O P JINDAL SCHOOL, SAVITRINAGAR

CLASS TEST & PRACTICE

CLASS X PHYSICS TOPIC : ELECTRICITY

Date : 05 /04/20 MAXIMUM MARKS ; 40

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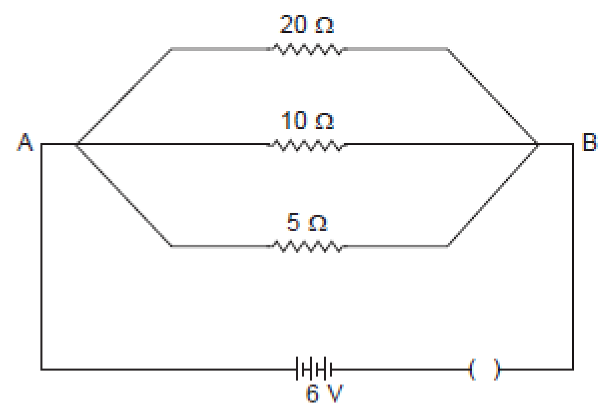


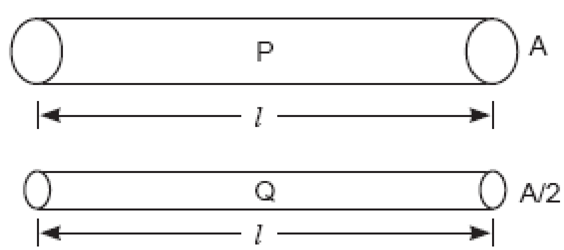
1

Calculate the current flows through the 10 Ω resistor in the following circuit.
(a) 1.2 A (b) 0.6 A
(c) 0.2 A (d) 2.0 A

ANS: (b) In parallel, potential difference across each resistor will remain same. So, current through 10 Ω resistor

$$I = \frac{V}{R} = \frac{6}{10} = 0.6\text{ A}$$

2 Out of the two wires P and Q shown below, which one has greater resistance? Justify it.



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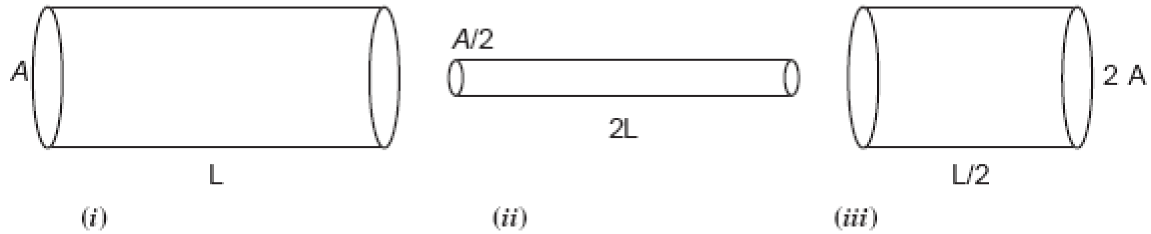
ANS: Smaller the area of cross-section, greater will be resistance as R ∝ $\frac{1}{A}$. ...(For the same length)
So, wire 'Q' has greater resistance.

3 Write S.I. unit of resistivity. 1

ANS: Ohm-metre.

4 The figure below shows three cylindrical copper conductors along with their face areas and lengths. Discuss in which geometrical shape the resistance will be highest.



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ANS: For geometrical shape shown in

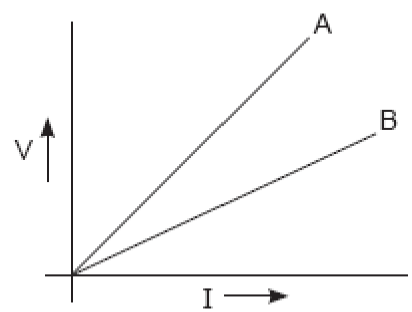
Figure (i) $R_1 = \rho\frac{L}{A}$

Figure (ii) $R_2 = \rho\frac{2L}{A/2} = 4\left(\rho\frac{L}{A}\right) = 4R_1$

Figure (iii) $R_3 = \rho\frac{L/2}{2A} = \frac{1}{4}\left(\rho\frac{L}{A}\right) = \frac{R_1}{4}$

Therefore, resistance of geometrical shape shown in figure (ii) will be highest.

5 V-I graph for two wires A and B are shown in the figure. If both wires are of same length and same thickness, which of the two is made of a material of high resistivity? Give justification for your answer.



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ANS: Greater is the slope of V-I graph, greater will be the resistance of given metallic wire. In the given graph, wire A has greater slope then B. Hence, wire A has greater resistance.

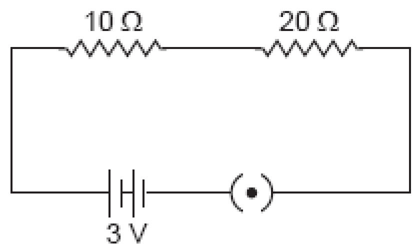
For the wires of same length and same thickness, resistance depends on the nature of material of the wire, i.e.

$$R_1 = \rho_1 \frac{l}{A} \quad \text{and} \quad R_2 = \rho_2 \frac{l}{A}$$

$\Rightarrow$
$$\frac{R_1}{R_2} = \frac{\rho_1}{\rho_2} \quad \text{or} \quad R \propto \rho$$

Hence, wire ‘A’ is made of a material of high resistivity.

6 Study the following electric circuit and find (i) the current flowing in the circuit and (ii) the potential difference across 10 Ω resistor. 3



ANS: 10 Ω and 20 Ω are connected in series, their equivalent resistance is

$R_s = R_1 + R_2 = 10 + 20 = 30\ \Omega$

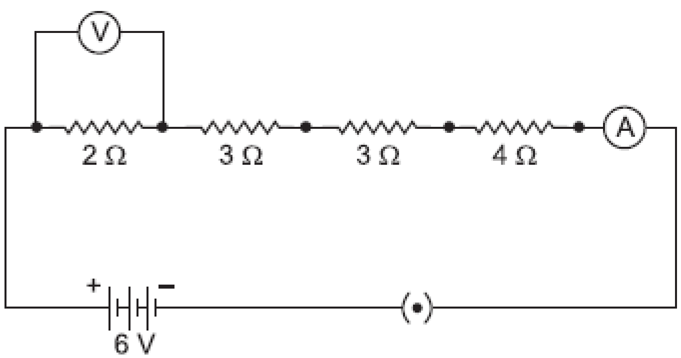
(i) Current flowing in the circuit

$$I = \frac{V}{R_s} = \frac{3}{30} = \frac{1}{10} = 0.1\text{ A}$$

(ii) Potential difference across 10 Ω resistor

$$V = IR = \frac{1}{10} \times 10 = 1\text{ volt.}$$

7 Find out the reading of ammeter and voltmeter in the circuit given below : 3

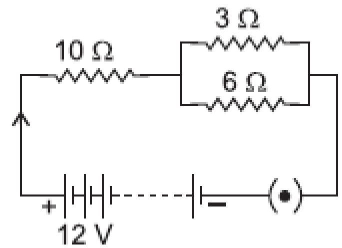


ANS: Equivalent resistance of given series combination

$R_s = R_1 + R_2 + R_3 + R_4 = 2 + 3 + 3 + 4 = 12\ \Omega$ (i) Ammeter reading, $I = \frac{V}{R} = \frac{6}{12} = 0.5\text{ A}$ (ii) Voltmeter reading, V = IR = 0.5

$\times 2 = 1$ V

8 Consider the circuit shown in the diagram. Find the current in 3 Ω resistor. 3



ANS: 3 Ω and 6 Ω are in parallel. $\therefore$

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{3} + \frac{1}{6} = \frac{1}{2}$$

$$R_P = 2\ \Omega$$

R_P and 10 Ω are connected in Series. So, $R_S = R_P + R_3 = 2 + 10 = 12\ \Omega$ Total current in the circuit,

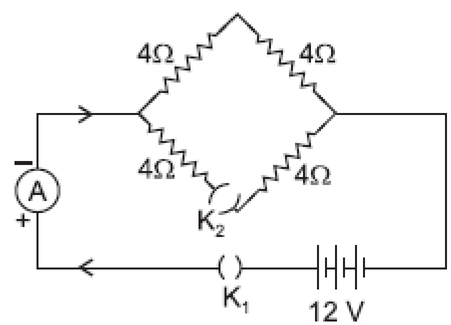
$$I = \frac{V}{R_S} = \frac{12}{12} = 1\ \text{A}$$

P.d across $R_P = IR_P = 1 \times 2 = 2$ V

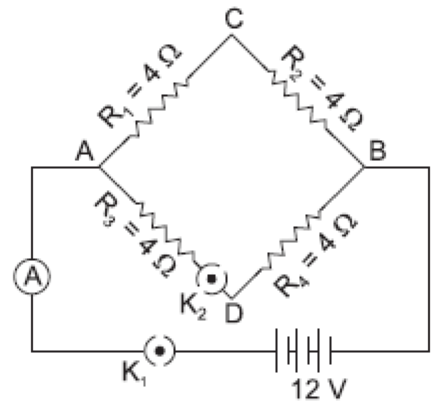
So, p.d. across $3\ \Omega = 2$ V

Current through 3 Ω, $I_1 = \dfrac{V}{R_1} = \dfrac{2}{3} = 0.67$ A

9 Calculate the electric current in the given circuit when 3
(i) key K_1 is open and K_2 is closed
(ii) both the keys are closed
(iii) K_1 is closed and K_2 is open



ANS: (i) Key K_1 is open and K_2 is closed, then no current flows in the circuit as circuit is an open circuit.



(ii) Both the keys are closed : Current flows through the circuit.

Equivalent resistance of the circuit, $\frac{1}{R} = \frac{1}{R_1+R_2} + \frac{1}{R_3+R_4} = \frac{1}{4+4} + \frac{1}{4+4} = \frac{1}{8} + \frac{1}{8} = \frac{2}{8} = \frac{1}{4}$ So, R = 4 Ω

Electric current, I = $\frac{V}{R} = \frac{12}{4} = 3\text{ A}$ (iii) K_1 is closed and K_2 is open

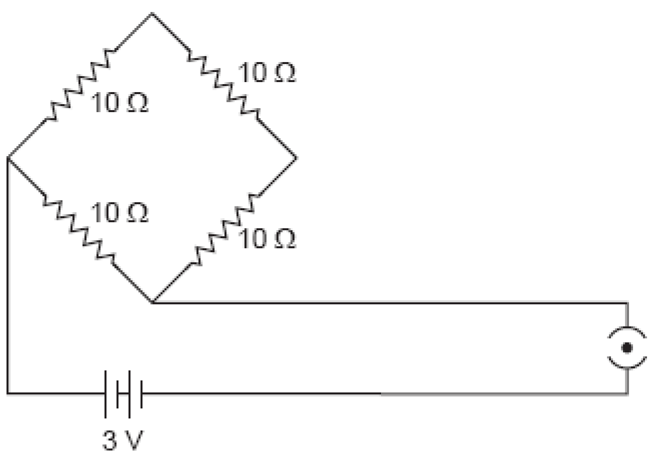
When K_2 is open, the part ADB will become an open circuit, So no current will flow in the ADB part.

∴ Net resistance of circuit,

$$R = R_1 + R_2 = 4 + 4 = 8\,\Omega$$

∴ Electric current, $I = \frac{V}{R} = \frac{12}{8} = \frac{3}{2} = 1.5\text{ A}$

10 Find the current drawn from the battery by the network of four resistors shown in the figure.



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ANS: Equivalent resistance of the given network is

$$\frac{1}{R} = \frac{1}{R_4} + \frac{1}{R_1 + R_2 + R_3} = \frac{1}{10} + \frac{1}{10+10+10} = \frac{1}{10} + \frac{1}{30} = \frac{3+1}{30} = \frac{4}{30}$$

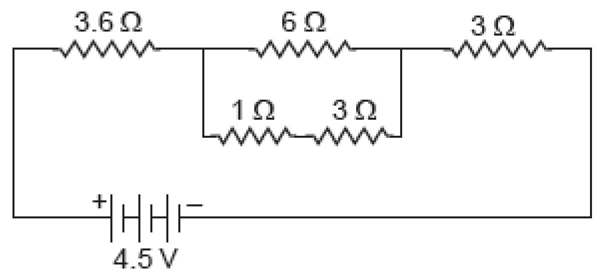
$\therefore \quad R = \frac{30}{4} = 7.5\ \Omega$

Current drawn from the battery $\Rightarrow$

$$I = \frac{V}{R} = \frac{3}{7.5} = \frac{30}{75} = \frac{2}{5}$$

$$I = 0.4\ \text{A}$$

11 Find the current flowing through the following electric circuit. 3



ANS: Series combination of 1 Ω and 3 Ω resistance is in parallel combination with 6 Ω. Their equivalent resistance is

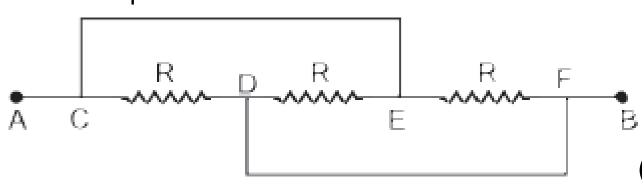
$$\frac{1}{R_P} = \frac{1}{6} + \frac{1}{3+1} = \frac{1}{6} + \frac{1}{4} = \frac{2+3}{12}$$

$\therefore \quad R_P = \frac{12}{5} = 2.4\ \Omega$

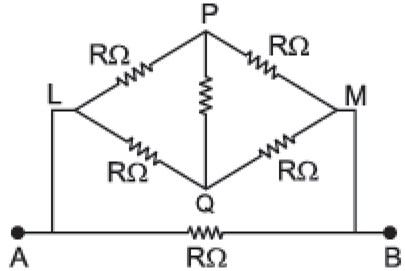
Now, 3.6 Ω, 2.4 Ω and 3 Ω are in series, their equivalent resistance be $R_S = R_1 + R_2 + R_3 = 3.6 + 2.4 + 3 = 9\ \Omega$ Hence, the current flowing through the circuit is

$$I = \frac{V}{R} = \frac{4.5}{9} = \frac{45}{90} = \frac{1}{2} = 0.5\ \text{A.}$$

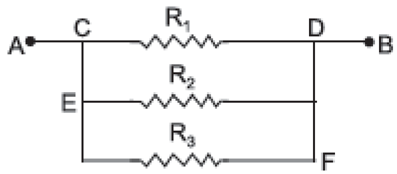
12 Find the equivalent resistance across the two ends A and B of the following circuits. (i) 3



(ii) Assume that P and Q are at the same potential.



ANS: (i) The equivalent circuit is shown in figure below. Here all the three resistances are in parallel combination between point A and B



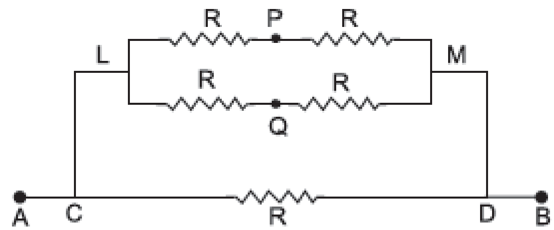
Therefore, equivalent resistance of the circuit is

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{3}{R}$$

$$\therefore \quad R_{eq} = \frac{R}{3}\,\Omega$$

Given : P and Q are at the same potential. It means, no current will flow through the resistance between P and Q. Therefore, the resistance between P and Q is ineffective.

The circuit can be redrawn as



From figure,

$$\frac{1}{R_{LM}} = \frac{1}{R_{LP}+R_{PM}} + \frac{1}{R_{LQ}+R_{QM}} = \frac{1}{R+R} + \frac{1}{R+R} = \frac{1}{2R} + \frac{1}{2R} = \frac{1}{R}$$

$$\therefore \quad R_{LM} = R$$

Now R_{LM} and R_{CD} are in parallel combination.

$$\therefore \quad \frac{1}{R_{AB}} = \frac{1}{R_{LM}} + \frac{1}{R_{CD}} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R}$$

So, $$R_{AB} = \frac{R}{2}\,\Omega$$

13 (a) Calculate the resistance of 1 Km long copper wire of radius 1 mm. Resistivity of the copper is $1.72 \times 10^{-8}\ \Omega$ m. 5

(b) Draw a schematic diagram of a circuit consisting of a battery of 4 cells of 2 V each connected to a key, an ammeter and two resistors of 2 Ω and 3 Ω respectively in series and a voltmeter to measure potential difference across 3 Ω.

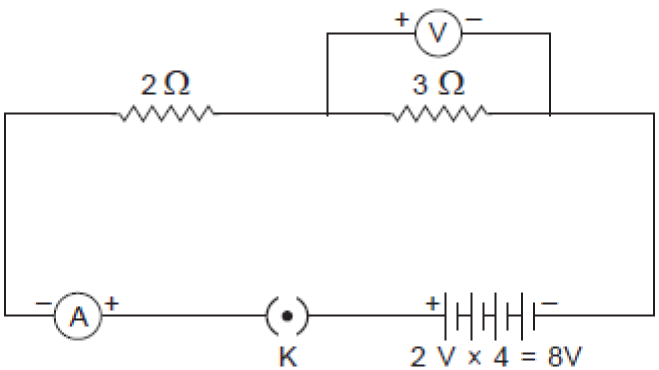
ANS:

(*a*) Resistance, $R = \rho\frac{l}{A} = \rho\frac{l}{\pi r^2}$

On substituting the values, we get

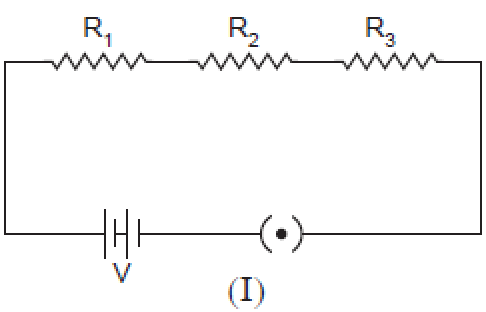
$$R = \frac{1.72\times10^{-8}\times10^{3}}{3.14\times(1\times10^{-3})^2} = \frac{1.72}{3.14}\times10 = \frac{17.2}{3.14} = 5.47\ \Omega$$

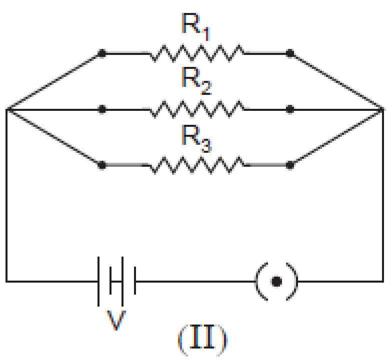
(*b*)



14 Name an instrument that measures potential difference between two points in a circuit. Define the unit of potential difference in terms of SI unit of charge and work. Draw the circuit symbols for a, (i) variable resistor, (ii) a plug key which is closed one.

Two electric circuits I and II are shown below





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(i) Which of the two circuits has more resistance?

(ii) Through which circuit more current passes?

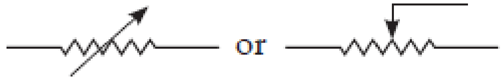
(iii) In which circuit, the potential difference across each resistor is equal?

(iv) If $R_1 > R_2 > R_3$, in which circuit more heat will be produced in R_1 as compared to other two resistors? Given given.

ANS: • Voltmeter

• Unit of potential difference is volt.

One volt: The potential difference between two points in an electrostatic field is said to be 1 volt if one joule of work is done in moving one coulomb of electric charge from one point to another in the same electrostatic field.

• (a) Variable resistor 

(b) a plug key which is closed one 

(i) Equivalent resistance of a series combination is more that of a their parallel combination. Hence, circuit 'I' has more resistance.

(ii) From Ohm's Law, for the same applied potential difference, current is inversely proportional to equivalent resistance of the combination, i.e. $I = \frac{1}{R}$

Therefore, in parallel combination, circuit II, has less resistance, hence, more current will pass through it.

(iii) Parallel combination, the potential difference across each resistance is equal to the applied potential difference.

(iv) More heat will be produced in R_1 in circuit II as compared to other two resistor (for ($R_1 > R_2 > R_3$).

Justification: In series, less current will flow due to increase in resistance of the circuit and potential difference across each resistance is less than that of applied potential. While in parallel combination for the same potential, current is inversely proportional to resistance $\left(I \propto \frac{1}{R}\right)$ more current will flow through R_1 than that in series combination. Hence, from Jule's law of heating, $H = I^2Rt$

heat produced in R_1 in parallel combination will be more as compared to their series combination.