Problems

1) Two insulated charged spheres of charges 6.5 x 10^{-7}C each are separated by a distance of 0.5m. Calculate the electrostatic force between them and calculate the force :

(i) when the charges are doubled and the distance of separation is halved.

(ii) when the charges are placed in a dielectric medium water (ε_r = 80)

Data : $q_1 = q_2$ = 6.5 x 10^{-7}C, r = 0.5 m

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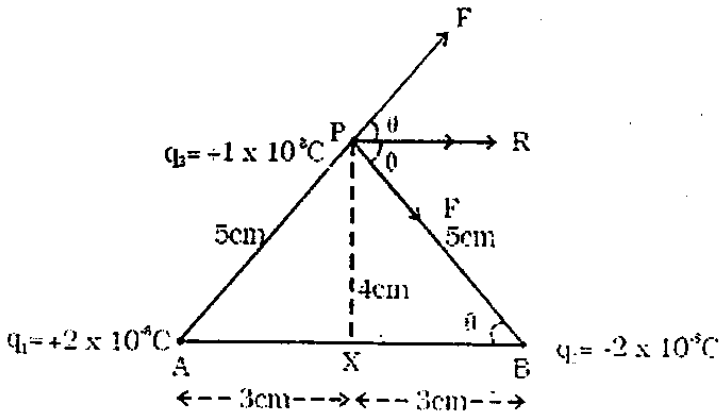
2) Two small equal and unlike charges 2 x 10^{-8} C are placed at A and B at a distance of 6 cm. Calculate the force on the charge 1 x 10^{-8} C placed at P, where P is 4 cm on the perpendicular bisector of AB .

Data : q_1 = 2 x 10^{-8}C, q_2 = -2 x 10^{-8} C, q_3 = 1 x 10^{-8} C

at P X_P = 4cm or 0.04 m, AB = 6 cm or 0.06 m



3) **Compare the magnitude of the electrostatic and gravitational force between an electron and a proton at a distance r apart in hydrogen atom.**

(Given : $m_e = 9.11 \times 10^{-31}$ kg ; mP = 1.67×10^{-27} kg ;

G = 6.67×10^{-11} Nm kg^{-2} ; e = 1.6×10^{-19} C).

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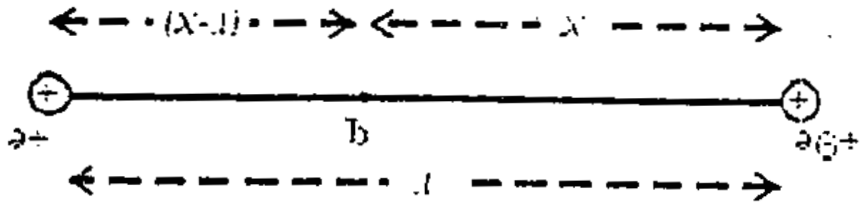
4) **Two point charges +9e and + 1e are kept at a distance of 16 cm from each other. At what point between these charges, should a third charge q to be placed so that it remains in equilibrium?**

Data: r =16 cm or 0.16 m; q_1 = 9e and q2 = e.



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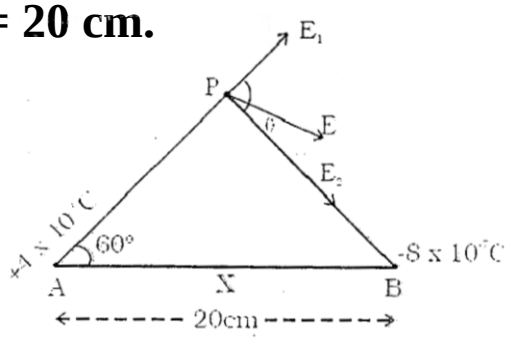
5) **Two charges 4×10^{-7} C and -8×10^{-7}C are placed at the two corners A and B of an equilateral triangle ABP of side 20 cm. Find the resultant intensity at P:**

Data : $q_1 = 4 \times 10^{-7}$C ; $q_2 = -8 \times 10^{-7}$ C ; r = 20 cm.



6) **Calculate (i) the potential at a point due a charge of 4×10^{-7}C located at 0.09m away (ii) work done in bringing a charge of 2×10^{-9} C from infinity to the point.**

Data : $q_1 = 4 \times 10^{-7}$ C, $q_2 = 2 \times 10^{-9}$ C, r = 0.09 m.

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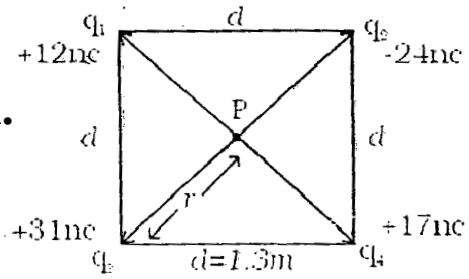
7) **A sample of HCI gas is placed in an electric field of 2.5×10^{4} N C^{-1} . The dipole moment of each HCl molecule is 3.4×10^{-30} C m. Find the maximum torque that can act on a molecule.**

Data : E = 2.5×10^{4} NC^{-1} , p= 3.4×10^{-30} Cm.



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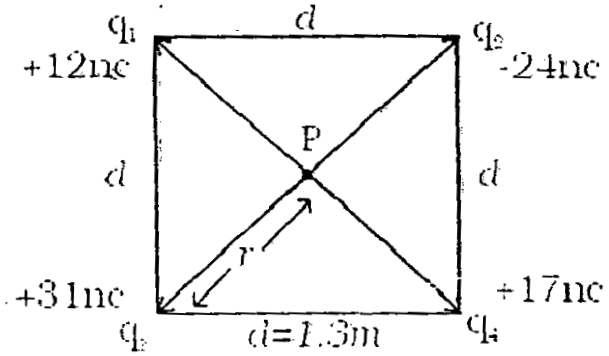
8) **Calculate the electric potential at a point P, located at the centre of the square of point charges shown in the figure.**

Data : q_1 = + 12 n C ; q_2 = -24 n C ; q_3 = +31n C ; q_4 = +17nC ; d = 1.3m



9) **The sum of two point charges is 6 μ C. They attract each other with a force of 0.9 N, when kept 40 cm apart in vacuum. Calculate the charges.**

10) **Two small charged spheres repel each other with a force of 2×10^{-3} N. The charge on one sphere is twice that on the other. When one of the charges is moved 10 cm away from the other, the force is 5×10^{-4} N. Calculate the charges and the initial distance between them.**

11) **Four charges + q, + 2q, +q and -q are placed at the corners of a square. Calculate the electric field at the intersection of the diagonals of the square of side 10 cm if $q = 5/3 \times 10^{-9}$C.**

12) **Two charges 10×10^{-9} C and 20×10^{-9}C are placed at a distance of 0.3 m apart. Find the potential and intensity at a point mid-way between them.**

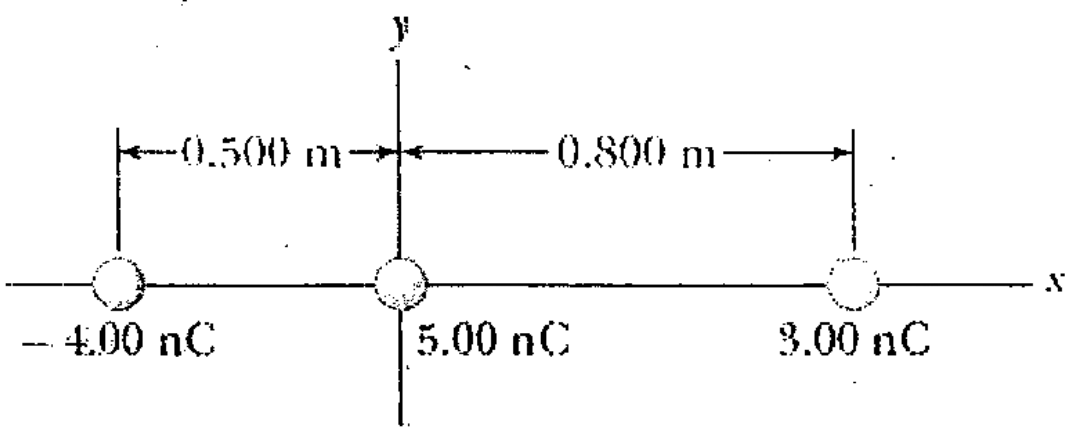
13) **An electric dipole of charges 2×10^{-10} C and -2×10^{-10} C separated by a distance 5 mm, is placed at an angle of 60° to a uniform field of 10 Vm^{-1} .**

Find the (i) magnitude and direction of the force acting on each charge, (ii) Torque exerted by the field.

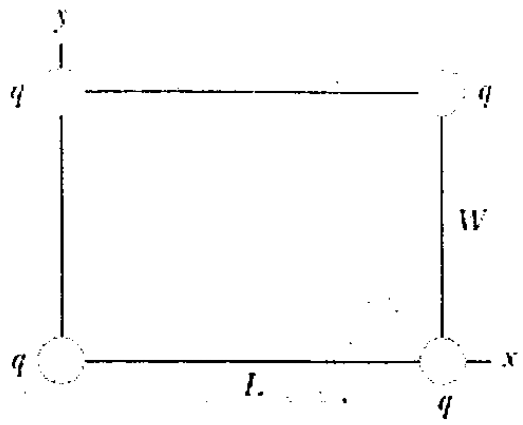
14) **An electric dipole of charges 2 x 10^{-6} C , -2 x 10^{-6} C are separated by a distance 1 cm. Calculate the electric field due to dipole at' a point on its. (i) axial line 1 m from its centre (ii) equatorial line 1 m from its centre.**

15) **Two charges +q and -3q are separated by a distance of 1 m. At what point if; between the charges en its axis is the potential zero ?**

16) **Three point charges are aligned along the X axis as shown in Figure, Find the electric field at (a) the position (2.00, 0) and (b) the position (0, 2.00).**



17) **Four identical point charges (q =10.0 C) are located on the corners of a rectangle' as shown in Figure. The dimensions of the rectangle are L = 60.0 cm and W = 15.0 cm. Calculate the magnitude and direction of the resultant electric force exerted on the charge at the lower left corner by the other three charges.**



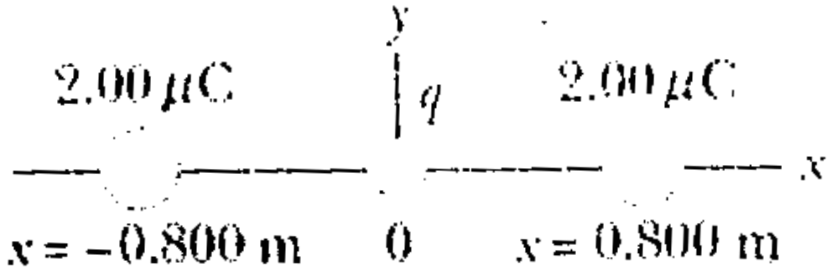
18) Three charges +1μC, +3μC and -5μ C are kept at the vertices of an equilateral triangle of sides 60 cm. Find the electrostatic potential energy of the system of charges.

19) Two positive charges of 12 μ C and 8 μ C respectively are 10 cm apart. Find the work done in bringing them 4 cm closer, so that, they are 6 cm apart.

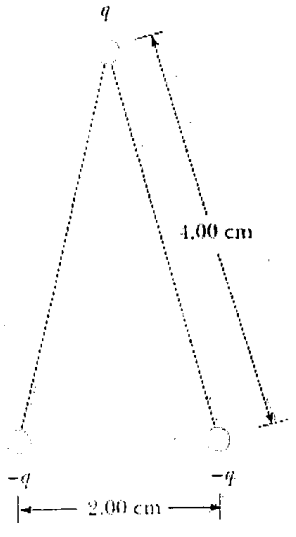
20) Find the electric flux through each face of a hollow cube of side 10 cm, if a charge of 8.85 μC is placed at the centre.

21) A spherical conductor of radius 0.12 m has a charge of 1.6 x 10^{-7} C distributed uniformly on its surface. What is the electric field (i) inside the sphere (ii) on the sphere (iii) at a point 0.18 m from the centre of the sphere?

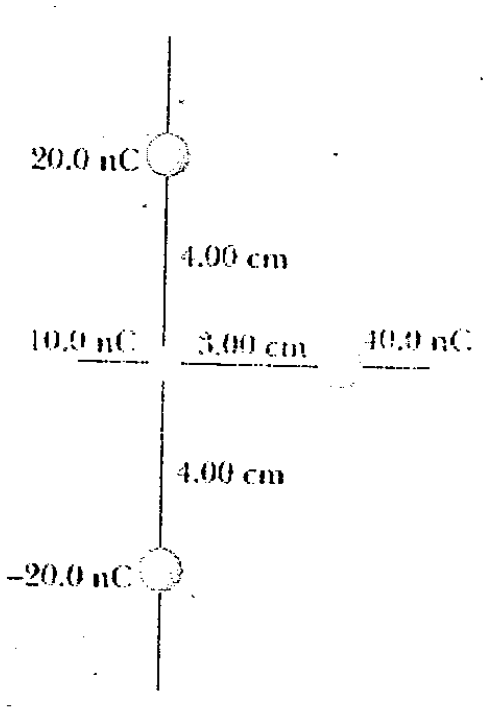
22) **Given two 2.00 μC charges, as shown in Figure, and a positive test charge q = 1.28 x 10^{-18} C at the origin, (a) what is the net force exerted by the two 2.00 μC charges on the test charge q? (b) What is the electric field at the origin due to the two 2.00 μC charges? (c) What is the electric potential at the origin due to the two 2.00 μC charges?**



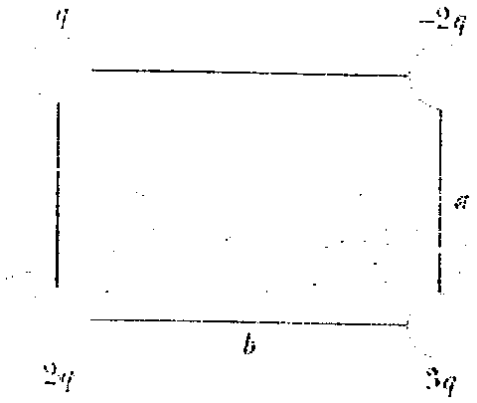
23) **The three charges in Figure are at the vertices of an isosceles triangle. Calculate the electric potential at the midpoint of the base, taking q = 7.00 μC.**



24) Two particles, with charges of 20.0 nC and -20.0 nC, are placed at the points with coordinates (0, 4.00 cm) and (0, -4.00 cm), as shown in Figure. A particle with charge 10.0 nC is located at the origin, (a) Find the electric potential energy of the configuration of the three fixed charges, (b) A fourth particle, a charge of 40.0 nC, is released from rest at the point (3.00 cm, 0). Find its speed after it has moved freely to a very large distance away.



25) Calculate the energy required to assemble the array of changes shown in figure , where a = 0.200 m , b= 0.400 m, and q = 6.00 μC



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26) A parallel-place capacitor with air between the plates has an area A m 2.00 x 10^{-4} m^2 and a plate separation d = 1.00 mm. Find its capacitance.

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27) A parallel plate capacitor has plates of area 200 cm^2 and separation between the plates 1 mm. Calculate (i) the potential difference between the plates if In C charge is given to the capacitor (ii) with the same charge (In C) if the plate separation is increased to 2 mm, what is the new potential difference and (iii) electric field between the plates.

Data : d = 1 mm = l x 10^{-3} m ; A = 200 cm^2 or 200 x 10^{-4} m^2 ;

q = 1 nC = l x10^{-9} C

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28) A parallel plate capacitor with air between the plates has a capacitance of 8 pF. What will be the capacitance, if the distance between the plates be reduced to half and the space between them is filled with a substance of dielectric constant 6.

Data : C_0 = 8 pF , ε_r = 6, distance d becomes, d/2 with dielectric

29) The plates of a parallel plate capacitor have an area of 90 cm^2 each and are separated by 2.5 mm. The capacitor is charged by connecting it to a 400 V supply. How much electrostatic energy is stored by the capacitor?

Data : A=90 cm^2 = 90 x 10^{-4} m^2 ; d = 2.5 mm = 2.5 x 10^{-3} m ;

V = 400 V

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30) Calculate the resistance- of an aluminum cylinder that has a length of 10.0 era and a cross-sectional area of 2.00 x 10^{-4} m^2. Repeat the calculation for a cylinder of the same dimensions and made of glass having a resistivity of 3.0 x $l0^{10}$ Ω.m

31) A resistance thermometer, which measures' temperature by measuring the change in resistance of a conductor, is made from platinum and has a resistance of 50.0 ' at 20.0°C. When immersed in a vessel containing melting indium, its resistance increases to 76.8 '. Calculate the melting point of the indium.

32) If 6.25 x 10^{18} electrons flow through a given cross section in unit time, find the current. (Given : Charge of an electron is 1,6 x 10^{-19} C)

33) The resistance of a copper wire of length 5m is 0.5 Ω . If the diameter of the wire is 0.05 cm, determine its special resistance.

34) Two wires of same material and length have resistances 5 Ω and 10 Ω respectively. Find the ratio of radii of the two wires.

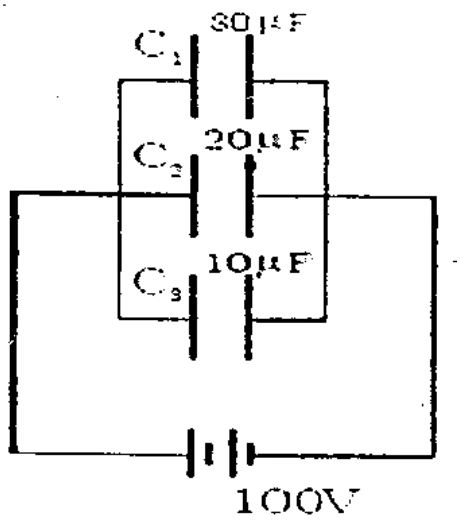
35) The resistance of a field coil measures 50 Ω at 20°C and 65 Ω at 70°C. Find the temperature coefficient of resistance .

36) **The area of each plate of a parallel plate capacitor is 4×10^{-2} sq m. If the thickness of the dielectric medium between the plates is 10^{-3} m and the relative permittivity of the dielectric is 7. Find the capacitance of the capacitor.**

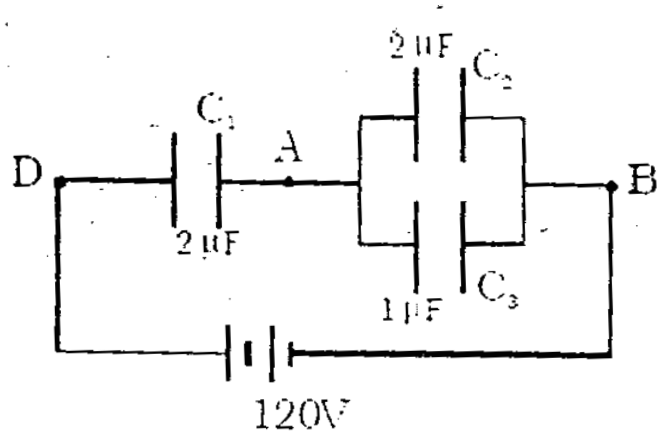
37) **Two capacitors j of unknown capacitances are connected in series and parallel. If the net capacitances in the two combinations are 6 μF and 25 μF respectively, find their capacitances.**

38) **Two capacitances 0.5 μF and 0.75 μF are connected in parallel and the combination to a 110 V battery. Calculate the charge from the source and charge on each capacitor.**

39) **Three capacitors are connected in parallel to a 100 V battery as shown in figure. What is the total energy stored in the combination of capacitor?**

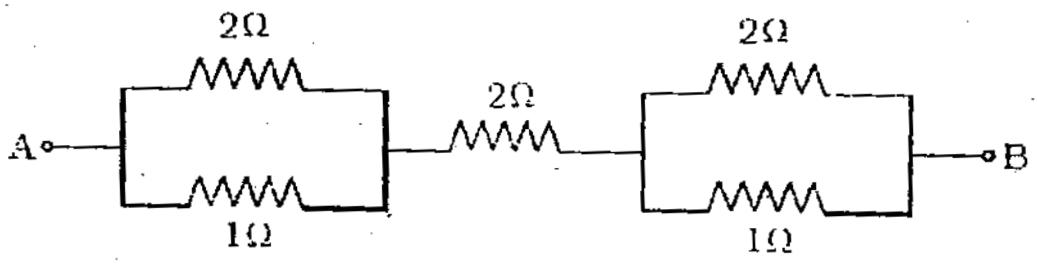


40) Find the charges on the capacitor shown in figure and the potential difference across them.

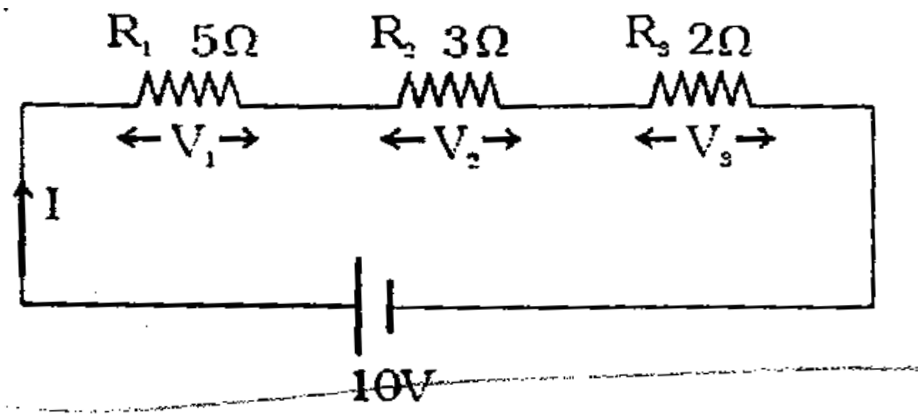


41) Three capacitors each of capacitance 9 pF are connected in series (i) What is the total capacitance of the combination? (ii) What is the potential difference across each capacitor, if the combination is connected to 120 V supply?

42) Find the effective resistance between A and B in the given circuit

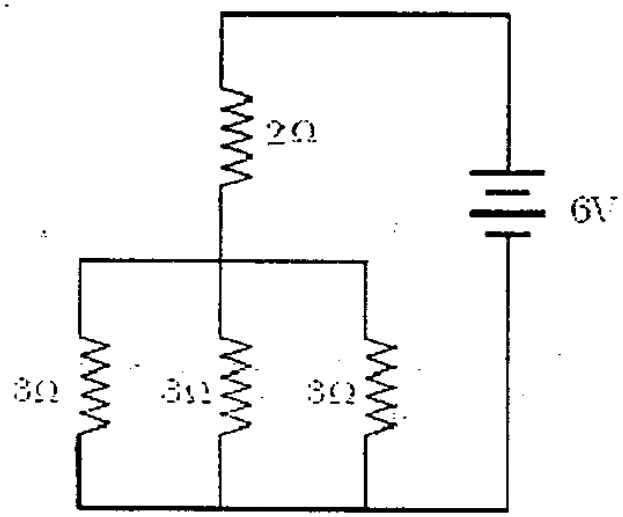


43) Three resistors are connected in series with 10 V supply as shown in the figure. Find the voltage drop across each resistor.

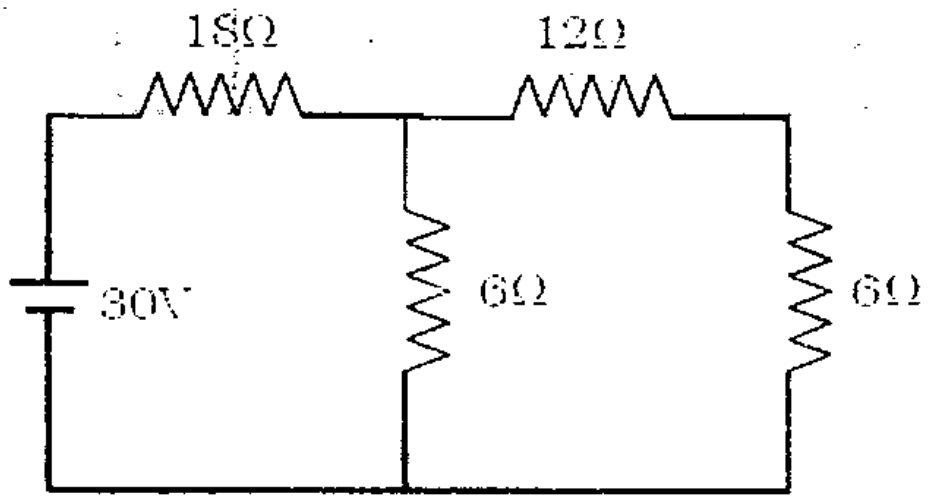


44) Find the current flowing across three resistors 3 Ω , 5 Ω and 2Ω connected in parallel to a 15 V supply. Also find the effective resistance and total current drawn from the supply.

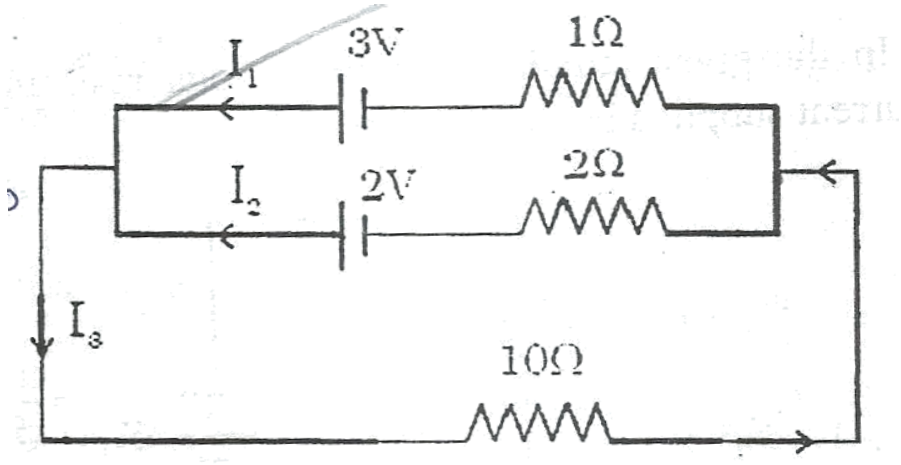
45) In the given circuit, what is the total resistance and current supplied by the battery.



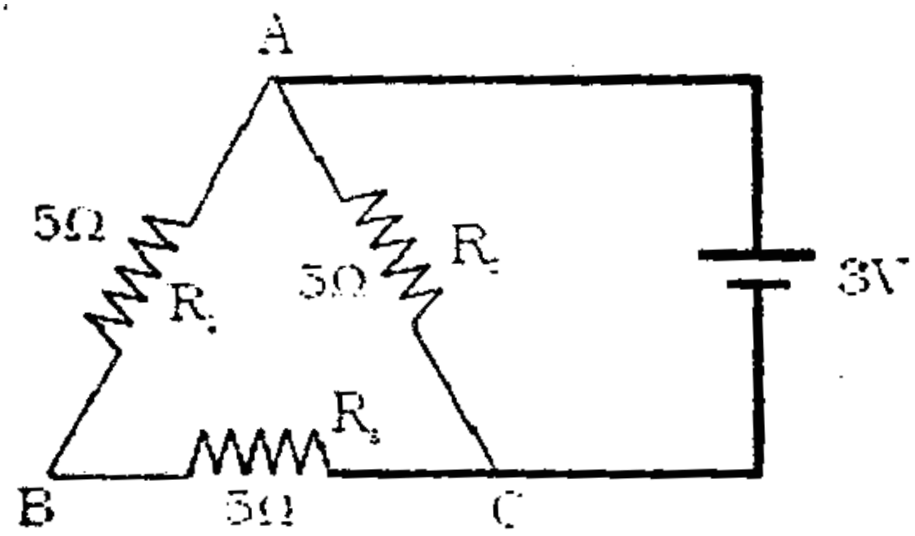
46) Find the voltage drop across 18 Q resistor in the given circuit.



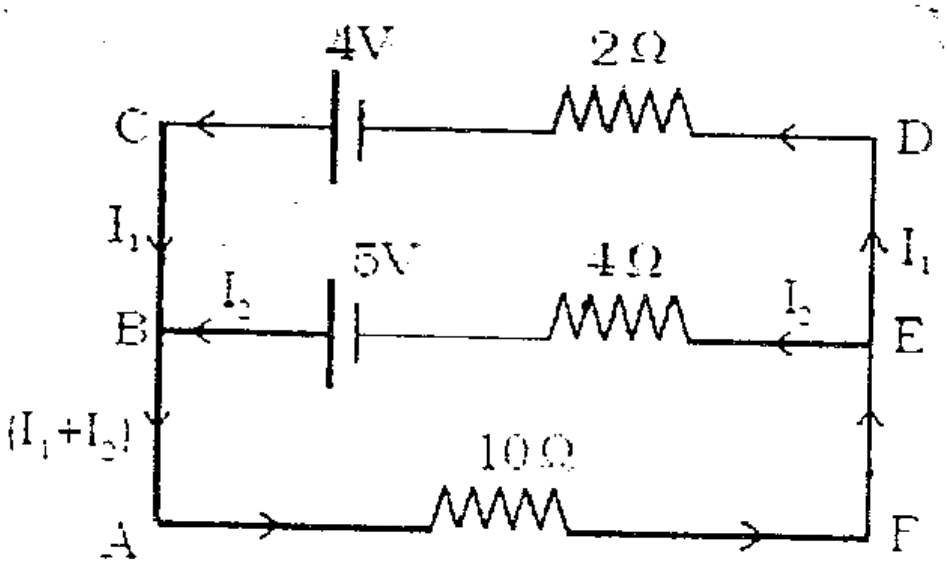
47) Calculate the current II, 12 and 13 in the given electric circuit.



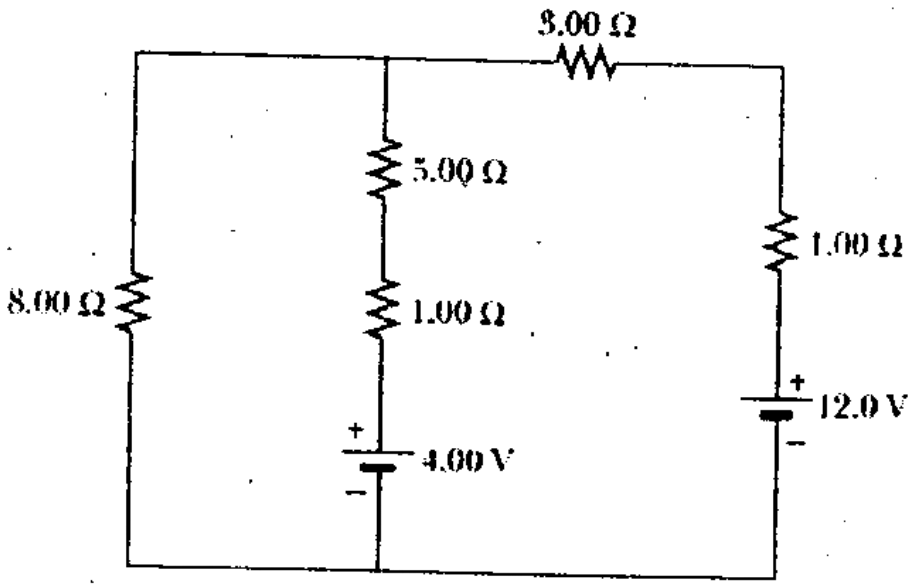
48) Find the electric current flowing through the given circuit connected to a supply of 3 V.



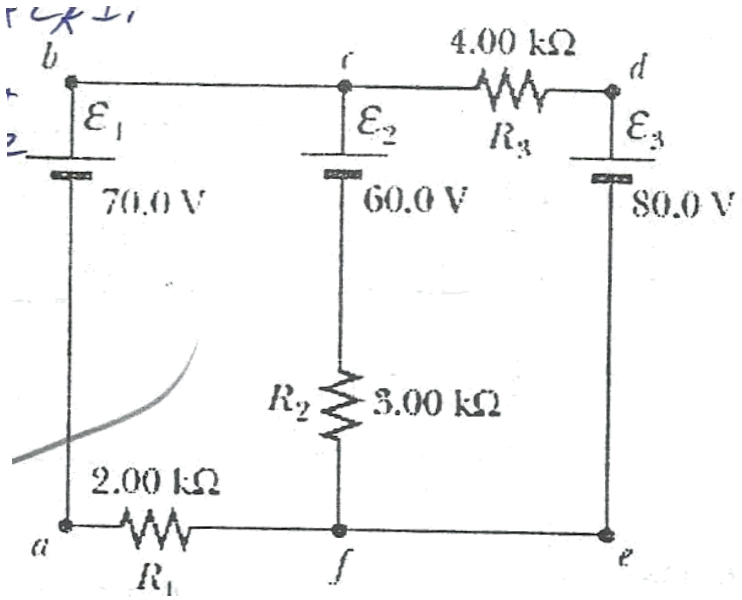
49) In the given circuit, find the current through each branch of the circuit and the potential drop across the 10 Ω resistor.



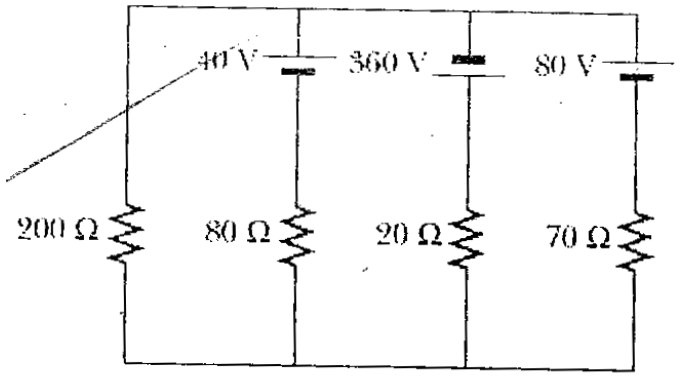
50) Determine the current in each branch of the circuit shown in Figure .



51) Using Kirchhoff s rules, (a) find the current in each resistor in Figure, (b) Find the potential difference between points c and f.



52) In the circuit of Figure, determine the current in each resistor and the voltage across the 200 Ω resistor.



53) A coils of 200 turns is wound uniformly over a wooden ring having a mean circumference of 600 mm and a uniform cross sectional area of 500 mm2. If the current through the coil is 4 A, calculate:

a) The magnetic field strength,

b) the flux density, and

c) the total flux

54) A mild steel ring having a cross sectional area of 500 m^2 and a mean circumference of 400 mm has a coil of turns wound uniformly around it. Calculate:

a) the reluctance of the ring and

b) the current required to produce a flux of 800 Wb in the ring. (Given that is about 380).

55) Shows an iron circuit with a small air gap cut in it. A- 6000 turn coil carries a current I=20 mA which sets up a flux within the iron and across the air gap. If the iron cross section is 0.8 x 10^{-4} m^2, the mean length of flux path in iron is 0.15 m, μ_r=800 in iron and air gap length is 0.75 mm, calculate the air gap flux density. It may be assumed that the flux lines flow straight across the air gap, i.e. air gap cross section is also 0.8 x 10^{-4} mm^2.

56) A magnetic circuit is made of mild steel arranged. The center limb is wound with 500 turns and has a cross sectional area of 800 mm^2. Each of the outer limbs has a cross sectional area of 500 mm^2. The air gap has a length of 1 mm. Calculate the current required to set up a flux of 1.3 mWb in the center limb, assuming no magnetic leakage and fringing. The mean lengths of the various magnetic paths are shown on the diagram. (Use the given B-H curve).