REVISION TEST SERIES-1

PHYSICS (042)

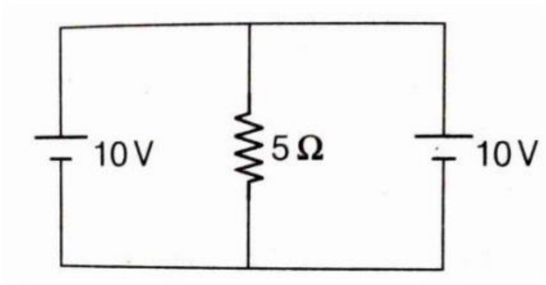
Time: 1½ HOURS **SET A** **Maximum Marks: 35**

General Instructions:

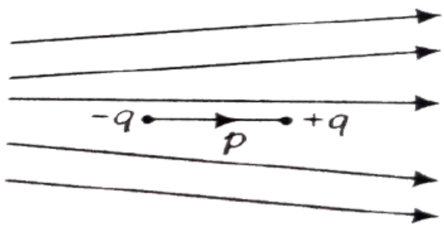
1. There are questions in all. All questions are compulsory.
2. There are five sections Section A, Section B, Section C, Section D and Section E.
3. Section A contains nine MCQ of 1mark each, Section B contains four questions of 2marks each, Section C contains three questions of 3marks each, Section D contains one long answer type questions of 5mark and Section E contains one case study question of 4mark.

SECTION A

1. The charges on two spheres are +7μC and -5 μC respectively. They experience a force F. If an additional charge of -2 μC is given to each of them the force between them is
   a. F   b. F/2   c. F/√3   d. 2F
2. The current through the 5Ω resistor is



   a. 2A   b. 4A   c. 0   d. 1A
3. Drift velocity varies with the intensity of electric field as per the relation
   a. V α E   b. V α 1/E   c. V α E^2 d. V α E^{-2}
4. Figure shows electric field lines in which an electric dipole P is placed as shown. Which of the following statements is correct?



   a. The dipole will not experience any force.
   b. The dipole will experience a force towards right.
   c. The dipole will experience a force towards left
   d. The dipole will experience a force upwards.
5. Kirchhoff's second law for the electric network is based on
   a. Law of conservation of charge   b .Law of conservation of energy
   c. Law of conservation of angular momentum   d. Law of conservation of mass

6. The electric potential V at any point (x, y, z) in space is given by $V=3x^2$ where x, y and z are all in metre. The electric field at the point (1m, 0, 2m) is
   a. 6V/m along -x axis   b. 6V/m along +x axis
   c. 1.5V/m along -x axis   d. 1.5V/m along +x axis
7. Two parallel plate capacitors X and Y have same plate area and same separation between the plates. X has air between the plates and Y has a dielectric medium of K=4. When they are connected in series with a source of 12V, what is the ratio of energies stored in X to Y
   a. 1:4   b. 8:1   c. 4:1   d. $\sqrt{2}$:5
8. 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.

   Assertion (A): The work done by an electrostatic field in moving a charge from one point to another depends only on the initial and the final points.

   Reason (R): Electrostatic force is a conservative force.
   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 but R is true.

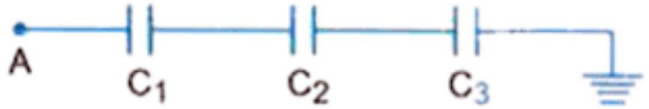
9. Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below.

   Assertion (A): A charge is quantized because only integral number of electrons can be transferred.

   Reason (R): There is no possibility of transfer of some fraction of electron.
   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 but R is true.

SECTION B

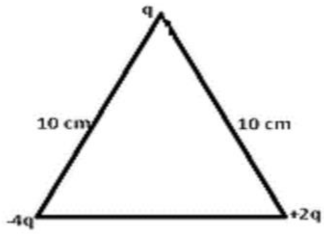
10. Four-point charges $q_A = 2\mu C$, $q_B = -5\mu C$, $q_C = 2\mu C$, and $q_D = -5\mu C$ are located at the corners of a square ABCD of side 10 cm. What is the force on a charge of $1\mu C$ placed at the centre of the square?
11.
    A. An electrostatic field line is a continuous curve. That is, a field line cannot have sudden breaks. Why not?
    B. Explain why two field lines never cross each other at any point?
12. Calculate the potential difference in the capacitance C_2 in the circuit shown. The potential at A is 90V and $C_1 = 20\ \mu F$, $C_2 = 30\ \mu F$, $C_3 = 15\ \mu F$



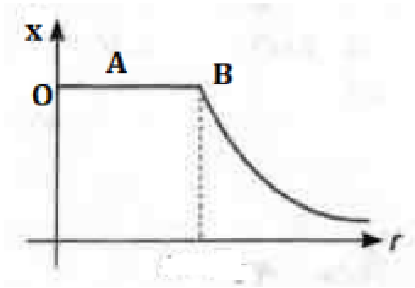
13. An electric field $\vec{E} = 20\hat{\imath} + 30\hat{\jmath}$ exists in space. if the potential at the origin is taken to be zero, then what is the potential at (2m,2m)?

SECTION C

14. Consider a uniform electric field $\vec{E} = 3 \times 10^3\ \hat{\imath}$ N/C.
    a. 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?
    b. What is the flux through the same square if the normal to its plane makes a 60° angle with the *x*-axis?
15. Calculate the work done to dissociate the system of three charges placed at the vertices of a triangle as shown. Given: q = 1.6 x 10^{-10} C



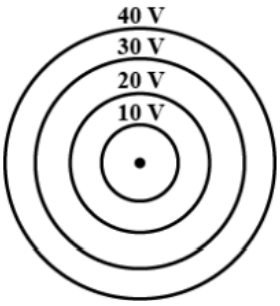
16. A graph showing variation between two physical quantity 'x' with 'r', where 'r' is the distance from the centre of a charged conducting sphere.



    i. Name the physical quantity 'x'
    ii. What does the distance 'OB' represent?
    iii. At what point the electric field of this conducting sphere (a) minimum (b) maximum? Write the values

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 has greater (i) capacitance (ii) energy density just outside the spheres.
    b. Concentric equipotential surfaces due to a point charge at the centre are shown. Identify the polarity of the charge and draw the field lines.

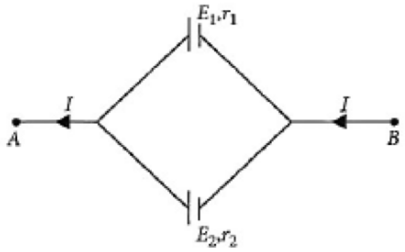


SECTION D

17.

a. Explain the term drift velocity of electrons in a conductor. Hence obtain the expression for the current through a conductor in terms of drift velocity.

b. Two cells of emfs E_1 and E_2 and internal resistances r_1 and r_2 respectively are connected in parallel as shown in the figure.
Deduce the expression for the
   i. equivalent emf of the combination
   ii. equivalent internal resistance of the combination
   iii. potential difference between the points A and B.



OR

a. State the two Kirchhoff's rules used in the analysis of electric circuits and explain them.

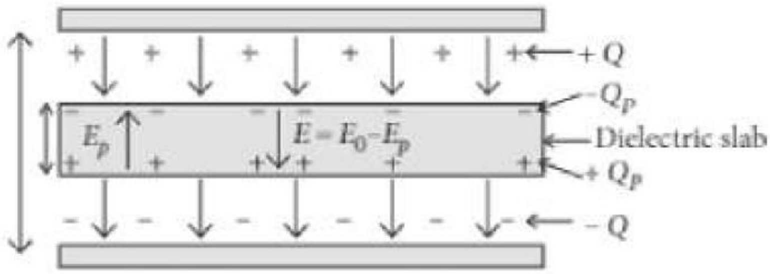
b. Derive the equation of the balanced state in a Wheatstone bridge using Kirchhoff's laws.

SECTION E

18. Case Study:

Read the following paragraph and answer the questions.

A dielectric slab is a substance which does not allow the flow of charges through it but permits them to exert electrostatic forces on one another. When a dielectric slab is placed between the plates, the field E_0 polarises the dielectric. This induces charge $-Q_p$ on the upper surface and $+Q_p$ on the lower surface of the dielectric. These induced charges set up a field E_p inside the dielectric in the opposite direction of $\overrightarrow{E_0}$ as shown.



i. In a parallel plate capacitor, the capacitance increases from 4μF to 80μF, on introducing a dielectric medium between the plates. What is the dielectric constant of the medium?

ii. A parallel plate capacitor with air between the plates has a capacitance of 8pF. The separation between the plates is now reduced half and the space between them is filled with a medium of dielectric constant 5. Calculate the value of capacitance of the capacitor in second case.

iii. What happens to the charge and the electric field between the plates of capacitor on introducing the dielectric between the plates of capacitor?

OR

A parallel plate capacitor of capacitance 1 pF has separation between the plates is d. When the distance of separation becomes 2d and wax of dielectric constant x is inserted in it the capacitance becomes 2pF. What is the value of x?

REVISION TEST SERIES-1

PHYSICS (042)

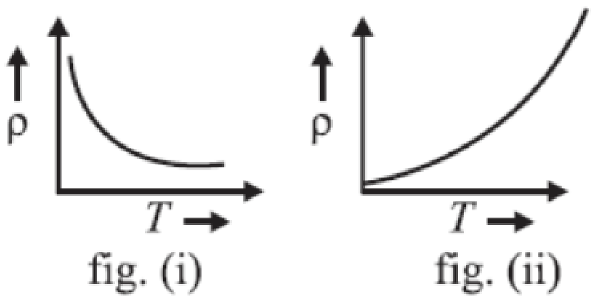
Time: 1½ HOURS **SET B** **Maximum Marks: 35**

General Instructions:

4. There are questions in all. All questions are compulsory.
5. There are five sections Section A, Section B, Section C, Section D and Section E.
6. Section A contains nine MCQ of 1mark each, Section B contains four questions of 2marks each, Section C contains three questions of 3marks each, Section D contains one long answer type questions of 5mark and Section E contains one case study question of 4mark.

SECTION A

1. The temperature (T) dependence of resistivity of materials A and material B is represented by fig (i) and fig (ii) respectively. Identify material A and material B.



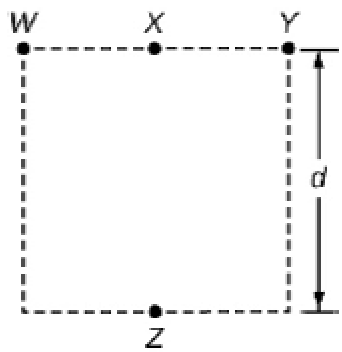
a) material A is copper and material B is germanium

b) material A is germanium and material B is copper

c) material A is nichrome and material B is germanium

d) material A is copper and material B is nichrome

2. Four objects W, X, Y and Z, each with charge +q are held fixed at four points of a square of side 'd' as shown in the figure. Objects X and Z are on the mid points of the sides of the square. The electrostatic force exerted by object W on object X is F. Then the magnitude of the force exerted by object W on Z is

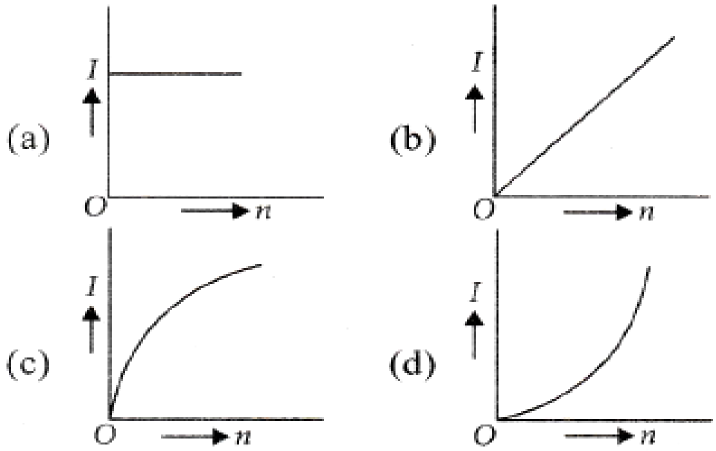


a) F/7 b) F/5 c) F/3 d) F/2

3. A parallel plate capacitor with oil in between the plates (dielectric constant of oil is 2) has a capacitance 'C'. If the oil is removed, what will be the new capacitance

a) $\frac{C}{\sqrt{2}}$ b) $\frac{C}{2}$ c) 2C d) $\sqrt{2}C$

4. A battery consists of a variable number(n) of identical cells, each having an internal resistance r connected in series. The terminals of the battery are short-circuited. A graph of current(I) in the circuit verses the number of cells will be as shown in the figure.



5. Two-point charges are placed at a distance d apart. If a copper plate is placed between the charges the effective force will be
   a) F b) 2F c) $\sqrt{F}$ d) 0
6. Which of the following characteristics of electrons determines the current in a conductor?
   a) Drift velocity alone b) Thermal velocity alone
   c) Both drift velocity and thermal velocity
   d) Neither drift velocity and thermal velocity
7. Four equal point charges, Q each are placed in the XY-plane at (0, 2), (4, 2), (4, -2) and (0, -2). The work required to put a fifth charge 'Q' at the origin of the coordinate system will be,
   a) $\frac{Q^2}{2\sqrt{2\pi\varepsilon_0}}$ b) $\frac{Q^2}{4\pi\varepsilon_0}\left(1+\frac{1}{\sqrt{3}}\right)$ c) $\frac{Q^2}{4\pi\varepsilon_0}$ d) $\frac{Q^2}{4\pi\varepsilon_0}\left(1+\frac{1}{\sqrt{5}}\right)$
8. 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 and 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

   Assertion (A): The expression of potential energy, $= \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r_{12}}$, is unaltered whatever way the charges are brought to the specified locations.
   Reason (R): Path independence of work for electrostatic force.
9. 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 and 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

Assertion (A): A graph showing the variation of electric field at a point with distance due to an infinite plane sheet of charge is a straight line parallel to the distance axis.
Reason (R): The electric field at a point due to an infinite plane sheet of charge is independent of the distance to the point.

SECTION B

10. Given the electric field in the region $\vec{E} = 2x\hat{\imath}$, find the net electric flux through the cube and the charge enclosed by it.
11. Two-point charges q and -2q are kept d distance apart. Find the location of the point relative to charge q at which potential due to this system of charges is zero.

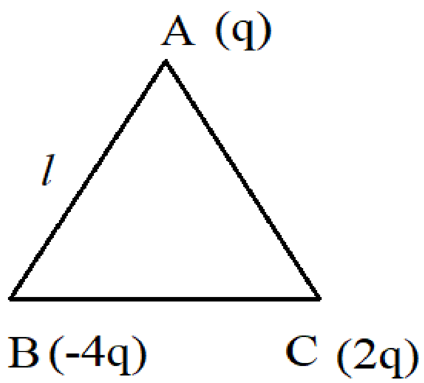
OR

Derive expression for the electric potential at any point along the axial line of an electric dipole.

12. Draw a plot showing the variation of
    i. electric field (E) and
    ii. electric potential(V) with distance(r) due to a point charge Q.
13. A parallel plate capacitor of capacitance 'C' is charged to a potential 'V'. It is then connected to another uncharged capacitor having the same capacitance. Find out the ratio of the energy stored in the combined system to that stored initially in the single capacitor

SECTION C

14. Three-point charges q, -4q and 2q are placed at the vertices of an equilateral triangle ABC of side *l* as shown in the figure.



    i. Obtain the expression for the magnitude of the resultant electric force acting on the charge q.
    ii. Find out the amount of the work done to separate the charges at infinite distance.

OR

Two large charged plane sheets of charge densities σ and -2σ C/m² are arranged vertically with a separation of 'd' between them. Deduce expressions for the electric field at the points,

i. to the left of the first sheet,
ii. to the right of the second sheet and
iii. between the two sheets.

15. Draw equipotential surfaces: (a) in the case of a single point charge, and (b) in a constant electric field in Z-direction. Why the equipotential surfaces about a single charge are not equidistant? Give reason.
16. State three difference between electromotive force and terminal potential difference of a cell.

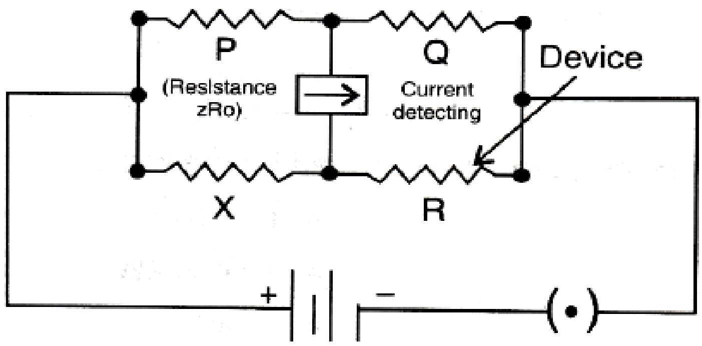
SECTION D

17.

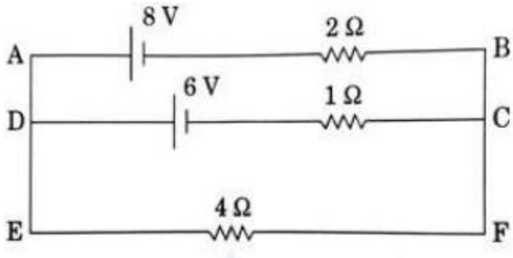
i. Define the term drift velocity.
ii. On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time. On what factors does resistivity of a conductor depend?
iii. Why alloys like constantan and the manganin are used for making standard resistors?

OR

i. Obtain the condition under which the current flowing, in the current detecting device, used in circuit as shown in the figure, become zero.



ii. Calculate the potential difference across the 4Ω resistor in the given electrical circuit, using the Kirchhoff's rules.



SECTION E

18. Case Study: Read the following paragraph and answer the questions.

While travelling back to his residence in the car, Dr Pathak was caught up in a thunderstorm. It became very dark. He stopped driving the car and waited for thunderstorm to stop. Suddenly he noticed a child walking alone on the road. He asked the boy to come inside the car till the thunderstorm stopped. Dr Pathak dropped the boy at his residence. The boy insisted that Dr Pathak should meet his parents. The parents expressed their gratitude to Dr Pathak for his concern for safety of the child.

i. What is electrostatic shielding
ii. Why is it safer to sit inside a car during a thunderstorm?
iii. Write any two applications of electrostatic shielding

OR

Electric field inside hollow region of conductor in uniform electric field is same. What is the value of potential there? Explain (1+1+2=4marks)