केंद्रीय विद्यालय संगठन, पटना संभाग
ग्रीष्मावकाश गृहकार्य 2023 - 24
कक्षा- 12वीं
विषय- भौतिकी

Electrostatics

1. When a glass rod is rubbed with silk, it (a) gains electrons from silk.
   (b) gives electrons to silk.
   (c) gains protons from silk.
   (d) gives protons to silk.

2. The force between two charges is 120N. If the distance between the two charges is doubled, the force will be
   (a) 30N
   (b) 60N
   (c) 15N
   (d) 40N

3. Twelve charges of charge q are situated at the corners of the 12 sided polygon of side a. What is the net force on the charge Q at the centre
   (a) Zero
   (b) $3qQ/\pi\varepsilon_0 a^2$
   (c) $qQ/\pi\varepsilon_0 a^2$
   (d) None of the above

4. What will be the value of the electric field at the centre of the electric dipole: -
   (a) Zero
   (b) Equal to the electric field due to one charge at the centre
   (c) Twice the electric field due to one charge at centre
   (d) half the value of the electric field due to one charge at centre

5. The electric field intensity at a point situated 4m from a point charge is 200N/C. If the distance is reduced to two meters, the electric field intensity will be
   (a) 400N
   (b) 600N
   (c) 800N
   (d) 1200N

6. Two positive point charge are placed at the distance a apart have sum Q. What values of the charges , coulomb force between them is maximum
   (a) $q_1=q_1=Q/2$
   (b) $q_1=3Q/4$,$q_2=Q/4$
   (c) $q_1=5Q/6$,$q_2=Q/6$
   (d) None of the above

7. A cylinder of radius R and length L is placed in a uniform electric field E parallel to the cylinder axis. The total flux for the surface of the cylinder is given by
   (a) $2\pi R^2E$
   (b) πR^2E
   (c) $E/ \pi R^2$
   (d) Zero

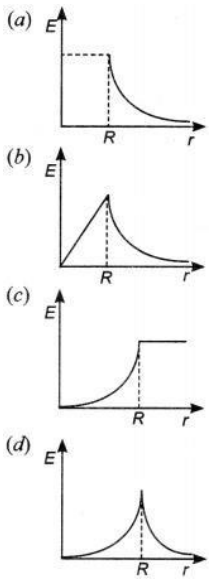
8. A metallic solid sphere of radius R is given the charge Q. Which of the following statement is true then
   (a) Electric field at points $0< r < R$ is zero
   (b) Electric field at $r>R$ is given by $Q/4\pi\varepsilon_0 r^2$
   (c) Electric field is perpendicular to the surface of the sphere
   (d) All of these

9. A point charge (Q) is located at the centre of a cube of edge length a, find the final electric flux over one face of the cube a. Q/ε_0
   b. $Q/6\varepsilon_0$
   c. $6Q/\varepsilon_0$
   d. none of the above

10. Two large metal sheets having surface charge density $+\sigma$ and $-\sigma$ are kept parallel to each other at a small separation distance d. The electric field at any point in the region between the plates is
   (a) σ/ε_0
   (b) $\sigma/2\varepsilon_0$
   (c) $2\sigma/\varepsilon_0$
   (d) $\sigma/4\varepsilon_0$

11. Three point charges q + Q, q, q - Q are enclosed by the surface S. What the net flux crosses S
   a. $3q/\boldsymbol{\epsilon}_0$
   b. $2q/\boldsymbol{\epsilon}_0$
   c. $3q - Q/\boldsymbol{\epsilon}_0$
   d. $2q/\boldsymbol{\epsilon}_0$

12. Which of the following graphs shows the variation of electric field E due to a hollow spherical conductor of radius R as a function of distance from the centre of the sphere?



13. The magnitude of electric field intensity E is such that, an electron placed in it would experience an electrical force equal to its weight is given by

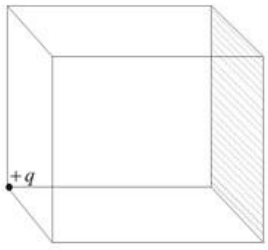
(a) mge

(b) mg/e

(c)e/mg

(d) e^2g/m^2

14. A charge Q is placed at the back corner of a cube. What is the flux of electric field through the shaded surface?



a) $\frac{Q}{\varepsilon_0}$

b) $\frac{Q}{24\varepsilon_0}$

c) $\frac{Q}{6\varepsilon_0}$

d) $\frac{Q}{2\varepsilon_0}$

15. SI unit of permittivity of free space is

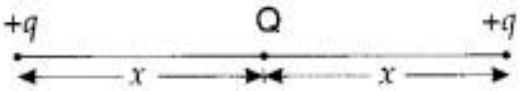
(a) Farad

(b) Weber

(c) C2N-1 m-2

(d) $C^2N\ m^{-2}$

16. A charge Q is placed at the centre of the line joining two point charges +q and +q as shown in the figure. The ratio of charges Q and q is



(a) 4

(b) 1/4

(c) -4

(d) -1/4

17. For a point charge, the graph between electric field versus distance is given by :

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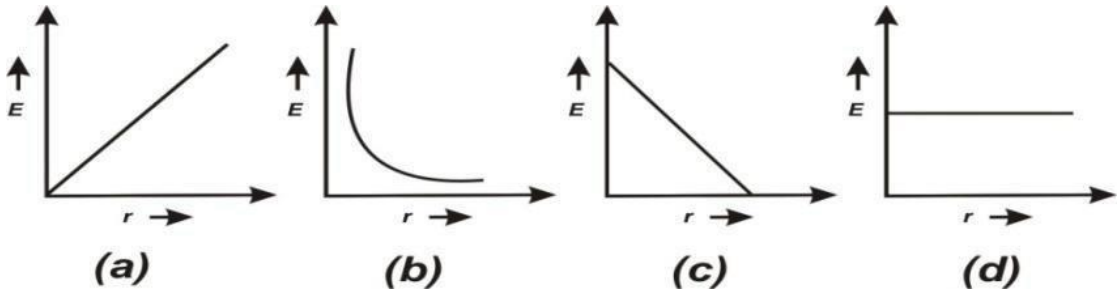


(a) (b) (c) (d)

18. Electric field lines provide information about

(a) field strength

(b) direction

(c) nature of charge

(d) all of these

19.The value of electric field inside a conducting sphere having radius R and charge Q will be:

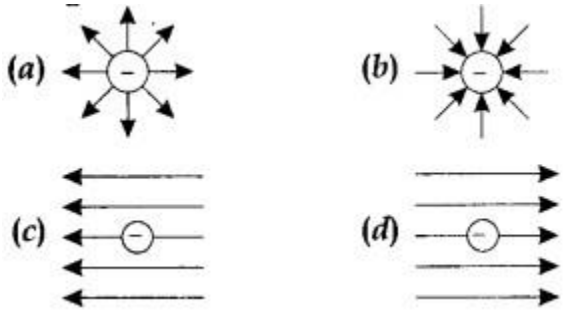
(a) KQ/R

(b) KQ/R^2

(c) KQ^2/R^2

(d) 0

20.Which of the following figures represent the electric field lines due to a single negative charge?



21.The SI unit of electric flux is

a. $N\ C^{-1}\ m^{-2}$
b. $N\ C\ m^{-2}$
c. $N\ C^{-2}\ m^{2}$
d. $N\ C^{-1}\ m^{2}$

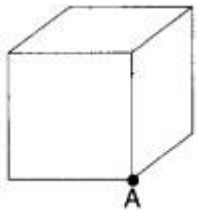
22.Four charges + 8Q, - 3Q +5Q and -10Q are kept inside a closed surface. What will be the outgoing flux through the surface?

(a) 26 V-m

(b) 0 V-m

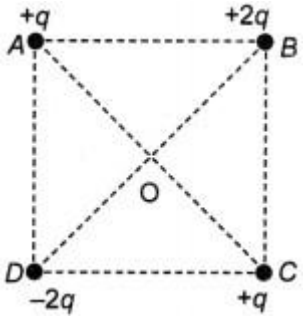
(c) 10 V-m (d) 8 V-m

23.The total flux through the faces of the cube with side of length a if a charge q is placed at corner A of the cube is



e. $\frac{q}{8€0}$
f. $\frac{q}{4€0}$
g. $\frac{q}{2€0}$
h. $\frac{q}{€0}$

24.Four charges are arranged at the comers of a square ABCD, as shown. The force on the charge kept at the centre O is



i. zero
j. along the diagonal AC
k. along the diagonal BD
l. perpendicular to side AB

25.An electron having charge e and mass m is moving in a uniform electric field E.

The acceleration will be

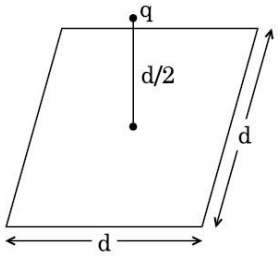
(a) e^2/m
(b) $e^2 E/m$
(c) eE/m
(d) mE/e

SHORT ANSWER TYPE QUESTIONS

1. What are the basic properties of charge?
2. Write the nature of force (1) $q_1q_2 > 0$ (2) $q_1q_2 < 0$.
3. What is the maximum value of torque acting on a dipole?
4. The torque acting on a dipole is τ = PXE. Name the pairs of vectors which are perpendicular to each other.
5. A charge Q is placed at the centre of a cube of side l. What is the electric flux passing through each face of the cube?
6. Write the values of net torque and the net force acting on a dipole.
7. Name the physical quantity whose unit is (1) N/C (2) C-m.
8. What is the value of the angle between the vectors $\boldsymbol{p}$ and $\boldsymbol{E}$for which the potential energy of an electric dipole of dipole moment$\vec{p}$, kept in an external electric field $\boldsymbol{E}$, has maximum value?
9. Draw lines of force to represent a uniform electric field.
10. What are the orientations corresponding to stable equilibrium and unstable equilibrium?
11. A glass rod when rubbed with silk cloth acquires a charge 1.6×10^{-13} C. what is the charge on the silk cloth?
12. What is the importance of the coulomb's law of electric force in vector form?
13. Two-point charges of +3μC each are 100cm apart. At what point on the line joining the charges will the electric intensity be Zero?
14. Why the electric field lines do not form closed loop?
15. An electrostatics field lines cannot be discontinuous except at charge. Why?
16. A closed surface encloses an electric dipole of dipole moment 20×10-6C. What is the net electric flux coming out of this surface?
17. If the radius of the Gaussian surface enclosing a charge is halved, how does the electric flux through the Gaussian surface change?
18. Does the charge outside the Gaussian surface contribute to total electric flux?
19. Define the term electric dipole moment of a dipole. State its S.I. Unit.
20. What is the general relation between electric field and potential?

LONG ANSWER TYPE QUESTIONS-

1. Define electric flux. Is it a scalar or a vector quantity?
   A point charge q is at a distance of d/2 directly above the centre of a square of side d, as shown in the figure. Use Gauss' law to obtain the expression for the electric flux through the square.

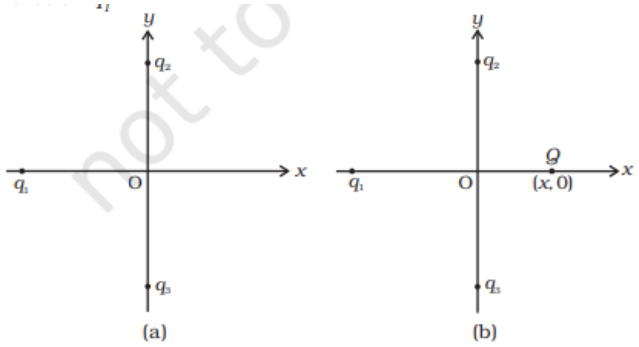


   If the point charge is now moved to a distance from the center of the square and the side of the square is doubled, explain how the electric flux will be affected. .

2. Use Gauss' law to derive the expression for the electric field (E) due to a straight uniformly charged infinite line of charge density λ C/m. Draw a graph to show the variation of E with perpendicular distance r from the line of charge.
3. State the theorem which relates the enclosed charge, inside a closed surface, with the electric flux through it. Use this theorem to obtain the electric field due to a uniformly charged thin spherical shell at an (i) outside point (ii) inside point.
4. An electric charge of 8.85×10^{-13} C is placed at the centre of a sphere of radius 1m. What is the total electric flux linked with the sphere? How will the electric flux change if another equal and dissimilar charge is introduced at a distance of
   (i) 0.5m from the centre, (ii) 1.5m from the centre?

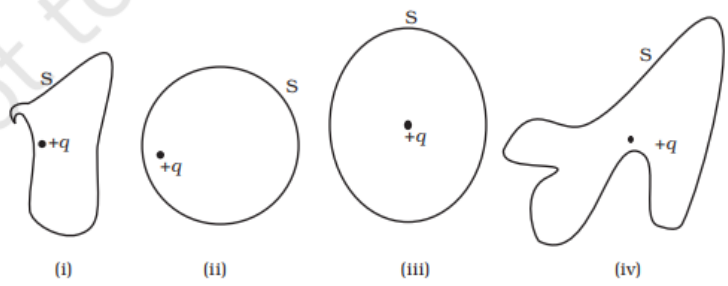
5. Use Gauss's law to obtain an expression for the electric field due to an infinitely long straight uniformly charged wire.

6.In Fig.1.1, two positive charges q2 and q3 fixed along the y axis, exert a net electric force in the + x direction on a charge q1 fixed along the x axis. If a positive charge Q is added at (x, 0), the force on q1



(a) shall increase along the positive x-axis.
(b) Shall decrease along the positive x – axis.
(c) Shall point along the negative x -axis.
(d) Shall increase but the direction changes because of the intersection of Q with q_2 and q_3.

7.The electric flux through the surface
(a) in (i) it is the largest.
(b) in fig. (iii) is the least.
(c) in fig. (ii) and (iii) flux are same but is smaller than (iv)
(d) is same for all figures.



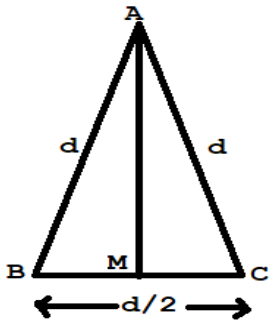
8. Two charges of magnitude 3Q and -2Q are placed at A(0,0) and B(a,0). At what point(s) on X-axis, the net electric field due to these charges would be zero?

9. An alpha particle (He nucleus) has a mass of 6.6 X 10-27 kg and a charge of +2e. What is the magnitude and direction of electric field that would balance its weight?

10. A particle having charge q and mass m is placed in uniform electric field E. Find the velocity of the particle after time t. [Ignore gravitational force]

11. What is the maximum torque experienced by a dipole placed in uniform electric field? A dipole rotates in a uniform electric field. Does a dipole stop when it experiences no net torque in uniform electric field? Justify your answer.

12.Using Coulomb's law and Superposition principle, find the net electrostatic force on a charge particle carrying charge Q located at point M shown in the diagram. Equal charges of magnitude q are placed at vertices A, B and C of the triangle.



13. Two point charges q_1 and q_2 are placed close to each other. What is the nature of the force between them when: (i) $q_1q_2 < 0$ and (ii) $q_1q_2 > 0$?

14. Name the quantity with unit J/C. Is it a scalar or vector quantity?

15. An electric dipole of dipole moment $2x10^{-6}$ C m is enclosed by a closed surface. What is the flux passing out of the surface?

16. What is the angle between the directions of electric field at any (i) axial point and (ii) equatorial point due to an electric dipole?

17. Two point charges placed at a distance *r* in air exert a force *F* on each other. At what distance will these charges experience the same force *F* in a medium of dielectric constant K?

18. Consider a dipole of length 2a. What is the magnitude and direction of electric field at the midpoint of the length of the dipole

19. Two charges +10μC and -20μC are placed 15 cm apart. At what point on the line joining the two charges is the electric potential zero?

20. The following data was obtained for the dependence of the magnitude of electric field, with distance, from a reference point O, within the charge distribution in the shaded region.

(i) Identify the charge distribution and justify your answer.

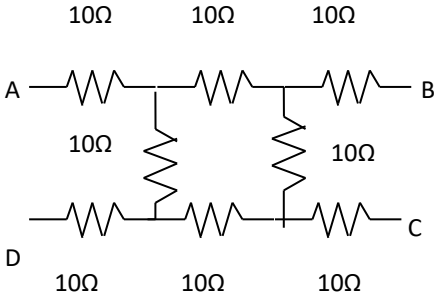
(ii) If the potential due to this charge distribution has a value V at the point A, what is its value at the point B and C?

Current Electricity

1. Why is resistance of thick wire smaller than that of thin wire ?
2. Electrons travel with very small speeds (drift speed) within wire. How come, a bulb starts glowing instantly after pressing the switch ?
3. When a wire carrying current is cut instantly, what happens to electrons flowing through it ?
4. Why is power pin of a heater plug is thicker and longer than the other two ?
5. What will happen experimentally if a meter bridge wire is made of copper instead of constantan ?

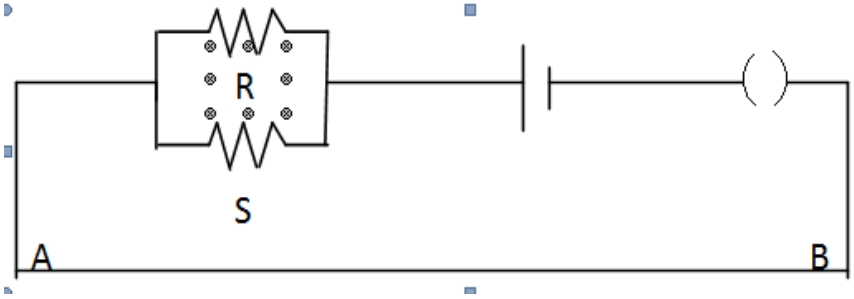
NUMERICALS (AISSCE)

1. A pd of 30V is applied across a colour coded carbon resistor with rings of blue, black and yellow colours. What is the current to the resistor?
2. Find the resistance between the points (i) A and B and (ii) A and C in the following network.

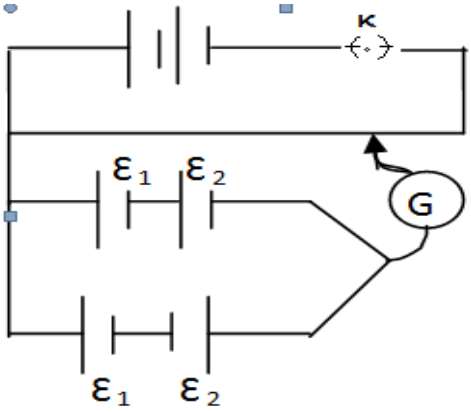


3. Nichrome and Cu wires of the same length and same diameter are connected in series in an electric circuit. In which wire will the heat be produced at a higher rate?
4. Two bulbs are marked 220V-100W and 220V-50W. They are connected in series to 220V mains. Find the ratio of heat generated in them.
5. State the Principle of working of a potentiometer.
6. An electric bulb rated for 500W at 100V is used in circuit having a 200V supply. Calculate the resistance R that must be put in series with the bulb, so that the bulb delivers 500W.

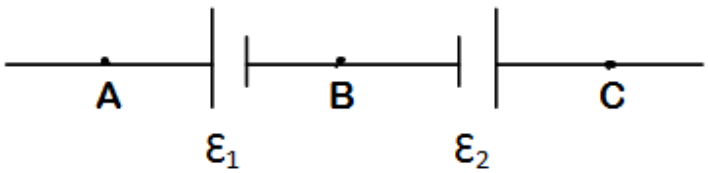
7. A potentiometer wire has a length L and resistance R_0. It is connected to a battery and a resistance combination as shown. Obtain an expression for the potential difference per unit length of the potentiometer wire. What is the maximum emf of a 'test cell' for which one can get a balance point on this potentiometer wire? What precautions should one take while connecting this test cell to the circuit?



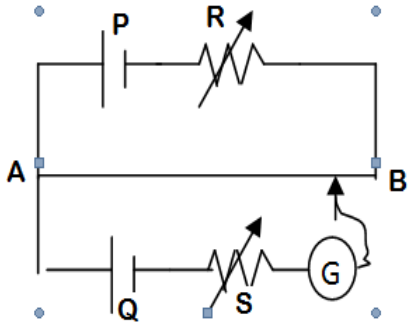
8. In a potentiometer circuit, a battery of negligible internal resistance is set up as shown to develop a constant potential gradient along the wire AB. Two cells of emfsε_1 and ε_2 are connected in series as shown in the combination (1) and (2). The balance points are obtained respectively at 400cm and 240cm from the point A. Find (i) $\varepsilon_1/\varepsilon_2$ and (ii) balancing length for the cell ε_1 only.



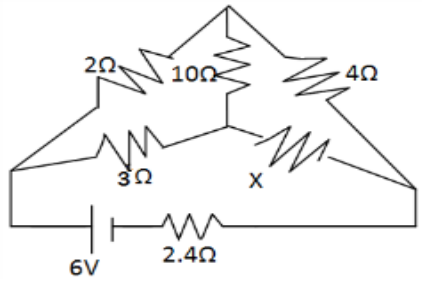
9. Two cells of emfsε_1 and ε_2 ($\varepsilon_1 > \varepsilon_2$) are connected as shown in figure When a potentiometer is connected between A and B, the balancing length of the potentiometer wire is 300cm. On connecting the same potentiometer between A and C, the balancing length is 100cm. Calculate the ratio of ε_1 and ε_2.



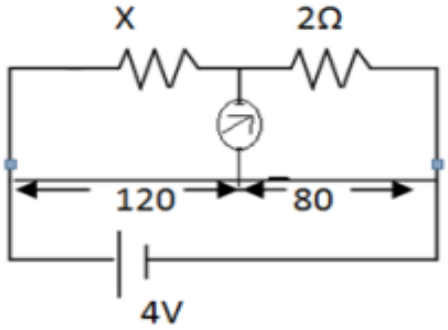
10. In the potentiometer circuit shown, the balance point is at X. State with reason where the balance point will be shifted when (i) Resistance R is increased, keeping all parameters unchanged.
(ii) Resistance S is increased keeping R constant.
(iii) Cell P is replaced by another cell whose emf is lower than that of that cell Q.



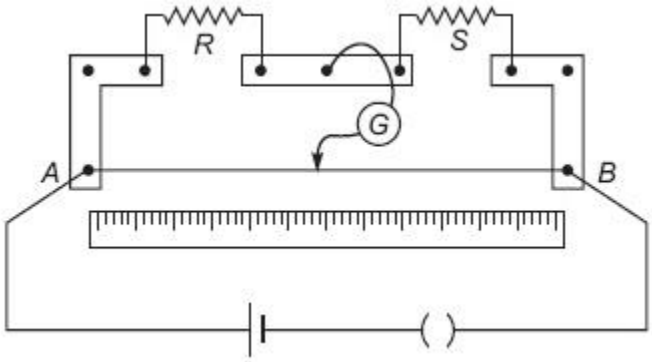
11. Find the value of X and current drawn from the battery of emf 6V of negligible internal resistance



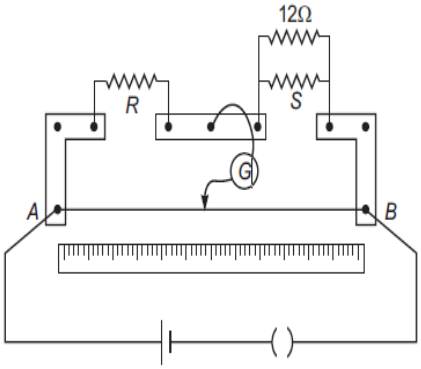
12. Find the value of the unknown resistance X and the current drawn by the circuit from the battery if no current flows through the galvanometer. Assume the resistance per unit length of the wire is $0.01\Omega cm^{-1}$.



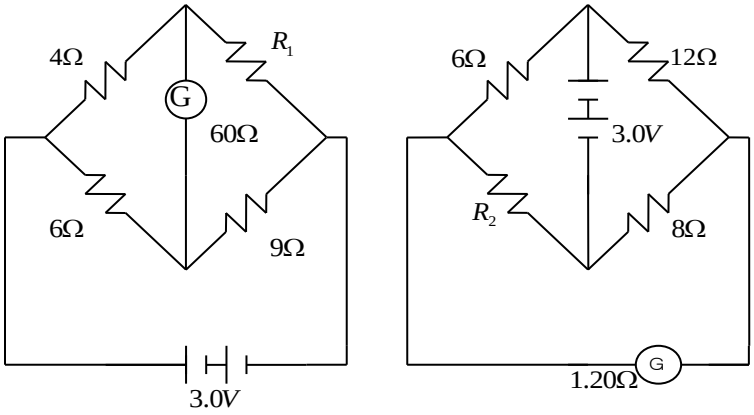
13. In a meter bridge, the null point is found at a distance of 60.0 cm from *A*. If now a resistance of 5Ω is connected in series with *S*, the null point occurs at 50 cm. Determine the values of *R* and *S.*



14. In a meter bridge, the null point is found at a distance of 40 cm from *A.* If a resistance of 12 ΩΩis connected in parallel with *S,* the null point occurs at 50Ω0 cm from *A.* Determine the values of *R* and *S*.



15. Figure shows two circuits in each having a galvanometer and a battery of 3 V. When the galvanometers in each arrangement do not show any deflection, obtain the ratio $R_1 : R_2$.



Project Work

1. Try to make an electroscope Generator using household things.
2. Collect 8-10 materials of different resistivity and list the values of resistivity for them.
3. List 8-10 electrical appliances, mention their power ratings and maintain screen shots of the values mentioned on them.

ACTIVITY

- Do the fun activities of charging a body by rubbing/induction.