss in the form of heat.
 - How much power must the plant supply, assuming there is negligible power loss due to leakage?
 - Characterise the step up transformer at the plant.
