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HOLIDAY HOME WORK-XII (SUMMER BREAK)2017-18
ARVIND KUMAR PGT PHYSICS

UNIT - I

ELECTROSTATICS

Q1. Electrostatic experiments do not work well on humid days. Give reasons.

A1) Electrostatic experiments require accumulation of charges; these are drained away through humid air.

Q2. An electron moves along a metal tube with variable cross-section as shown in figure. How will its velocity change when it approaches the neck of the tube?

A2) No Change. As electric field inside the conductor is zero.

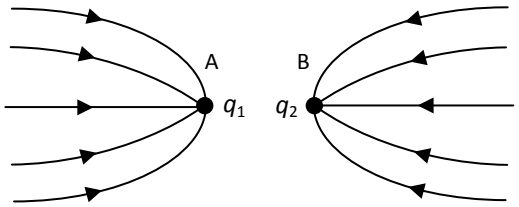
Q3. Why do the gramophone records get covered with dust easily? (**Alternate Question**: TV screen catches more dust.)

A3) Needle gives rubbing action i.e. frictional electricity records get charged.

Q4. A force F is acting between two charges placed some distance apart in vacuum. If a brass rod is placed between these two charges, how does the force change?

A4) K of brass = ∞ therefore $F_{brass} = 0$

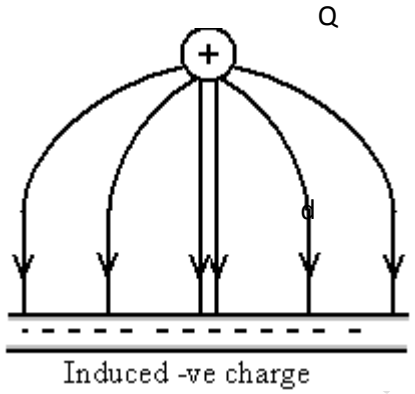
Q5. Figure shows electric lines of force due to point charge q_1 and q_2 placed at points A and B respectively. Write the nature of charge on them?



A5) Both –ve charges

Q6. If a charge + Q is fixed at a distance '*d*' in front of an infinite metal plate, draw the electric lines of force indicating the direction clearly.

A6)



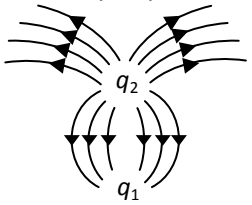
Q7. A point charge placed at any point on the axis of an electric dipole at some large distance experiences a force F. What will be the force acting on the point charge when its distance from the dipole is doubled?

A7) F' = $\frac{F}{8}$

Q8. What is the number of electric lines of force that radiate outwards from one coulomb of charge in vacuum?

A8) $\phi = \frac{q}{\varepsilon_0} = \frac{1}{\varepsilon_0} = 1.13 \times 10^{11}\ V_m$

Q9. Consider the situation shown in figure. What are the signs of q_1 and q_2? If the lines are drawn in proportion to the charge, what is the ratio q_1 / q_2?



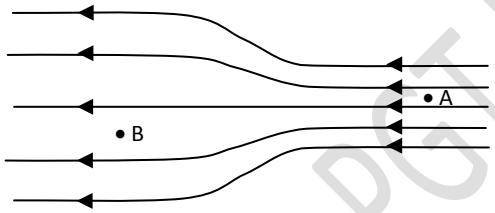
A9) $\frac{q_1}{q_2} = \frac{6}{18} = \frac{1}{3}$

Q10. Two small balls, having equal positive charge *q* coulomb are suspended by two insulating strings of equal length *l* metre from a hook fixed to a stand. The whole set up is taken in a satellite into space where there is no gravity. What is the angle between the two strings and the tension in each string?

A 10) $\theta = 180^{\circ}$, No mg (weight) component

$$F = T = \frac{1}{4\pi E_0} \frac{q^2}{(2l)^2}$$

Q11. In the electric field shown in figure, the electric field lines on the left have twice the separation as that between those on the right. If the magnitude of the field at point A is 40 NC^{-1}, calculate the force experienced by a proton placed at point A. Also find the magnitude of electric field at point B.



A11) $F_A = e E_A$, $F_B = e E_B$, $E_B = \frac{E_A}{2}$ Get E_B = 20 unit

Q12. Two positive charges Q and 4Q are fixed at a distance of 12 cm from each other. Sketch the lines of force and locate the neutral points, if any.

A12) For charge Q, less crowding of electric lines of force

For charge 4Q ,More crowding of electric lines of force

$$\frac{KQ}{x^2} = K\frac{4Q}{(12-x)^2}$$, x =4 cm

Q13. An electric dipole free to move is placed in a uniform electric field. Explain along with diagram its motion when it is placed, (*a*) parallel to the field, (*b*) perpendicular to the field.

A 13) (a) Net F = 0, $\tau = 0$ (b) $\tau = p E \sin 90°$

Q14. A point charge is placed at the centre of spherical Gaussian surface. How will electric flux ϕ_E change if

(i) The sphere is replaced by a cube of same or different volume,

(ii) A second charge is placed near, and outside, the original sphere,

(iii) A second charge is placed inside the sphere, and

(iv) The original charge is replaced by an electric dipole?

A 14) (i) doesn't change . ϕ_E independent of shape / size

(ii) doesn't change , (iii) change , (iv) zero

Q15. Consider a uniform electric field $\vec{E} = 3\times10^3\,\hat{i}\ \mathrm{NC}^{-1}$.

(i) What is the flux of this field through a square of 10 cm on a side whose plane is parallel to the Y-Z-plane?

(ii) What is the flux through the same square if the normal to its plane makes a 60° angle with the X-axis?

A15) (i) $\phi = (3\times10^3)\ \hat{i}.(0.01\,\hat{i}) = 30$ unit

(ii) use $\theta = 60°$

Q16. What are the points at which electric potential of a dipole has maximum value?

A 16) At axial points (+ve max. or –ve max.)

Q17. What are the points at which electric potential of a dipole has a zero value?

A17) Equatorial points

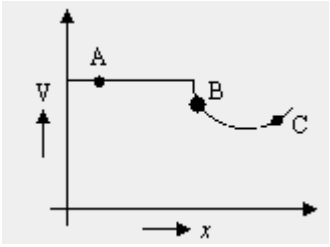
Q18. Write two applications of capacitors in electrical circuits?

A18) (i) For tuning purposes

(ii) For smoothening rectified current (filter)

(iii) Demodulator

Q19. The adjoining figure shows the variation of electrostatic potential V with distance '*x*' for a given charge distribution. From the points marked A, B and C, identify the point at which the electric field is : (*i*) Zero , (*ii*) Maximum. Explain your answer in each case.



A19) $E = \frac{-dv}{dx}$ = -ve slope

(i) At A, $\frac{dv}{dx} = 0$

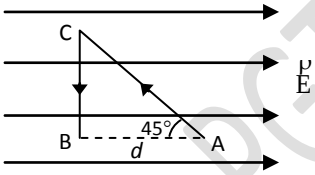
(ii) At B, $(\frac{dv}{dx})$ = -ve

$\therefore$ E = -(-ve) = +ve (max.)

At C, $\therefore$ $\frac{dv}{dx}$ = +ve

$\therefore$ E = -(+ve) = -ve (min.)

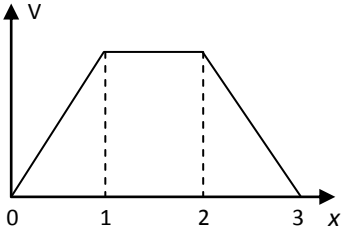
Q20. A test charge q_0 is moved without acceleration from point A to B along the path A $\rightarrow$ C $\rightarrow$ B as shown in figure. Calculate the potential difference between A and B.



A20) $E = \frac{-dv}{dr} = -\frac{(V_b - V_a)}{d} = \frac{V_a - V_b}{d}$

$V_a - V_b = Ed$

Q21. The electric potential as a function of distance *x* is shown in figure. Construct a graph of the electric field strength E.



A21) $E = \frac{-dv}{dx}$ = -ve slope

(i) For 0 < x < 1, $\frac{dv}{dx}$ = +ve $\therefore$ E = -ve Constant (V $\propto$ X)

(ii) For $1 < x < 2$, $\frac{dv}{dx} = 0$, E = 0

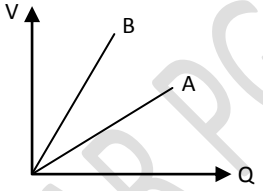
(iii) For $2 < x < 3$ $\frac{dv}{dx}$ = -ve , E = +ve Constant

Q22. Two metal plates form a parallel plate capacitor. The distance between the plates is *d*. A metal sheet of thickness *d*/2 and of the same area is introduced between the plates. What is the ratio of the capacitances in the two cases?

A22) use $C' = \frac{\epsilon_0 A}{(d-t)}$ and $C' = \frac{\epsilon_0 A}{d}$

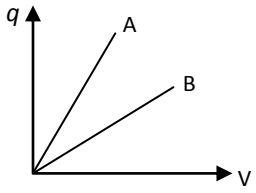
Get $\frac{C'}{C} = 2$

Q23. The graph shows the variation of voltage V across the plates of two capacitors. A and B versus increase of charge Q stored on them. Which of the capacitors has higher capacitance? Give reason for your answer.



A23) Slope = $\frac{1}{C}$; $C_A > C_B$

Q24. The given graph shows the variation of charge *q* versus potential difference V for two capacitors C_1 and C_2. The two capacitors have same plate separation but the plate area of C_2 is double than that of C_1. Which of the lines in the graph correspond to C_1 and C_2 and why?



A24) Use $C \propto A$, A for C_2 , B for C_1

Q25. What meaning would you give to the capacity of a single conductor?

A25) The second plate is at infinity

Q26. A capacitor is charged by a battery of potential difference V and it acquires charge Q. (i) How much energy is stored in the capacitor? (ii) How much energy is supplied by the battery?

A26) (i) $\frac{1}{2}$ qV (ii) Qv

Q27. A parallel plate capacitor is made by stacking '*n*' equally spaced plates connected alternately. If the capacity between any two plates be 'C', then find the resultant capacitance.

A27) Hint : Check combination of plates.

Q28. '*n*' identical drops each charged to V volt combine to form a big drop. Find the potential of the big drop.

A28) $\frac{4}{3}\pi R^3 = n\,\frac{4}{3}\pi r^3$ get $R = n^{1/3} r$,Ans. $n^{2/3} V$

Q29. Find the capacitance of three parallel plates, each of area A and separated by distance d_1 and d_2. The spaces in between are filled with dielectric of relative permittivity ε_1 and ε_2. The permittivity of free space is ε_0.

A29) Given system is equivalent to two II plate

Capacitor connected in series

Use $C_1 = \frac{\varepsilon_1 \varepsilon_0 A}{d_1}$, $C_2 = \frac{\varepsilon_2 \varepsilon_0 A}{d_2}$

$$\frac{1}{Cs} = \frac{1}{C_1} + \frac{1}{C_2}$$

Get $Cs = \frac{\varepsilon_1 \varepsilon_2 \varepsilon_0 A}{\varepsilon_2 d_1 + \varepsilon_1 d_2}$

Q30. A parallel plate capacitor with plates of area A and separation *d* is charged to a potential difference V and the battery used to charge is disconnected. A dielectric slab of thickness *d* and dielectric constant K is now placed between the plates. Explain changes, if any, in the charge, potential difference, capacitance, electric field and energy stored in the capacitor.

A30) (i) q remains unchanged

(ii) V decreases

(iii) C increases $C \propto \frac{1}{V}$

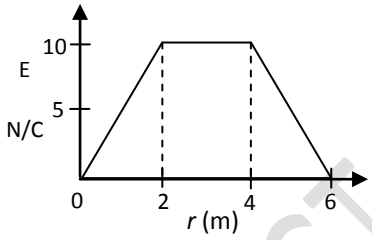
(iv) $E = \frac{V}{d}$, decreases

(v) U = $\frac{1}{2}$ qV, decreases

Q31. How will the above changes be modified if the battery is kept connected to the capacitor while the dielectric slab is inserted?

A31) Try it

Q32. The graph below shows the variation of electric intensity E with distance *r*. What is the potential difference between the points at *x* = 2 m and *x* = 6 m from O?



A32) use E = - $\frac{dV}{dx}$

Q33. What is the nature of symmetry of the potential of a point charge?

A33) Spherical

Q34. Can a metal sphere of radius 1 cm hold a charge of 1 coulomb? Justify your answer.

A34) E =$9 \times 10^9 \frac{q}{R^2}$, get E = 9×10^{13} v/m > dielectric strength of air . "Cannot hold"

Q35. What is an optical analogue of equipotential surface?

A35) Wave front

UNIT-2

CURRENT ELECTRICITY

Q1. A steady current flows in a metallic conductor of non-uniform cross-section. Which of the following quantities is constant along the conductor: current, current density, electric field, drift speed?

A-1 Only Current.

Hint use $V_d \propto 1/A$, $V_d \propto E$, $J \propto I/A$

Q2. Name substances which have positive value of temperature coefficient of resistance.

A-2 Metals, Alloys.

Q3. Name substances which have negative value of temperature coefficient of resistance.

A-3 Semiconductors and insulators.

Q4. Can Kirchhoff's laws be applied both the direct and alternating currents?

A-4 Yes

Q5. Under what circumstances can the terminal potential difference of a battery exceed its e.m.f.?

A-5 During Charging of battery, V>E

Q6. Under what condition is the series combination of cells useful?

A-6 When External resistance R >>r

Q7. Resistivity of the material of a conductor of uniform cross-section varies along its length as

$$\rho = \rho_0 (1 + \alpha x)$$

Find its resistance if its length is L and area of cross-section is A.

A7 Hint- small resistance, dR for small length dx

Use dR = ρ dx/A, get R

Q8. How does the drift velocity of electrons in a metallic conductor change, if the length of the conductor is doubled by stretching it, keeping the applied potential difference constant?

A-8 Hint - Use $V_d = I/neA$, $A^* = A/2$, $I^* = I/4$

$R^* = n^2 R$, Answer = ½ V_d

Q9. 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 in turn (*i*) V is halved, (*ii*) L is halved and (*iii*) D is doubled? Justify your answer in each case.

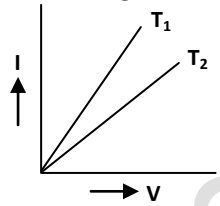
A-9 Hint, use $V_d = E\tau/m$, $V_d = \frac{I}{neA}$

$E = V/L$, $R = \rho\frac{l}{A}$

Q10. Two wires A and B of the same metal and of same length have their areas of cross-section in the ratio of 2 : 1. If the same potential difference is applied across each wire in turn, what will be the ratio of the currents flowing in A and B?

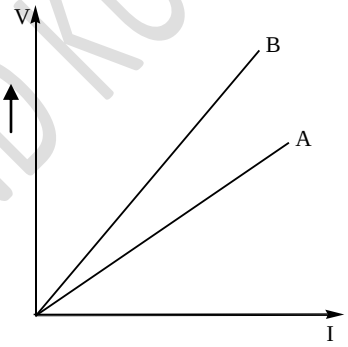
A- 10 Hint $I \propto A$, get $I_1/I_2 = A_1/A_2 = 2/1$

Q11. V – I graph for a metallic wire at two different temperatures T_1 and T_2 is as shown in figure. Which of the two temperatures T_1 and T_2 is higher and why?



A-11 $T_2 > T_1$, because R_2 is higher

Q12. V – I graphs for parallel and series combination of two metallic resistors are shown in figure. Which graph represents parallel combination? Justify your answer.

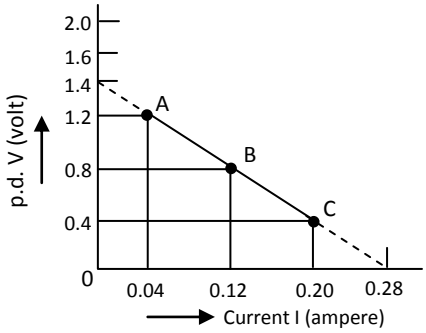


A-12 Graph A, because $R_A < R_B$

Q13. Potential difference across terminals of a cell were measured (in volts) against different currents (in ampere) flowing through the cell. A graph was drawn which was a straight line ABC. Using the data given in the graph determine,

(i) The e.m.f. and

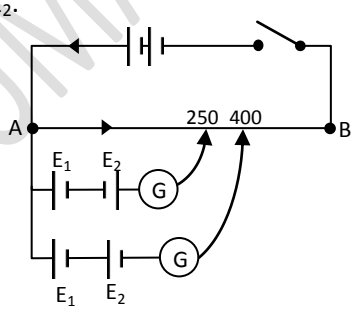
(ii) The internal resistance of the cell.



A-13 i) E = 1.4 V when I = 0

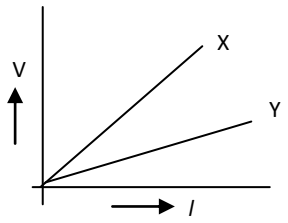
ii) Use V = E-Ir

Q14. Two primary cells of e.m.f. E_1 and E_2 ($E_1 > E_2$) are connected to the potentiometer wire AB as shown in figure. If the balancing lengths for the two combinations of the cells are 250 cm and 400 cm, find the ratio of E_1 and E_2.



A-14 Hint: $E_1 - E_2 \propto 250$, $E_1 + E_2 \propto 400$

Q15. The variation of potential difference V with length *l* in case of two potentiometers X and Y is as shown in the given diagram. Which one of these two will you prefer for comparing emfs of two cells and why?



A-15 Less Potential gradient, more sensitive.

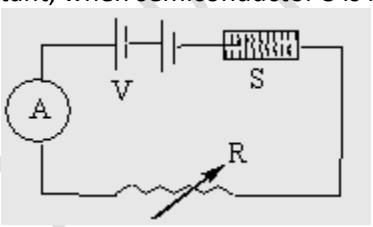
Q16. In an electric kettle, water boils in 20 minutes after the kettle is switched on. With the same supply voltage if the water is to boil in 10 minutes, should the length of the heating element be decreased or increased?

A-16 Hint: using $H_1 = H_2$ and $H = V^2 t/R$, $R \propto l$

Q17. Express power transferred per unit volume into joule heat in a resistor in terms of current density.

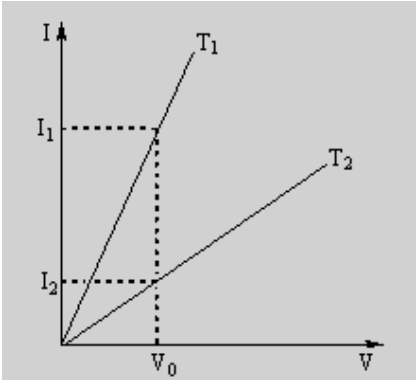
A-17 Hint: $P = VI$ and Current density $J = I/A$

Q18. The diagram shows a piece of pure semiconductor, S in series with a variable resistor R, and a source of constant voltage V. Would you increase or decrease the value of R to keep the reading of ammeter (A) constant, when semiconductor S is heated? Give reason.



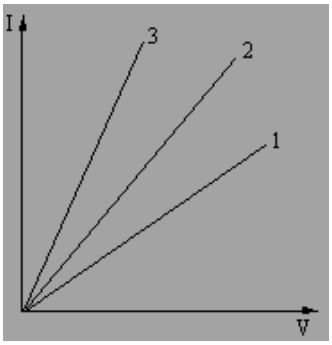
A-18 Hint: when S is heated, R decreases, I increases

Q19. The current voltage graphs for a given metallic wire at different temperatures T_1 and T_2 are shown in figure. Which of the temperatures T_1 and T_2 is greater?



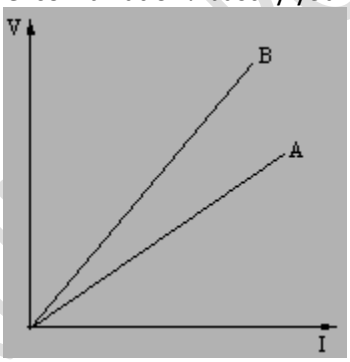
A-19 Answer is $T_2 > T_1$ Hint :- find R_1 and R_2 using at same V

Q20. The V – I graphs of two resistors, and their series combination, are shown in figure. Which one of these graphs represents the series combination of the other two? Give reasons for your answer.



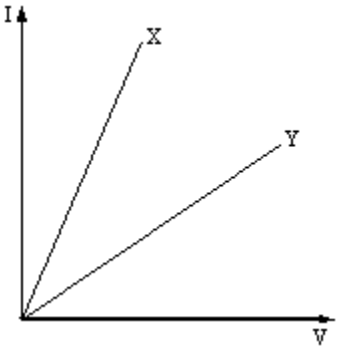
A-20 Answer graph 1. Hint: - Find R at same V

Q21. V – I graphs for parallel and series combination of two metallic resistors are as shown in figure. Which graph represents parallel combination? Justify your answer.



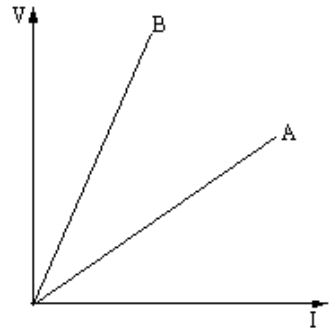
A-21 Use slope method, A represents. (Lower R)

Q22. The voltage current variation of two metallic wires X and Y at constant temperature are shown in figure. Assuming that the wires have the same length and the same diameter, explain which of the two wires will have larger resistivity.



A-22 $\rho_x < \rho_y$, Hint - use slope method

Q23. The voltage-current graphs for two resistors of the same material and the same radii with length L_1 and L_2 are shown in the figure. If $L_1 > L_2$, state with reason, which of these graphs represents voltage-current change for L_1.



A-23 B, Hint - $R \propto L$

Q24. A conductor of length '*l*' is connected to a d.c. source of potential 'V'. If the length of the conductor is tripled, by stretching it, keeping 'V' constant, explain how do the following factors vary in the conductor :

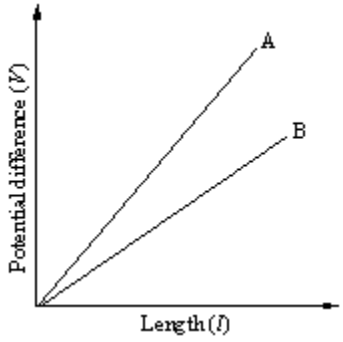
(a) Drift speed of electrons; (b) Resistance; and (c) Resistivity.

A-24 Hint: use $v_d = eV\tau / ml$, $R = \rho l/A$

Q25. Two metallic wires of the same material and same length but different cross-sectional areas are joined together (i) in series (ii) in parallel, to source of emf. In which of the two wires will the drift-velocity of electron be more in each of the two cases and why?

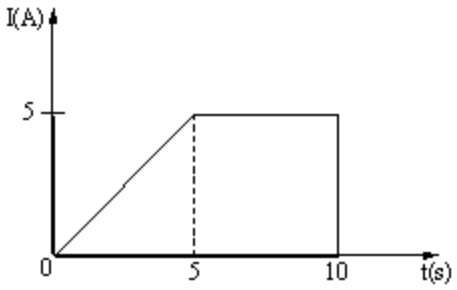
A-25 $I = neAV_d$ Hint: In series, I is constant, In parallel, V is constant

Q26. The variation of potential difference with length in case of two potentiometers A and B is shown in the figure. Which of the two is preferred to find e.m.f. of a cell? Give reason for your answer.



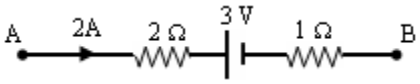
A-26 B is preferred. Hint:- less potential gradient, more accuracy

Q27. Show a plot of current I through the cross-section of a wire over a time interval of 10 s. Find the amount of charge that flows through the wire during this time period.



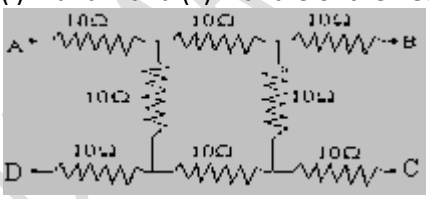
A-27 Hint:- Charge = Area under graph. Ans = 37.5 C

Q28. Figure represents a part of closed circuit. What is the potential difference between points A and B?



A28 Use Ohm's law with proper care of +ve & -ve signs. Ans = 9V

Q29. Find the resistance between (*i*) A and B and (*ii*) A and C of the network shown in the figure.



A29 1) R = 27.5 ohm , 2) R = 30 ohm. Hint- Leave open branches

Q30. Under what condition is the parallel combination of cells useful?

A-30 When External resistance R<<r

UNIT-3

MAGNETIC EFFECT OF CURRENT AND MAGNETISM

Q1. In what respect does a wire carrying a current differ from a wire, which carries no current?

Ans-1 A current carrying wire produces a magnetic field around it.

Q2. Where is the magnetic field at a current element (i) minimum and (ii) maximum?

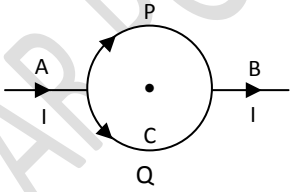
Ans-2 i) Minimum - along axis

ii) Maximum - in a plane passing thro' element and perpendicular to axis.

Q3. A straight conductor AB of a circuit lies along the X-axis from x = – a/2 to x = + a/2 and carries a current I. What is the magnetic field due to this conductor AB at a point x = + a ?

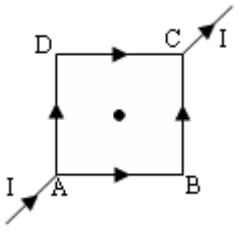
Ans-3 Zero. As observation point lies on the axis of straight conductor.

Q4. Consider the circuit shown, where APB and AQB are semicircles. What will be the magnetic field at the centre C of the circular loop?



Ans-4 Zero

Q5. Figure shows a square loop made from a uniform wire. If a battery is connected between the points A and C, what will be the magnetic field at the centre of the square?



Ans-5 Zero

Q6. What will be the path of a charged particle moving in a uniform magnetic field at any arbitrary angle?

Ans-6 Helical

Q7. An electron and a proton, moving parallel to each other in the same direction with equal momenta, enter into a uniform magnetic field which is at right angles to their velocities. Trace their trajectories in the magnetic field.

Ans-7 Hint- Use Fleming's left hand Rule

Q8. A charged particle moving in a uniform magnetic field penetrates a layer of lead and thereby loses one half of its kinetic energy. How does the radius of curvature of its path change?

Ans-8 $r = mv/qB$ and momentum $p = (2mE)^{1/2}$

Q9. When a charged particle moves in a magnetic field, its K.E. always remains constant or variable. Justify your choice.

Ans-9 Workdone , $W = \Delta KE = 0$ so K.E = constant

Q10. Uniform electric and magnetic fields are produced pointing to the same direction. An electron is projected in the direction of the fields. What will be the effect on the kinetic energy of the electron due to the two fields?

Ans-10 No effect of B on electrons, whereas electric field retarded.

Q11. A galvanometer gives full scale deflection with the current I_g. Can it be converted into an ammeter of range $I < I_g$?

Ans-11 Hint : Use $S = Ig\,G / (I - Ig)$, NO

Q12. A student wants to increase the range of an ammeter from 1 mA to 5 mA. What should be done to the shunt resistance?

Ans-12 Hint : As I-Ig increases, therefore S decreases.

Q13. A galvanometer is first converted into a voltmeter of range 0 – 3V and then into a voltmeter of range 0 – 6 V. In which case the resistance would be higher one?

Ans-13 Hint : Use $R = V/Ig - G$, $R \alpha V$

As shown in figure, a rectangular loop of width l is suspended from the insulated hook of a spring balance. A current I flows in the anticlockwise