Indian School Al Wadi Al Kabir
Assessment 1
Physics (Code: 042)
SET 1

Class : XII | Time: 3 Hours
Date : 20/09/2022 | Max. Marks : 70

General Instructions:
(1) All questions are compulsory. There are 29 questions in all.
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
(3) Section A contains ten objective multiple-choice questions of 1 mark each, Section B contains seven very short answer type questions of 2 marks each, Section C contains 7 short answer questions of 3 marks each, Section D contains three long answer type questions of 5 marks each and Section E contains two case-based study questions of 5 marks each.
(4) There is no overall choice. However internal choice is provided. You have to attempt only one of the choices in such questions.
(5) All questions are compulsory. In case of internal choices, attempt any one of them.

SECTION- A (1 x 10 = 10)

1. A certain physics textbook shows a region of space in which two electric field lines cross each other. We conclude that;
(a) at least two-point charges are present
(b) an electrical conductor is present
(c) the field points in two directions at the same place
(d) the author made a mistake

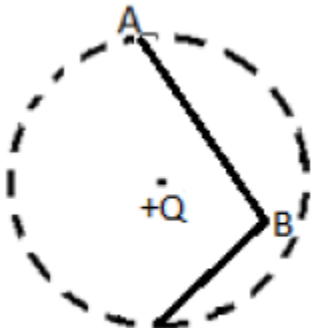
2. The flux of the electric field $(24\,\hat{\imath} + 30\hat{\jmath} + 16\hat{k})$ N/C, through an area of 2.0 m^2 portion of the yz plane is;
(a) 32 Nm^2/C (b) 34 Nm^2/C (c) 48 Nm^2/C (d) 42 Nm^2/C

3. How many pairs are matched incorrectly?

Physical quantity	**SI units**
Power	kWh
Energy	kW
Potential difference	joule/coulomb
Current	ampere/second
resistance	volt/coulomb

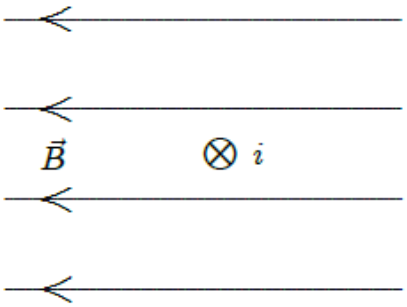
(a) one pair (b) two pairs (c) three pairs (d) four pairs

4. In the given figure, charge +Q is placed at the centre of a dotted circle. Work done in taking another charge +q from A to B is W_1 and from B to C is W_2. Which one of the following is correct?



(a) $W_1 > W_2$ (b) $W_1=W_2$ (c) $W_1 < W_2$ (d) $W_1=2W_2$

5. The figure shows a uniform magnetic field $\vec{B}$ directed to the left and a wire carrying a current into the page. The magnetic force acting on the wire is:



(a) towards the top of the page
(b) towards the bottom of the page
(c) towards the left
(d) towards the right

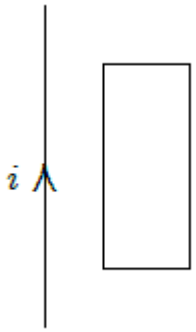
6. Suitable units for μ_0 are:
(a) tesla meter/ampere (b) weber/meter
(c) kilogram ampere/meter (d) newton/ampere^2

7. The magnetic field B inside a long ideal solenoid is independent of:
(a) the current (b) the core material
(c) the spacing of the windings (d) the cross-sectional area of the solenoid

8. 1weber is the same as:
(a) 1 V/s (b) 1 T m^2 (c) 1 T/m (d) 1 T/s

9. Faraday's law states that an induced emf is proportional to:
(a) the rate of change of the magnetic field (b) the rate of change of the electric field
(c) the rate of change of the magnetic flux (d) the rate of change of the electric flux

10. A long straight wire is in the plane of a rectangular conducting loop. The straight wire carries a constant current i, as shown. While the wire is being moved towards the rectangle the current in the rectangle is:



(a) clockwise (b) counterclockwise
(c) clockwise in the left side and counterclockwise in the right side
(d) counterclockwise in the left side and clockwise in the right side

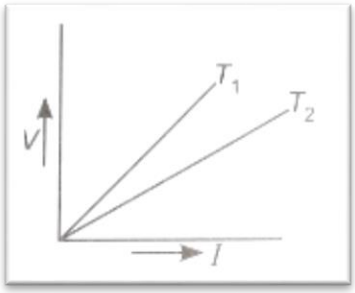
SECTION- B (2 x 7 = 14)

11. A regular hexagon of side 10 cm has a charge 5 μC at each of its vertices. Calculate the potential at the center of the hexagon.

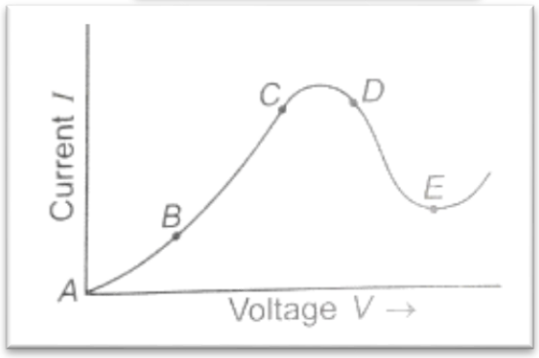
12. (a) Depict the expression of electric field due to a straight infinite uniformly line charge of linear charge density 'λ' C/m.
(b) Draw a graph to the variation in E with perpendicular distance 'r' from the line charge.

13.(a) Plot a graph showing the variation of resistance of a conducting wire as a function of its radius, keeping the length of the wire and its temperature as constant.

(b) V – I graph for a metallic wire at two different temperatures T_1 and T_2 is as shown in the figure. Which of the two temperatures is higher and why?



14. (a) Graph showing the variation of current Vs voltage for a material GaAs is shown in the figure. Identify the region of
(i) negative resistance.
(ii) where Ohm's law is obeyed.
(b) Give an example of a material each for which the temperature coefficient of resistivity is (i) positive, and
(ii) negative.



15. Define one tesla using the expression for the magnetic force acting on a particle of charge q moving with velocity $\vec{V}$ in a magnetic field $\vec{B}$.

OR

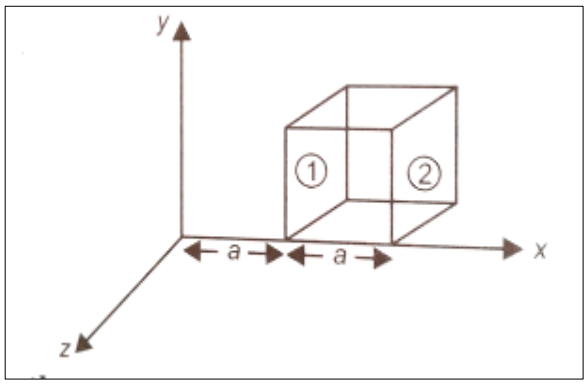
What is velocity selector? Write its SI unit.

16. Circular coil of closely wound 'N' turns and radius R carries a current I. Write the expression for the following
(i) The magnetic field at its center.
(ii) The magnetic moment of this coil.

17. A light bulb and a solenoid are connected in series across an ac source of voltage, explain how the glow of the light bulb will be affected, when an iron rod is inserted into solenoid?

SECTION- C (3 x 7 = 21)

18**.** State Gauss law in electrostatics a cube with each side 'a' is kept in an electric field given by $\vec{E}$ = Cx $\hat{\imath}$ (as shown in the figure), where C is a positive constant. find out
(a) the electric flux through the cube, and
(b) the net charge inside the cube.

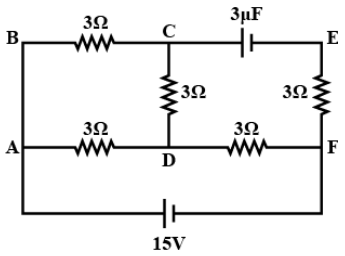


19. Two-point charges +q and +9q are separated by a distance of 10a. Find the point on the line joining the two charges where electric field is zero?

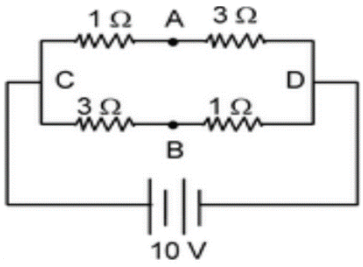
20. Define mobility of electrons in a conductor. How does electron mobility change? when
(i) temperature of conductor is decreased?
(ii) and applied potential difference is doubled at constant temperature?

OR

In the circuit shown in the figure, find the total resistance of the circuit and the current in the arm CD.

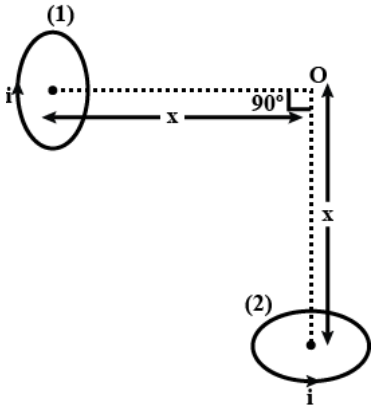


21. A battery of emf 10 V is connected to resistances as shown in the figure. Determine the potential difference between A and B.



22. (i) Write an expression for the force experienced by a charge Q moving with a velocity V in a magnetic field B. Use this expression to define the unit of magnetic field.
(ii) Obtain an expression for the force experienced by a current carrying wire in a magnetic field.

23. Two small identical circular loops marked (1), and (2), carrying equal currents I are placed with their geometrical axis perpendicular to each other, as shown in the figure. Find the magnitude and direction of the net magnetic field produced at the point 'O'.



24. State and prove Biot-Savart's law.

SECTION- D (5 x 3 = 15)

25. (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 plates, and (iii) energy is 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 on it, (ii) an electric dipole.

OR

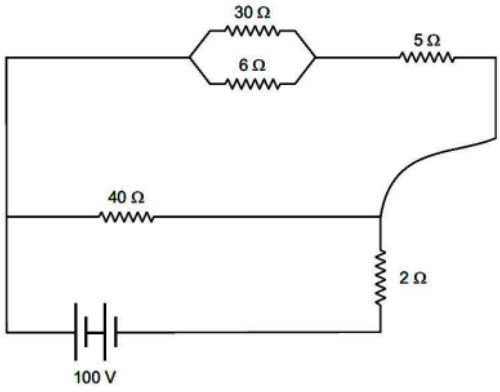
(a) Two isolated metal spheres A and B have radii R and 2R respectively and same charge 'q'. Find which of the two spheres have greater (i) capacitance, and (ii) energy density just outside the surface of the spheres.
(b) Show that the equipotential surfaces are closer together in the regions of strong field and far apart in the regions of weak field. Draw equipotential surfaces for two identical positive charges placed nearby.

26. (i) Explain, using a labelled diagram the principle and working of a moving coil galvanometer. What is the function of (a) radial magnetic field, and (b) soft iron core?
(ii) Define the terms (a) current sensitivity and (b) voltage sensitivity of a galvanometer.
(iii) Why does increasing the current sensitivity not necessarily Increase voltage sensitivity?

OR

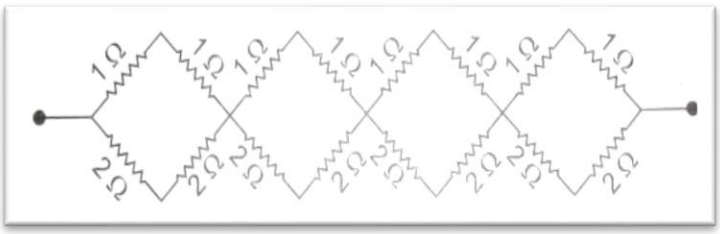
(I) Show that a planer loop carrying a current I, having N closely wound turns and area of cross section A, possesses a magnetic moment m = NIA.
(ii) When this loop is placed in a magnetic field B, find out the expression for the torque acting on it.
(iii) A galvanometer coil of 50 Ω resistance shows full deflection for a current of 5 mA. How will you convert this galvanometer into a voltmeter of range 0 to 15 V?

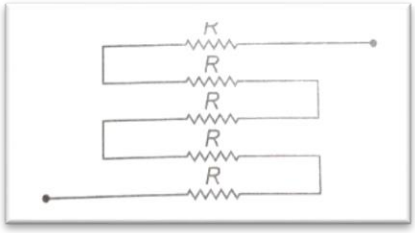
27. (a) Define the term drift velocity of charge carriers in a conductor. Obtain the expression for the current density in terms of relaxation time.
(b) A 100 V battery is connected to the electric network as shown. if the power consumed in the 2 Ω resistor is 200 W. Determine the power dissipated in the 5 Ω resistor.



OR

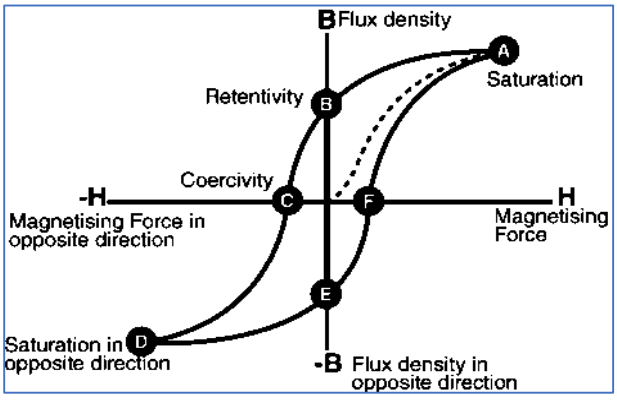
(a) Given *n* resistors each of resistance R, how will you combine them to get
(i) maximum (ii) minimum resistance? What is the ratio of maximum to minimum resistance?
(b) Given the resistances of 1 Ω, 2 Ω, 3 Ω, how will you combine them to get an equivalent resistance of: (i) 11/3 Ω (ii)11/5Ω (iii) 6 Ω, and (iv) 6/11 Ω.
(c) Determine the equivalent resistance of network shown in the figures.





SECTION- E (5 x 2 = 10)
Case-based study questions;

28. **HYSTERESIS LOSS**; The hysteresis loop shows the relationship between the magnetic flux density and the magnetizing field strength. The amount of magnetization present in the sample when the external magnetizing field is removed is known as **retentivity.** The amount of reverse (-ve H) external magnetizing field required to completely demagnetize the substance is known as **coercivity** of substance. A **smaller region** of the hysteresis loop is indicative of **less loss** of hysteresis. With increasing the magnetic field there is an increase in the value of magnetism and finally reaches point A, which is called saturation point, where B is constant. With a decrease in the value of the magnetic field, there is a decrease in the value of magnetism. But at B, H is equal to zero, substance or material retains some amount of magnetism is called **retentivity** or residual magnetism. When there is a decrease in the magnetic field towards the negative side, magnetism also decreases. At point C the substance is completely demagnetized. The force required to remove the retentivity of the material is known as **Coercive** force (C).



Answer the following questions;

(i) The strength of the earth's magnetic field varies from place on the earth's surface, its value being of the order of

(a) 10^5 T (b) 10^{-6} T (c) 10^{-5} T (d) 10^8 T

(ii) A bar magnet is placed North-South with its North-pole due North. The points of zero magnetic field will be in which direction from centre of magnet?

(a) North-South (b) East-West

(c) North- East and South-West (d) None of these

(iii) The material suitable for making electromagnets should have

(a) high retentivity and high coercivity.

(b) low retentivity and low coercivity.

(c) high retentivity and low coercivity.

(d) low retentivity and high coercivity.

(iv) A smaller region of the hysteresis loop is indicative of more loss of hysteresis.

(a) true (b) false

(v) A diamagnetic material in a magnetic field moves

(a) perpendicular to the field. (b) from weaker to stronger field.

(c) from stronger to weaker field. (d) in random direction.

29. **Self-Induction**;

When a current 'I' flows through a coil, flux linked with it is $\varphi = LI$, where L is a constant known as self-inductance of the coil. Any change in current sets up an induced emf in the coil. Thus, self-inductance of a coil is the induced emf set up in it when the current passing through it changes at the unit rate. It is a measure of the opposition to the growth or the decay of current flowing through the coil. Also, value of self-inductance depends on the number of turns in the solenoid, its area of cross-section and the permeability of its core material.

Answer the following questions;

(i) The inductance in a coil plays the same role as

(a) inertia in mechanics (b) energy in mechanics

(c) momentum in mechanics (d) force in mechanics

(ii) A current of 2.5 A flows through a coil of inductance 5 H. The magnetic flux linked with the coil is

(a) 0.5 Wb (b) 12.5 Wb (c) zero (d) 2 Wb

(iii) The inductance L of a solenoid depends upon its radius R as

(a) $L \propto R$ (b) $L \propto 1/R$ (c) $L \propto R^2$ (d) $L \propto R^3$

(iv) The unit of self-inductance is

(a) Weber ampere (b) Weber^{-1} ampere (c) Ohm second (d) Farad

(v) The induced emf in a coil of 10 henry inductance in which current varies from 9 A to 4 A in 0.2 second is

(a) 200 V (b) 250 V (c) 300 V (d) 350 V