Q-1 - 11964648

Two uniform wires $A$ and $B$ are of the same total metal and have equal masses. The radius of wire $A$ is twice that of wire $B$. The total resistance of $A$ and $B$ when connected in parallel is

(A) $4\Omega$ when the resistance of wire $A$ is $4.25\Omega$

(B) $5\Omega$ when the resistance of wire $A$ is $4.25\Omega$

(C) $4\Omega$ when the resistance of wire $B$ is $4.25\Omega$

(D) $4\Omega$ when the resistance of wire $B$ is $4.25\Omega$

---

CORRECT ANSWER: A

---

SOLUTION:

(a)

$$\frac{R_A}{R_B} = \left(\frac{r_B}{r_A}\right)^4$$

$$\Rightarrow \frac{R_A}{R_B} = \left(\frac{1}{2}\right)^4$$

$$= \frac{1}{16} \Rightarrow R_B = 16R_A$$

When $R_A$ and $R_B$ are connected in parallel the equivalent resistance

$$R_{eq} = \frac{R_A R_B}{(R_A + R_B)}$$

$$= \frac{16}{17} R_A$$

If $R_A = 4.25\Omega$ then $R_{eq} = 4\Omega$



Q-2 - 19037511

In Bohr's model of $H_2$ atom, the electrons move around the nucleus in a circular orbit of radius $5 \times 10^{-11}$ m. Its time period is $1.5 \times 10^{-16}$ s, the current associated with electron motion is

(A) zero

(B) $1.6 \times 10^{-19}$A

(C) 0.17 A

(D) $1.07 \times 10^{-3} A$

---

CORRECT ANSWER: D

---

SOLUTION:

$r = 5 \times 10^{-11} m, t$
$= 1.5 \times 10^{-16} s$

$$i = \frac{q}{t} = \frac{1.6 \times 10^{-19}}{1.5 \times 10^{-16}}$$
$\Rightarrow I = 1.07 \times 10^{-3} A$

---

Q-3 - 13156685

Two tungsten lamps $A$ and $B$ of resistances $R_1$ and $R_2$ respectively are connected in a circuit of negligible internal resistance, if

$R_1 > R_2$

(i) The lamp $A$ will glow brightly if lamps are connected in series

(ii) the lamb $A$ will glow brightly if lamps are connected in parallel

(iii) the lamp $B$ will glow brightly if lamps are connected in series.

(iv) the lamb $B$ will glow brightly if lamps are connected in parallel

(A) (i),(ii)

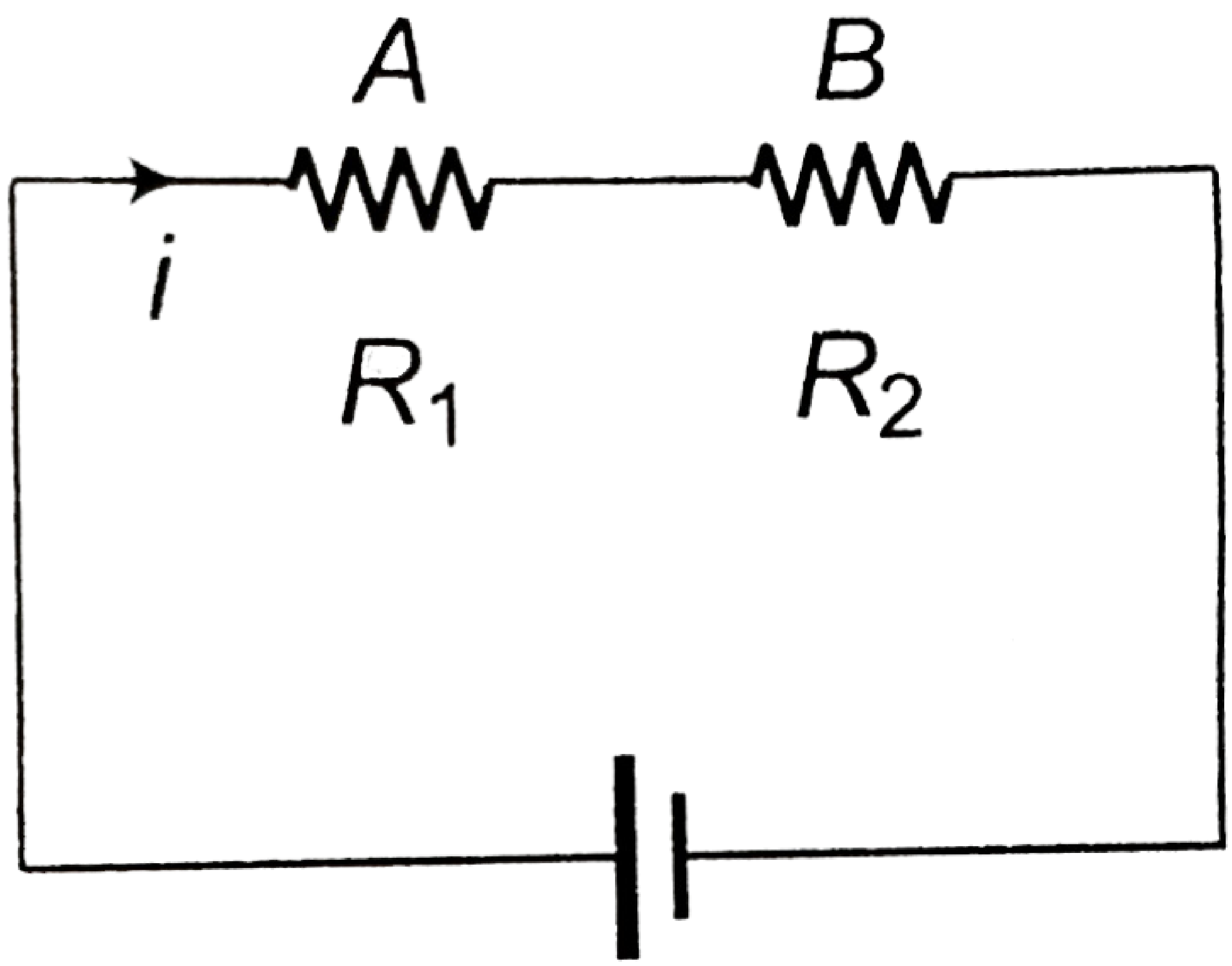
(B) (i),(iv)

(C) (i), (iii)

(D) (ii),(iii)

CORRECT ANSWER: B

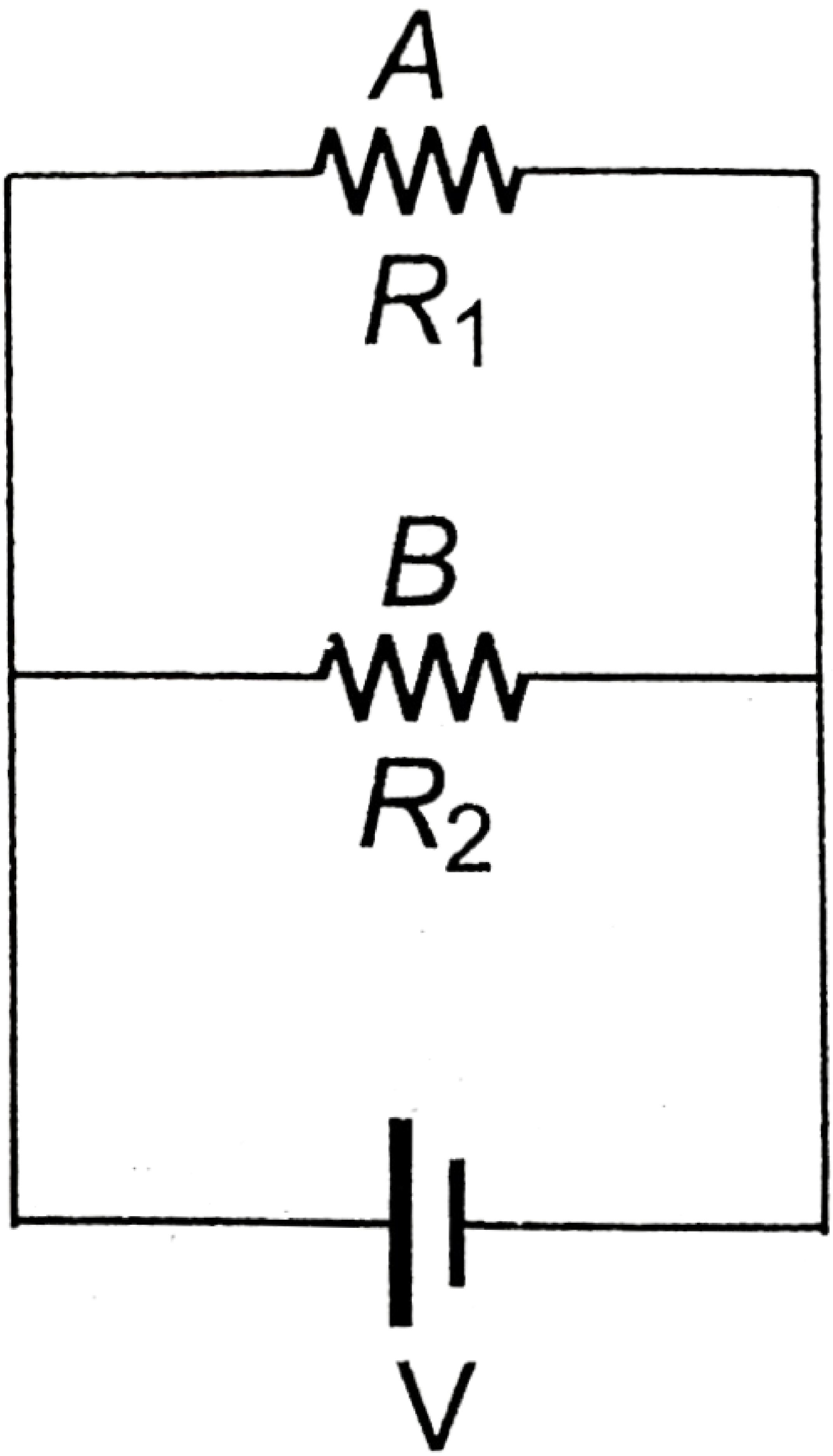
SOLUTION:




$P_A = i^2 R_1, P_B = i^2 R_2$

$R_1 > R_2 \Rightarrow P_A > P_B$

The lamb $A$ glows brightly

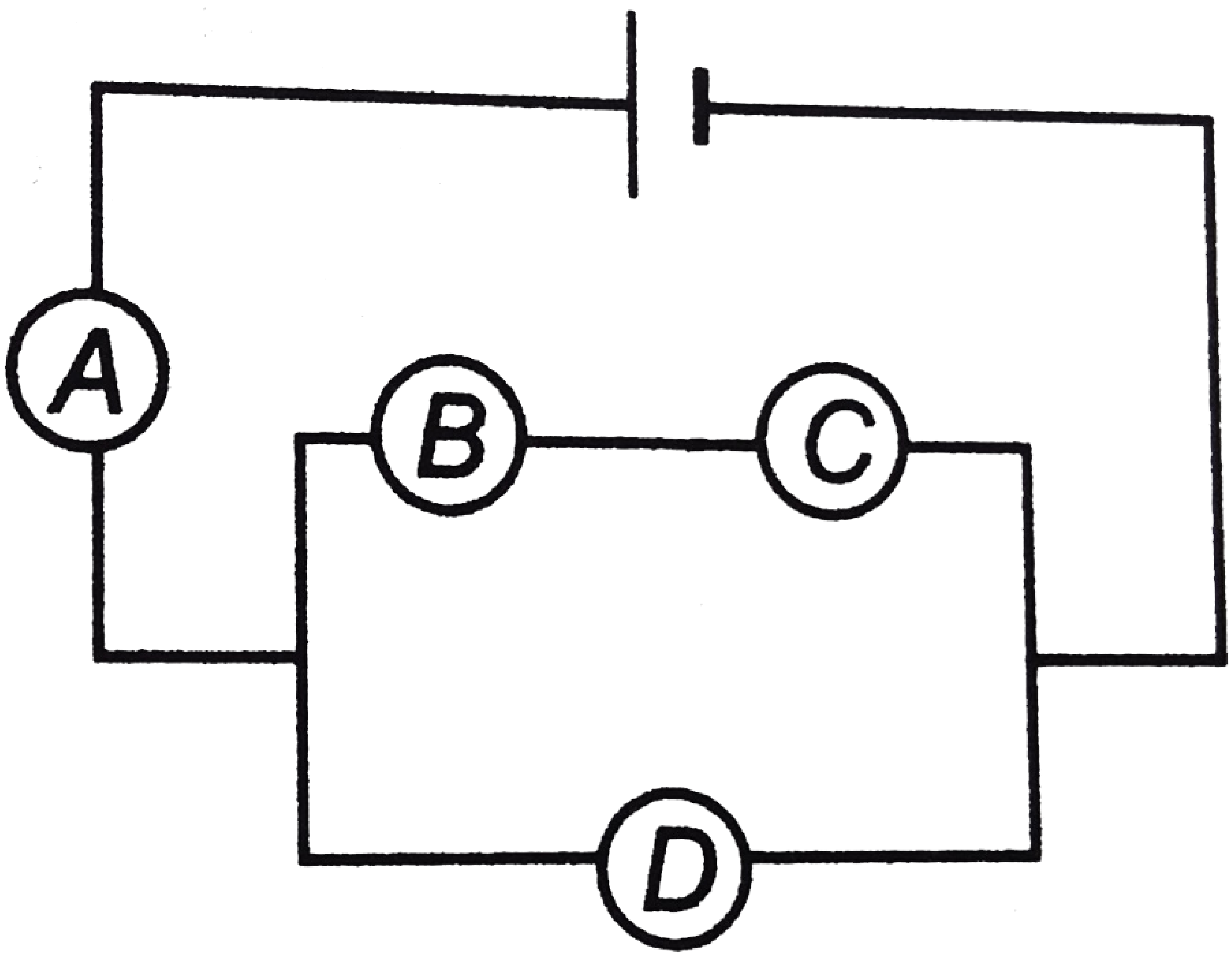



$P_A = V^2 / R_1, P_B$
$= V^2 / R_2$
ltbr .$P_B > P_A$

The lamp $B$ glows brightly.

Q-4 - 10966819

All bulbs in the circuit shown in figure are identical. Which bulb glows most brightly?




(A) $B$

(B) $A$

(C) $D$

(D) $C$

---

CORRECT ANSWER: B

---

SOLUTION:

Maximum current will pass through A

$$P = i^2 R$$

or $P \propto i^2$ ($R$ is same)

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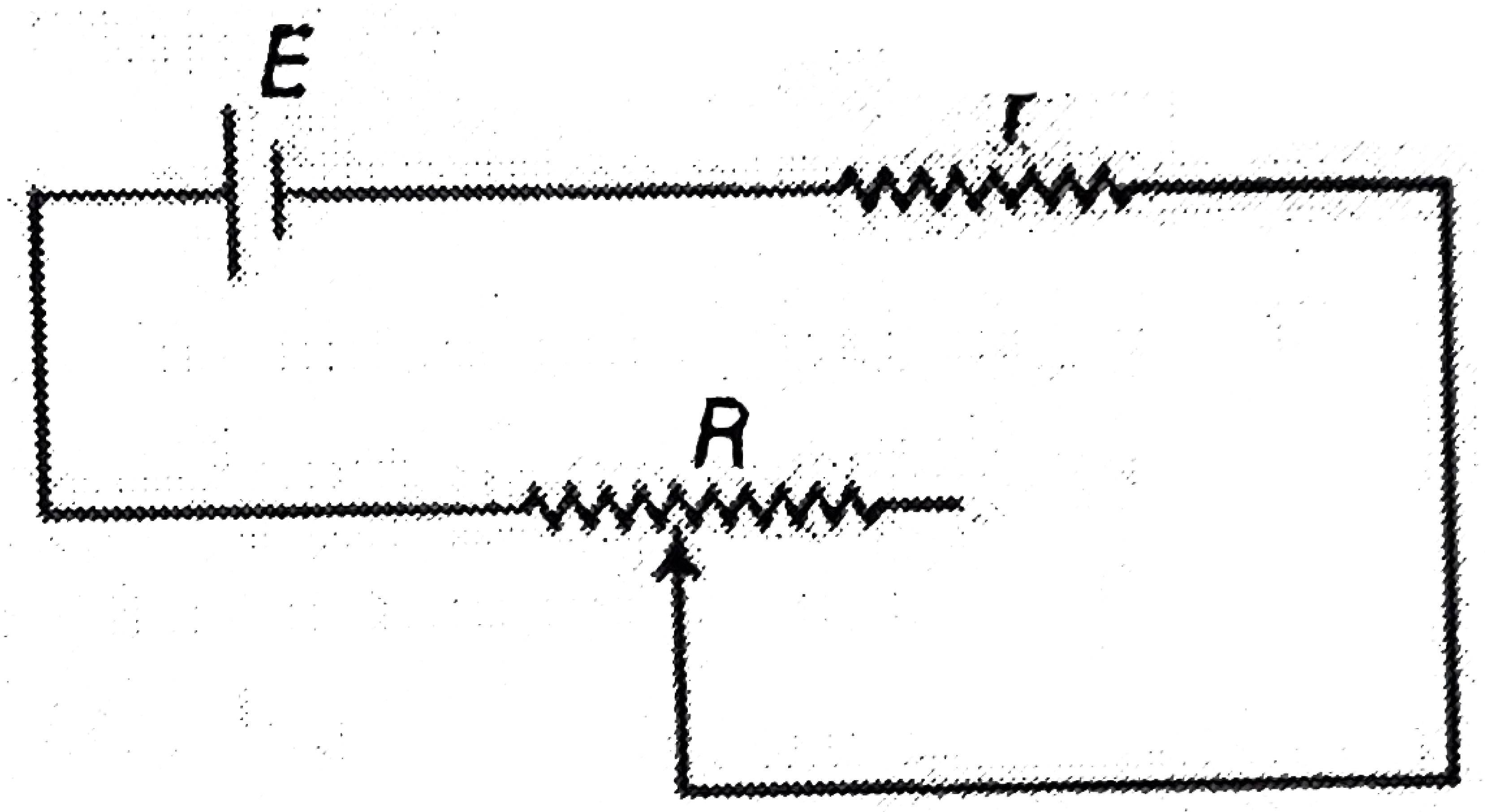
Q-5 - 19037540

A battery of emf E and internal resistance r is connected to a variable resistor R as shown in figure. Which one of the following is true ?



(A) Potenital difference across the terminals of the battery is maximum, when R=r

(B) Power delivered to the resistor is maximum when R=r

(C) Current in the circuit is maximum when R=r

(D) Current in the circuit is maximum when $R > > r$

---

CORRECT ANSWER: C



Q-6 - 11310211

Statement I: When an external resistor of resistance R (connected across a cell to internal resistance r ) is varied, power consumed by resistance R is maximum when R = r.

Statement II: Power consumed by a resistor of constant resistance R is maximum when current through it is maximum.

(A) Statement I is true, Statement II is True, Statement II is a correct explanation for Statement I.

(B) Statement I is True, Statement II is True, Statement II is not a correct explanation for Statement I.

(C) Statement I is True, Statement II is False.

(D) Statement I is False, Statement II is True.

---

CORRECT ANSWER: B

---

SOLUTION:

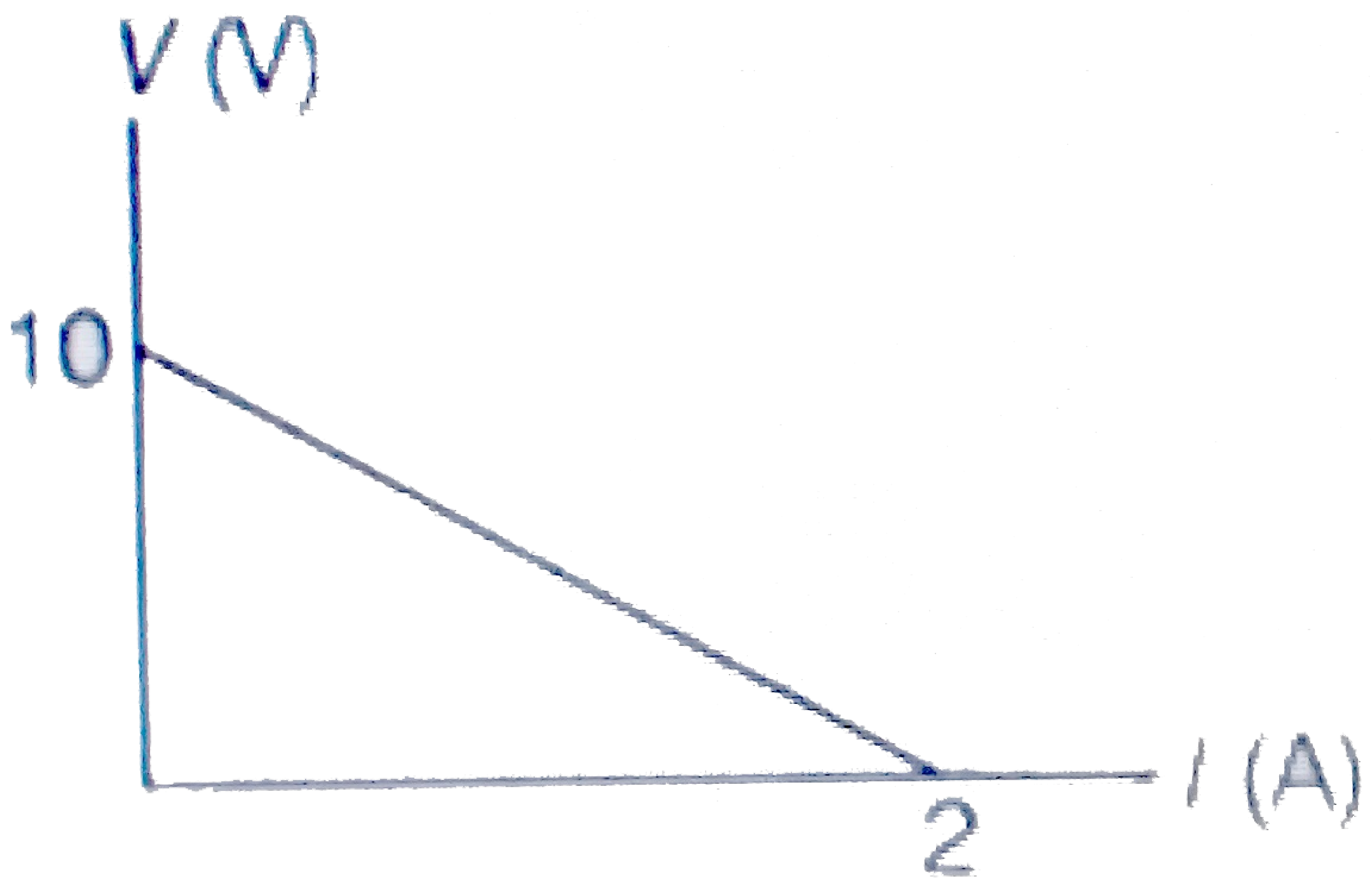
b. Both statements I and II are true. In Statements I, R is varied

while in Statement II, R is kept constant. Hence, both statements

are independent.

Q-7 - 17817803

A battery of emf E and internal resistance r is connected across a resistance R. Resistance R can be adjusted to any value greater than or equal to zero. A graph is plotted between the current passing through the resistance (I) and potential difference across the terminals of the battery (V). Maximum power developed across the resistance R is




(A) 5 W

(B) 10 W

(C) 15 W

(D) 25 W

---

CORRECT ANSWER: A

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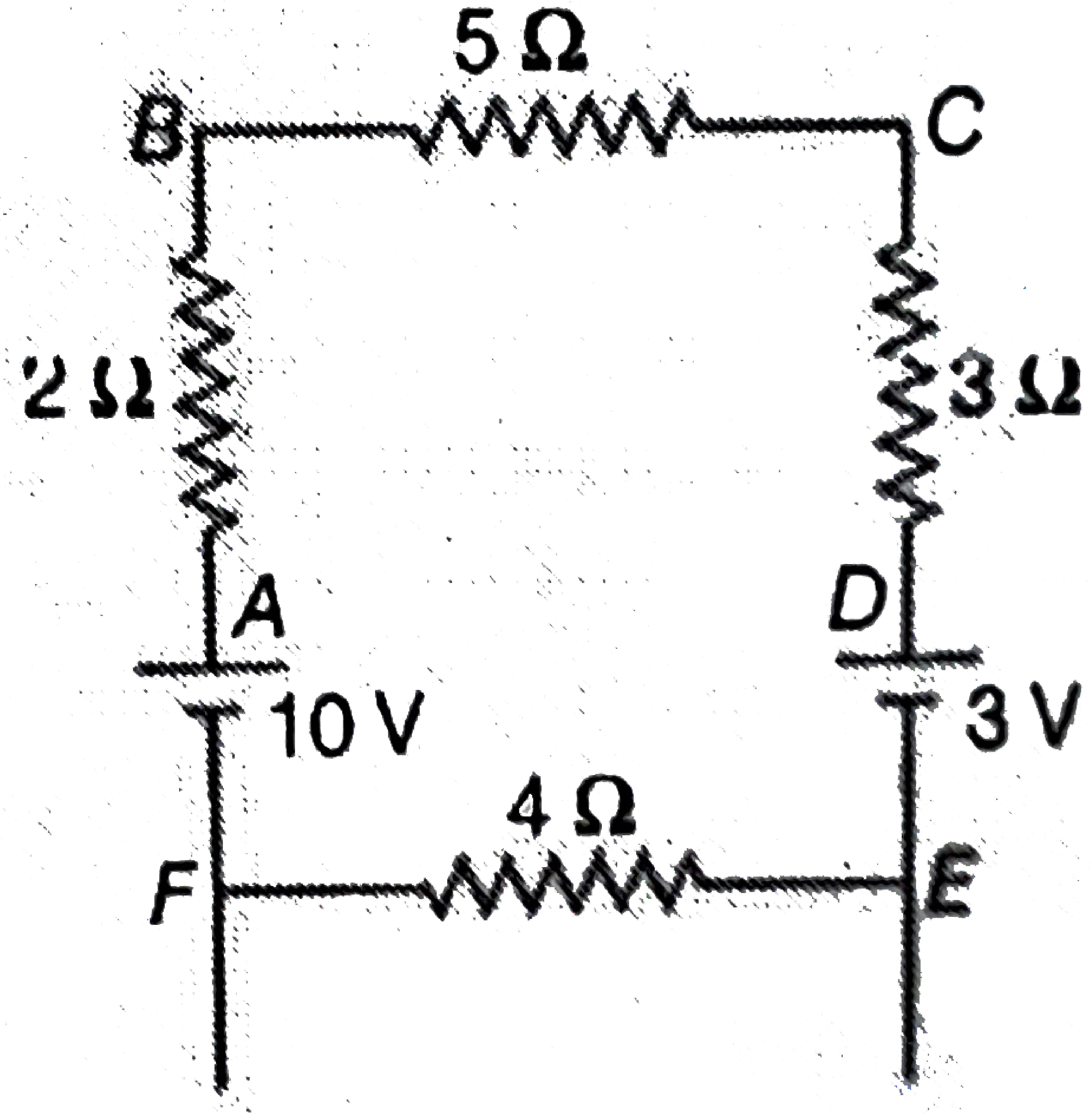
Q-8 - 19037548

For the circuit shown in figure. The point F is grounded. Which of the following is wrong statement ?




(A) D is at 5 V

(B) E is at zero potential

(C) The current in the circuit will be 0.5 A

(D) None of the above

---

CORRECT ANSWER: A

---

SOLUTION:

Effective emf of circuit =10-3=7 V

Total resistance of circuit

$= 2 + 5 + 3 + 4 = 14$
$\Omega$

Current $I = 7/14 = 0.5A$

Potential difference between A and D

$= 0.5 \times 10 = 5A$

Potential at D=10-5=5 V

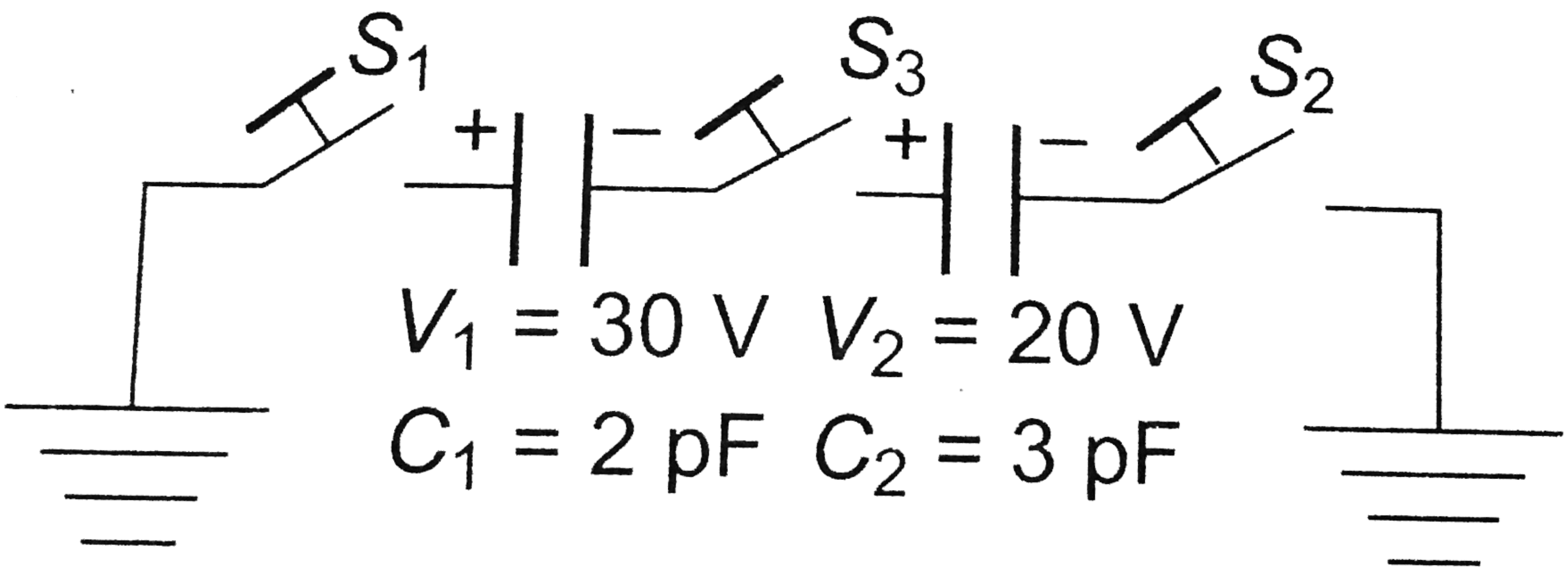
Potential at E=5-3=2 V

Hence, E cannot be at zero potential, as there is a potential drop at E.



Q-9 - 11964363

For the circuit shown in figure, which of the following statements is true ?




(A) With $S_1$ closed, $V_1 = 15V, V_2 = 20V$

(B) With $S_3$ closed, $V_1 = V_2 = 25V$

(C) With $S_1$ and $S_2$ closed $V_1 = V_2 = 0$

(D) With $S_1$ and $S_3$ closed $V_1 = 30V$ and $V_2 = 20V$

---

CORRECT ANSWER: D

---

SOLUTION:

When $S_1$ is closed $V_1 = 30V, V_2 = 20V$

When $S_3$ is closed $V_1 = 30V, V_2 = 20V$

When $S_1$ and $S_2$ are closed $V_1 = 30V, V_2 = 20V$

When $S_1$ and $S_3$ are closed $V_1 = 30V, V_2 = 20V$

When $S_1$, $S_2$ and $S_3$ are closed
$V_1 + V_2 = 0V, V_1 = 0,$
$V_2 = 0V$

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Q-10 - 19037553

In which property of free electrons causes increase in the resistance of a conductor with rise in temperature ?

(A) Number density

(B) Relaxation time

(C) Mass

(D) None of these

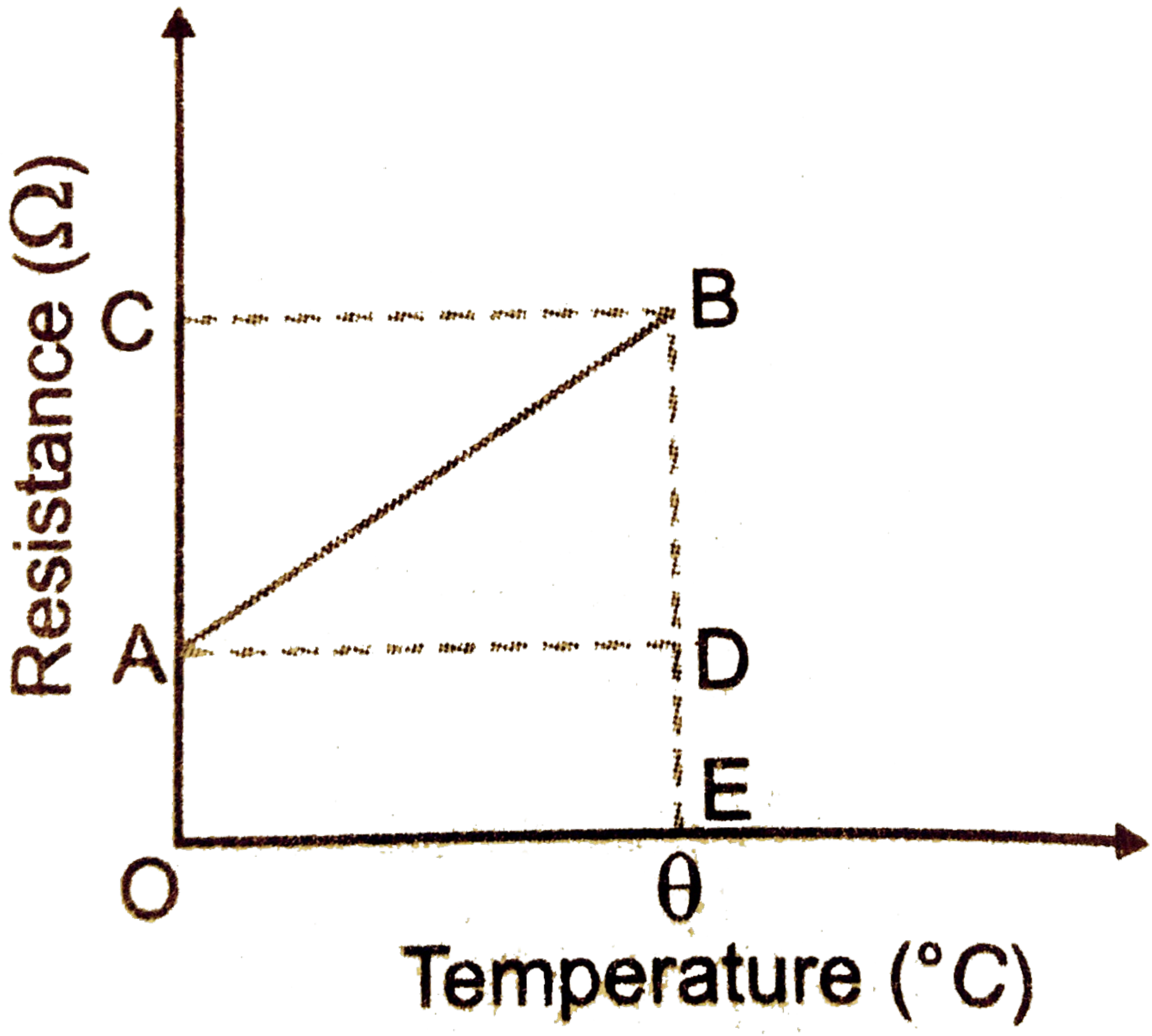
---

CORRECT ANSWER: B

---

Q-11 - 12297765

The variation of resistance of a metallic conductor with temperature is shown in figure. (i) Calculate the temperature coefficient of resistance from the graph. (ii) State why the resistance of the conductor increases with the rise in temperature.



SOLUTION:

(i) From graph, corrensponding to point A, let the resistance be $R_0$ and corresponding to point B, the resistance be R. When temperature changes from 0 to $\theta^C$, the resistance changes from $R_0$ to R .

Thus change in temperature $= \theta - 0 = \theta^C$

Change in resistance $= R - R_0$

Temperature coefficient of resistnace,

$\alpha$

$$= \frac{\text{change in resistance}}{\text{original resistance} \times \text{change in temp.}}$$

$$\frac{R - R_0}{R_0 \times \theta}$$

$$= \frac{OC - OA}{OA \times OE}$$

(ii) With the rise of temperature of conductor, the resistance of a conductor increases because the frequency of collision of electrons with ions/atoms of the conductor increases, resulting decreases in relaxtion time $(\tau)$ of electrons.

As $R \propto 1/\tau$, so R increases as $\tau$ decreases.

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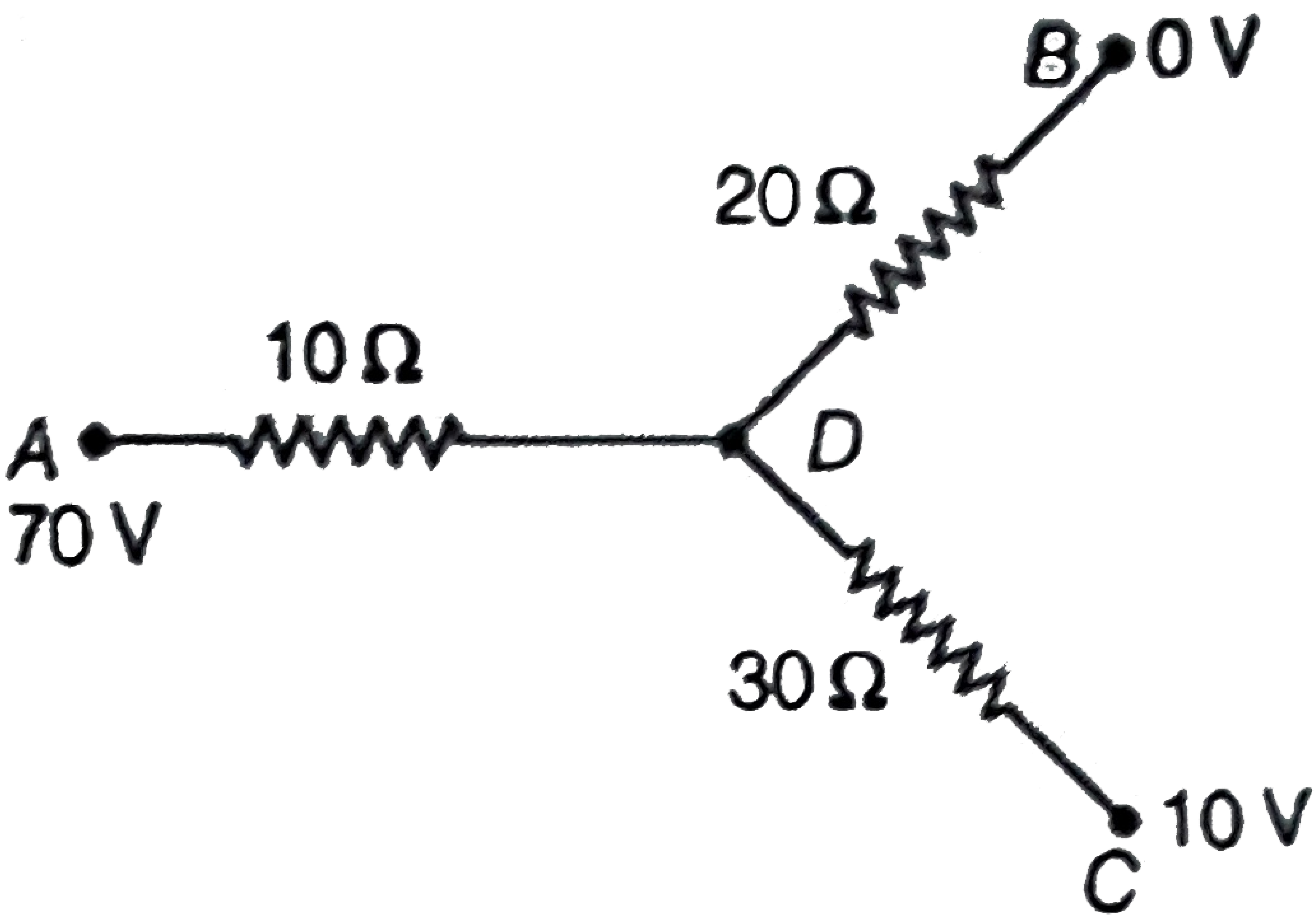
Q-12 - 19037558

For the network shown in figure, points A, B and C are at potentials of 70 V, zero and 10 V respectively



(A) point D is at a potential of 40 V

(B) the currents in the sections AD, DB and DC are in the ratio $4:3:2$

(C) the current in the sections AD, DB and DC are in the ratio $1:2:3$

(D) the network draws a total power of 100 W

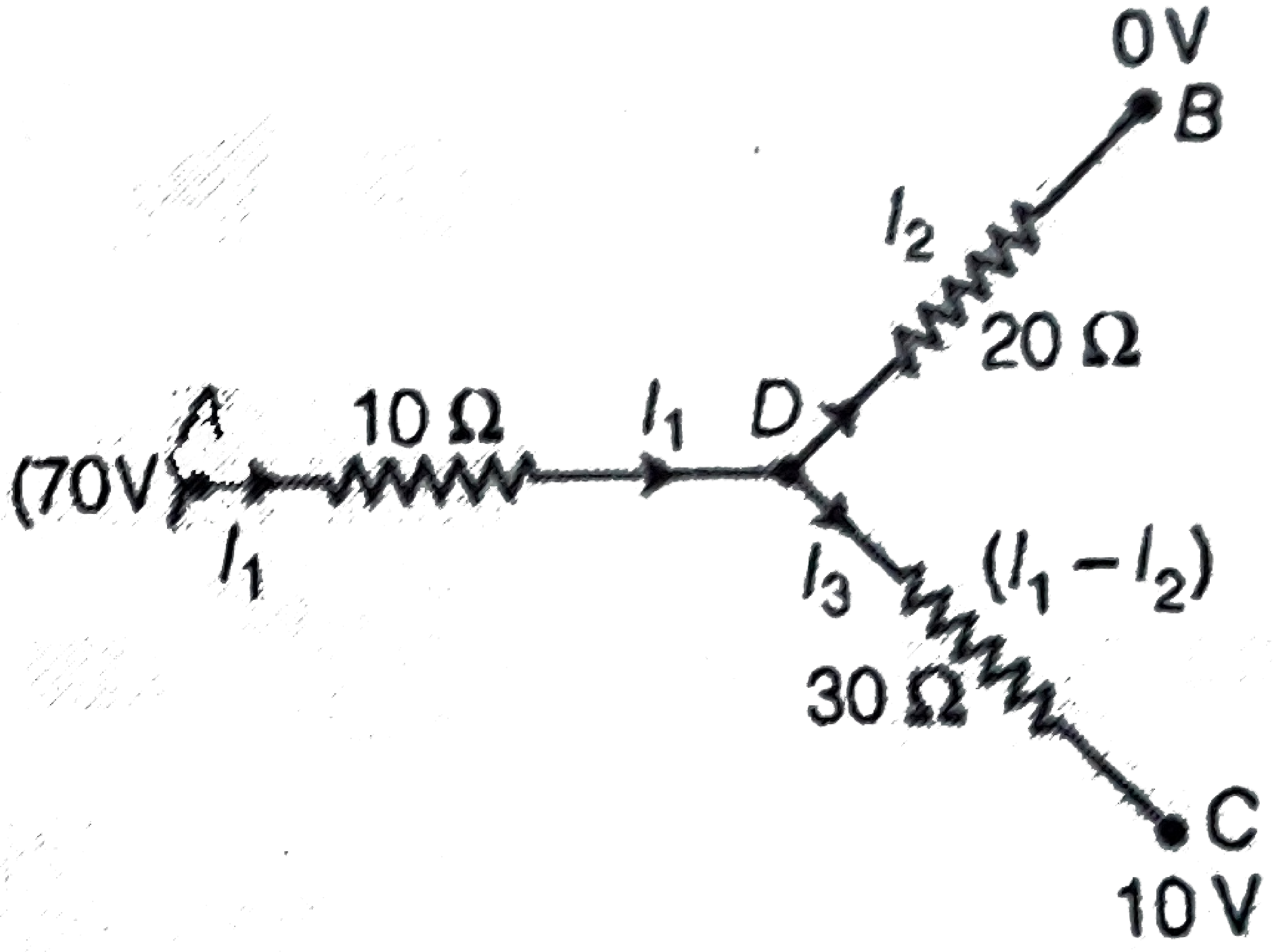
---

CORRECT ANSWER: A

---

SOLUTION:

Consider the current distributions in the circuit as shown below




By

$KVL, V_A - l_1 10$
$- l_2 20 - V_B = 0$

$\Rightarrow l_1 10 + l_2 20 = 70$

$V_A - l_1 10 - l_3 30 - V_C$
$= 0$

$\Rightarrow \quad l_1 10 + l_3 30$
$= 60$

Also, $l_3 = l_1 - l_2$

So, Eq. (ii) becomes

$$l_1 10 + 30(l_1 - l_2) = 60$$

$$l_1 40 - 30 l_2 = 60$$

Solving Eqs. (i) and (iii), we get

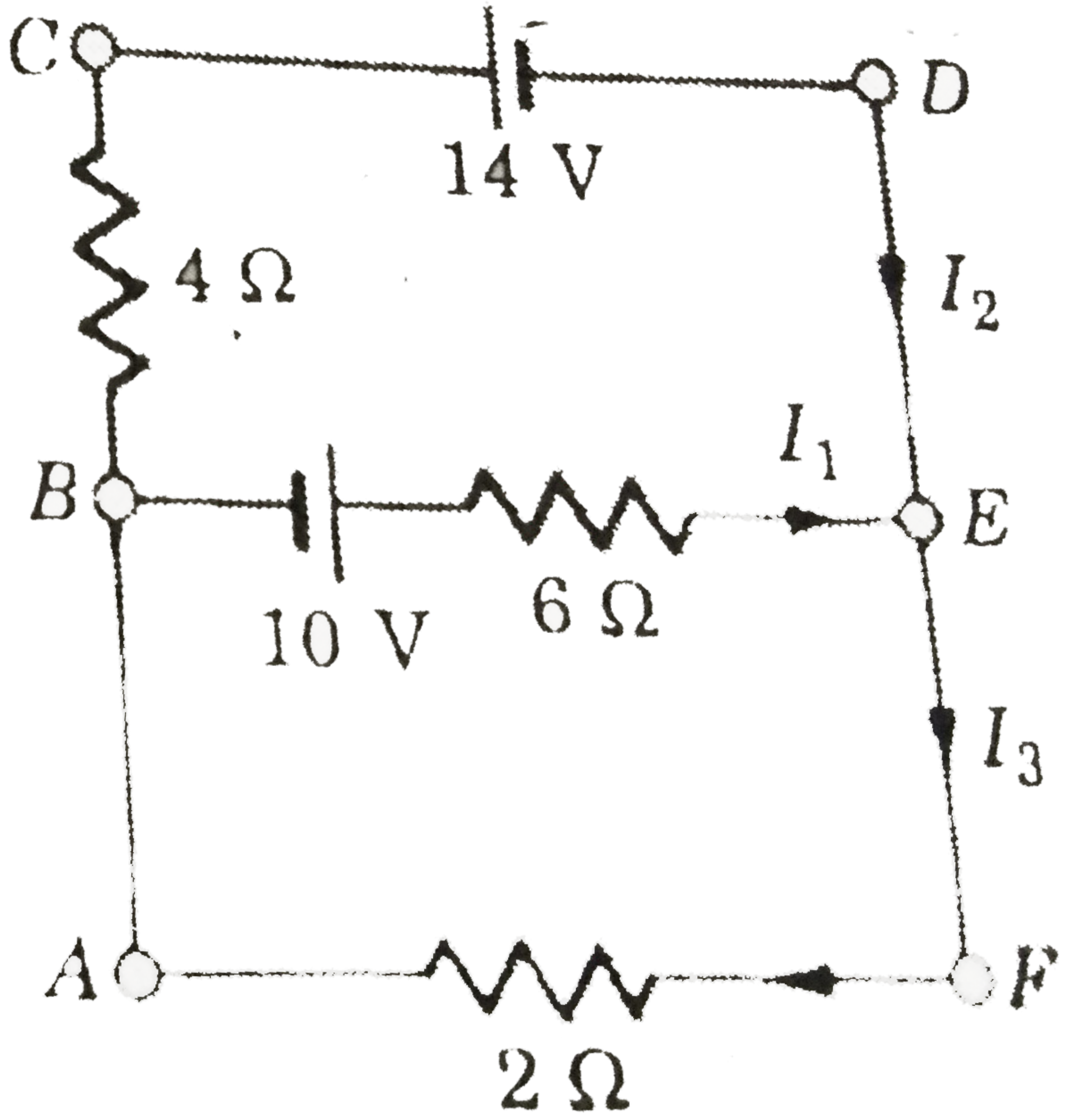
$$l_2 = 2A, l_1 = 3A, l_3 = 1A$$

Potential drop across branch AD,

$$V_A - V_D = l_1 \times 10$$
$$\Rightarrow 70 - V_D = 30$$
$$\Rightarrow V_D = 40V$$



Q-13 - 17960886




In the network shown in figure. Find (i) the currents $I_1$, $I_2$ and $I_3$ and (ii) the potential difference between the points B and F.

---

CORRECT ANSWER: (I).

$I_1 = 2A, I_2 = -3A,$

$I_3 = -1A, (II) 2V$

Q-14 - 19037562

An electric heater rated as (500 W and 200 V) raises the temperature of 1 kg water from $15C$ to its boiling point in 15 min. the heat effeciency of the heater is

(A) 0.79

(B) 0.97

(C) 0.69

(D) 0.96

---

CORRECT ANSWER: A

---

SOLUTION:

Heat absorbed by water $= ms\Delta T$

Heat supplied by heater $= v \leq Pt$

$\therefore$ Efficiency

$$= \frac{ms\Delta T}{Pt} \times 100$$

By putting given value, efficiency $\approx 79\,\%$

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Q-15 - 11964980

Assertion : Potential measured by a voltmeter across a wire a always less than actual potential diference across it.

Reason : Finite resistance of voltmeter changes current flowing through the resistance across which potential difference is to be measured.

(A) If both assertion and reason are ture and reason is the correct explanation of assertion.

(B) If both assertion and reason are true but reason is not the correct explanation of assertion.

(C) If assertion is true but reason is false.

(D) If assertion and reason both are false.

---

CORRECT ANSWER: A

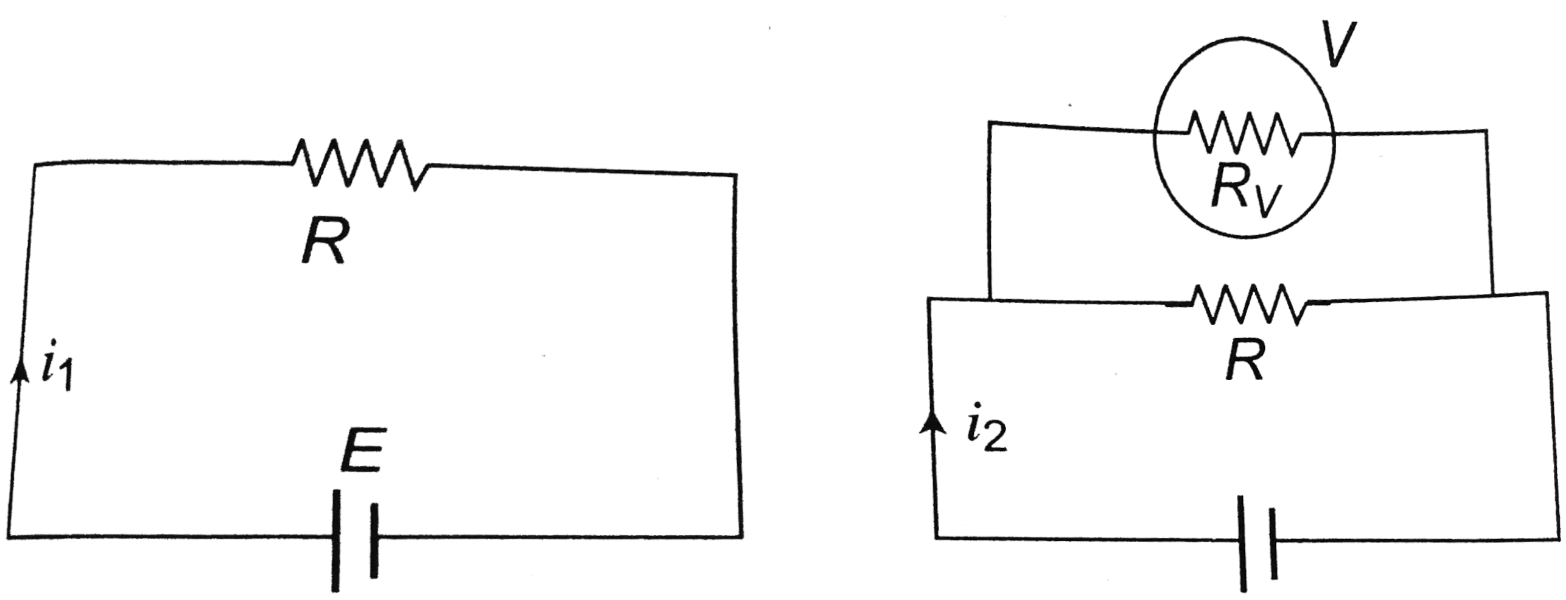
---

SOLUTION:

(a) $i_1 = \frac{E}{R}$

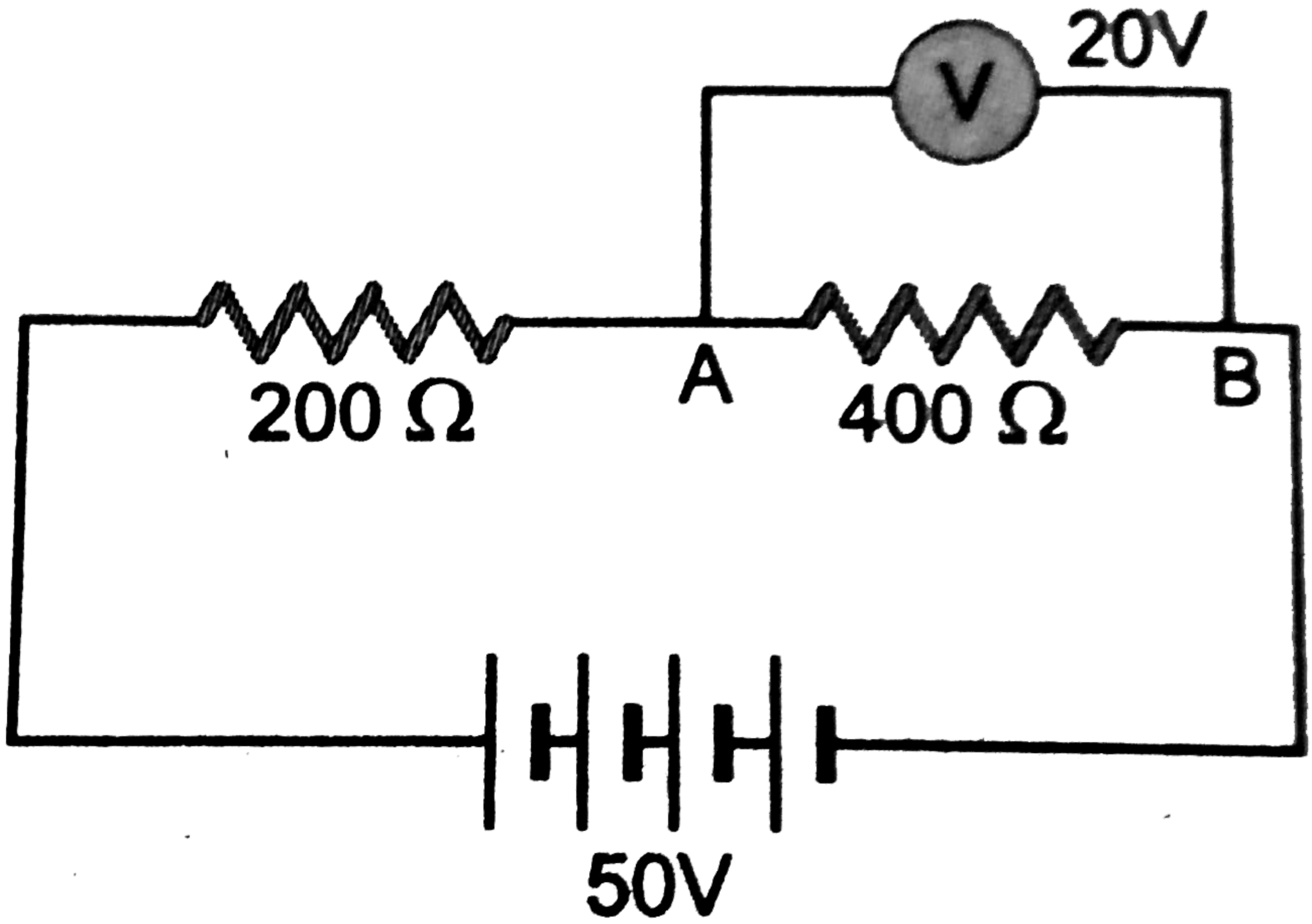
$$R_{eq} = \frac{RR_V}{R + R_V}$$

$$i_2 = \frac{E}{(RR_V / R + R_V)}$$



Q-16 - 12012523

In the circuit given below, a voltmeter reads $20V$ when it is connected across $400\Omega$ resistance. Calculate what the same voltmeter will read when connected across the $200\Omega$ resistance.




(A) $100V$

(B) $50V$

(C) $30V$

(D) $10V$

SOLUTION:

Let G be the resistance of voltmeter connected in

parallel to $400\Omega$ resistance. Net resistance

$$R_P = \frac{400G}{400+G}$$

Now, Resistance $200\Omega$ and $R_P$ are in series. Total

effective resistance

$$R_S = 200 + \left(\frac{400G}{400+G}\right)$$

Now, current in the circuit $I = \frac{V}{R_S}$

$$I = \frac{50}{200 + \left(\frac{400G}{400+G}\right)}$$

$$= \frac{50(400+G)}{200(400+G)+400G}$$

Pot. difference between A and B $= IR_P = 20$

$$\therefore \frac{50(400+G)}{200(400+G)+400G} \times \frac{400G}{400+G}=20$$

or

$$\frac{50}{200[400+3G]} \times 400G=20$$

$100G=8000+60G$ or $G=200\Omega$

When the voltmeter is connected in parallel to the resistance $200\Omega$, Net resistance becomes

$$R_p'=\frac{200 \times 200}{200+200}=100\Omega$$

Total resistance of the circuit $=100+400$

$=500\Omega$

Current $I'=\frac{50}{500}=\frac{1}{10}A$

Reading of voltmeter =Potential difference across $R_p'$

$$= I'R_p' = \frac{1}{10} \times 100$$

$$= 10V$$

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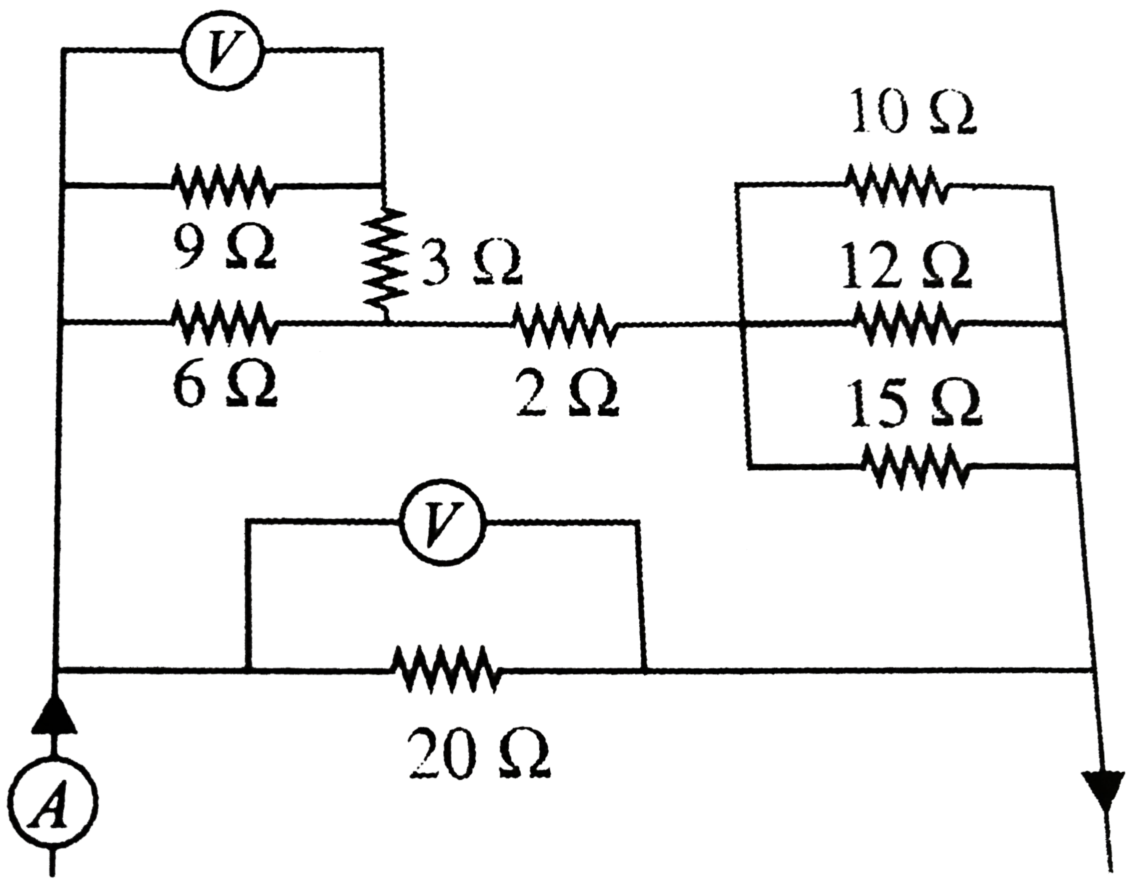
Q-17 - 11309354

Shown two ideal voltmeters and an ammeter, which are connected across the various circuit elements. If the voltmeter connected across $9\Omega$ resistance reads 4.5 V, then answer the following problems.




The reading of the voltmeter connected across $20\Omega$ resistance is

(A) 15V

(B) 10V

(C) 5V

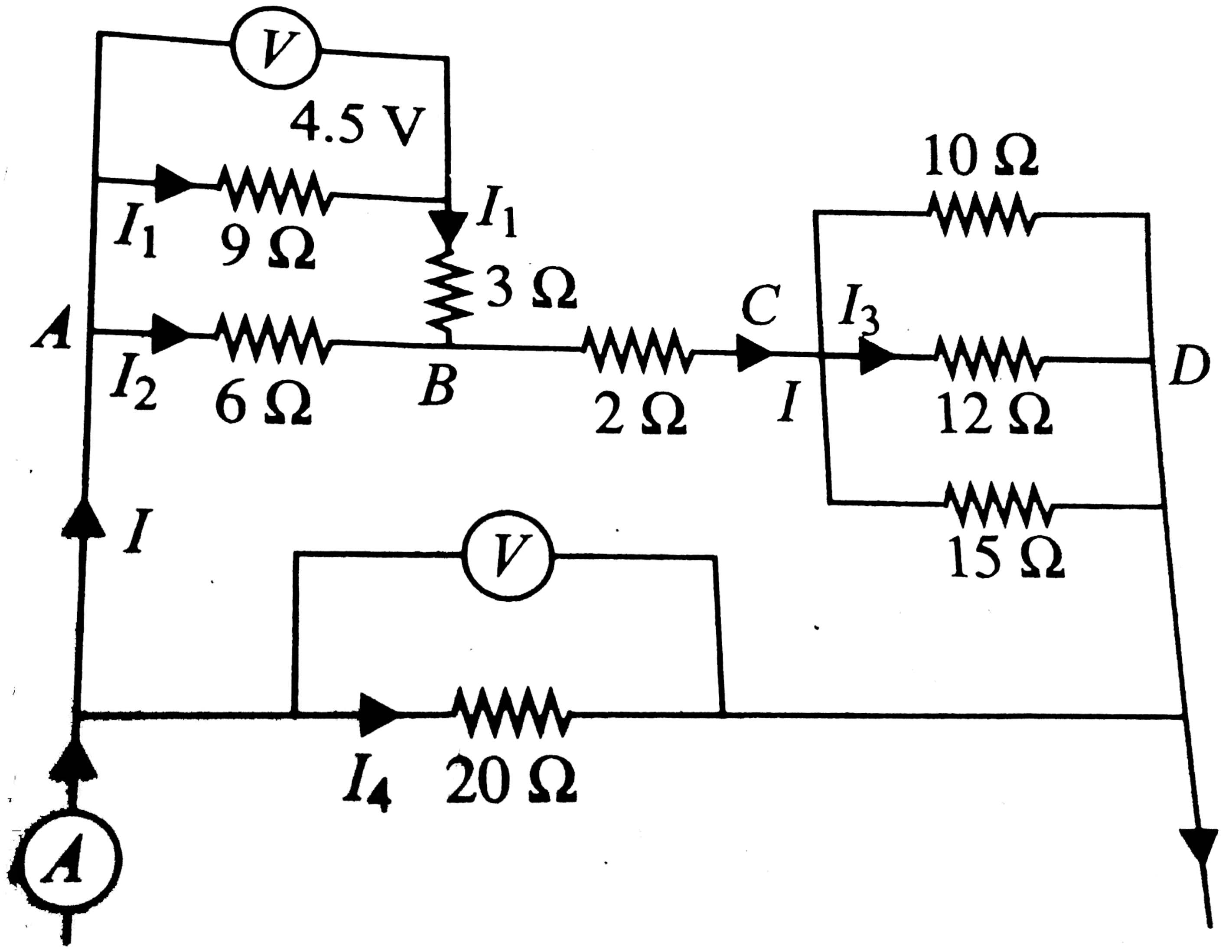
(D) $22.5V$

---

CORRECT ANSWER: A

---

SOLUTION:




$$I_1 = \frac{4.5}{9} = \frac{1}{2}A$$

Potential difference across AB:

$4.5 + 3I_1 = 6I_2$ or $I_2$
$= 1A, I = I_1 + I_2$
$= 1.5A$

Equivalent resistance between C and D: $R_1 = 4\Omega$

Potential difference across
$CD: R_1 I = 4 \times 1.5$
$= 6V$

Current through $12\Omega$, $I_3 = \frac{6}{12} = \frac{1}{2}A$

Potential difference across AD is
$6I_2 + 2I + 12I_3 = 6$
$\times 1 + 2 \times 1.5 + 12$
$\times 0.5 = 15V$

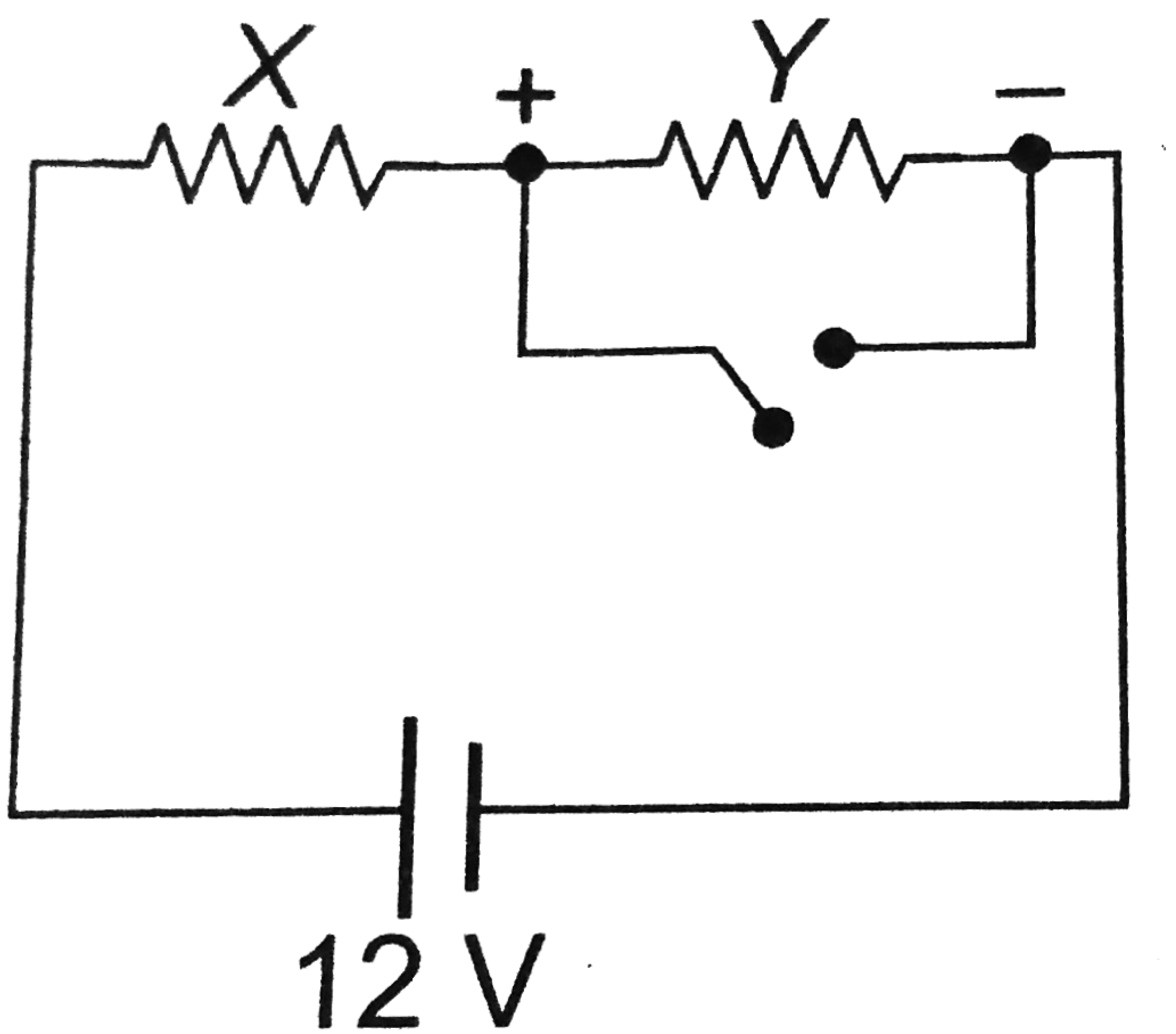
This will be equal to the reading of voltmeter across $20\Omega$

$I_4 = \frac{15}{20} = 0.75A$

Reading of the ammeter is
$I + I_4 = 1.5 + 0.75$
$= 2.25A$

Q-18 - 11964966

When an ammter of negligible internal resistance is inserted in series with circuit it reads $1A$ When the voltmeter of very large resistance is connected across $X$ it reads $1V$. When the point $A$ and $B$ are shorted by a conducting wire, the voltmeter meausres $10V$ across the battery. The internal resistance of the battery is equal to



(A) zero

(B) $0.5\Omega$

(C) $0.2\Omega$

(D) $0.1\Omega$

---

CORRECT ANSWER: C

---

SOLUTION:

(c )

$$\frac{12}{X+Y+r}=1A$$
$$\Rightarrow V_X=1=1\times X$$
$$\Rightarrow X=1\Omega$$

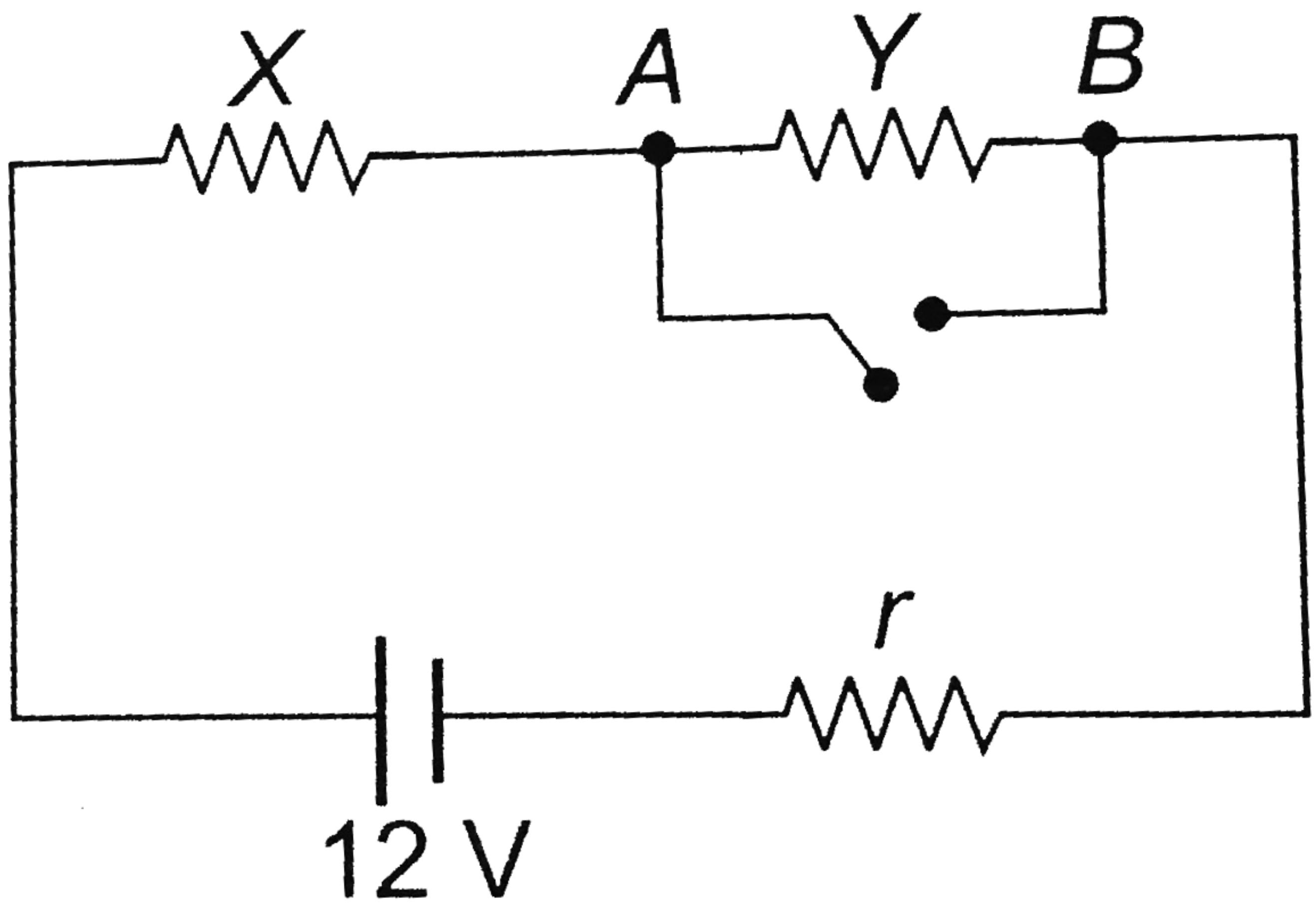
When $Y$ shorted $I=\frac{12}{1+r}$

$10=12-Ir\Rightarrow 10$

$$=12-\frac{12}{(1+r)^2}$$

$\Rightarrow 10 + 10r = 12 + 12 - 12r$

$\Rightarrow 10r = 2 \Rightarrow r = 0.2\Omega$

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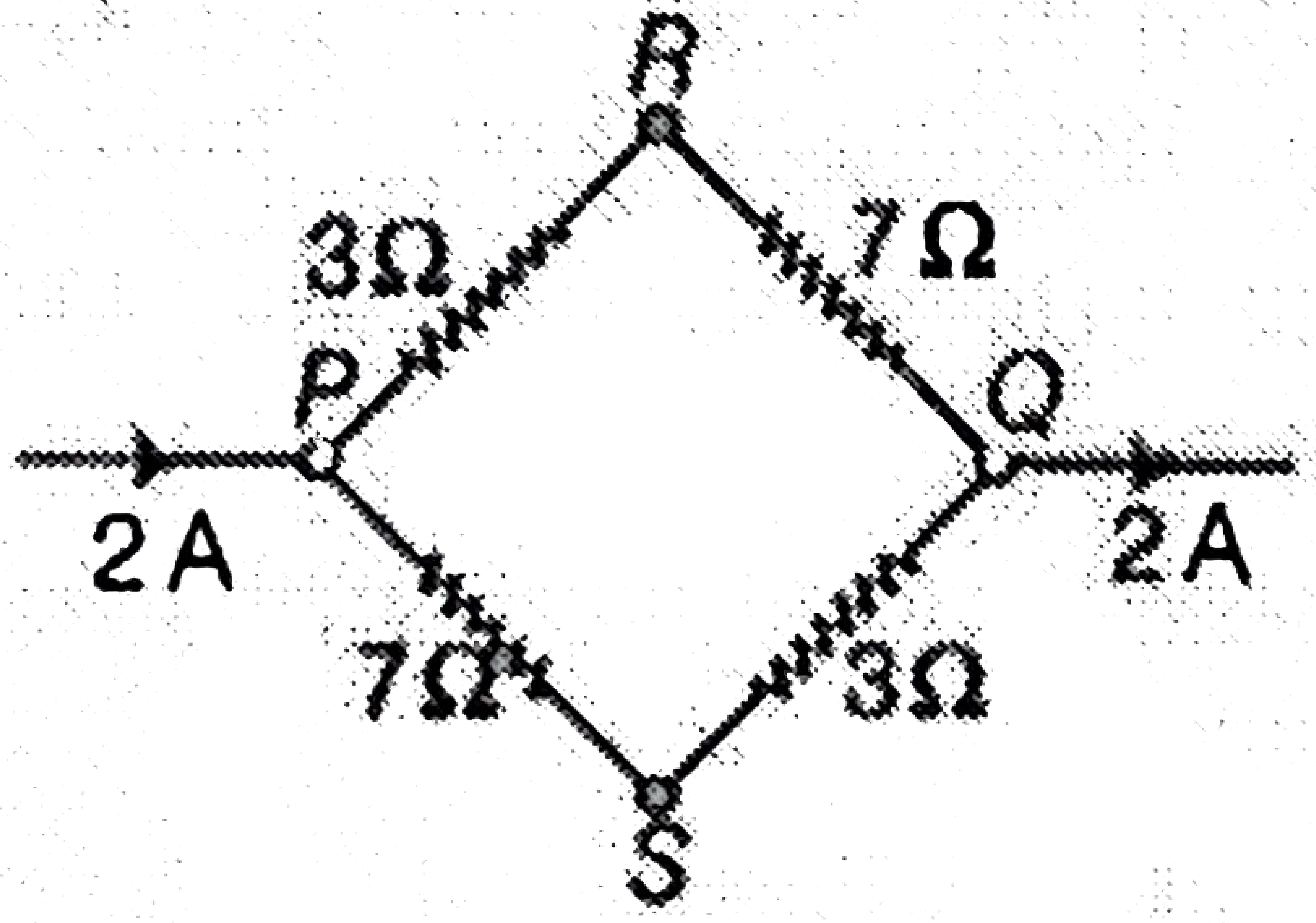
Q-19 - 19037594

A current of 2 A flows in an electric circuit as shown in figure. The potential difference $(V_R - V_S)$, in volts ($V_E$ and $V_S$ are potenitals at R and S respectively) is




(A) $-4$

(B) $+2$

(C) $+4$

(D) $-2$

---

CORRECT ANSWER: C

---

SOLUTION:

Current through each arm

PQR and PSQ = 1A

$$V_p - V_R = 3V$$
$$V_P - V_S = 7V$$

From Eqs. (i) and (ii), we get

$$V_R - V_S = +4V$$

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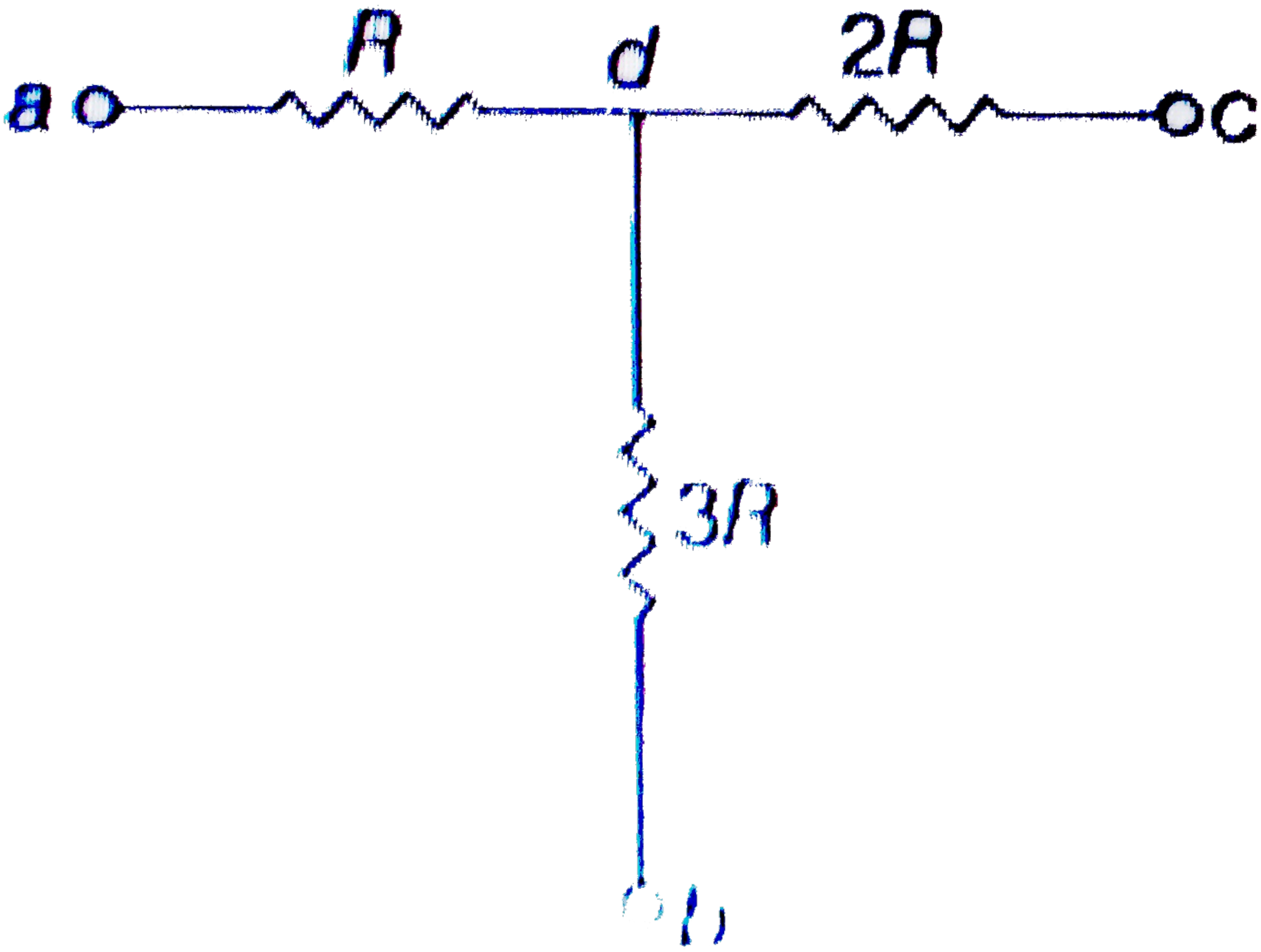
Q-20 - 17817843

In the circuit shown in figure points a, b and c are maintained at constant (but may be different) potentials. When a resistance is connected between a and b no current flows through it, when the same resistance is connected between b and c current flows from c to b.




When only three resistance shown in figure are in the circuit

(A) current in resistance 2R is from c to d

(B) current in 2R is four times the current in R

(C) both (a) and (b) are correct

(D) both (a) and (b) wrong

---

CORRECT ANSWER: A

Q-21 - 19037588

24 identical cells, each of internal resistance $0.5\Omega$, are arranged in a parallel combination of n rows, each row containing m cells in series. The combination is connected across a resistor of $3\Omega$. In order to send maximum current through the resistor, we should have

(A) m=12, n=2

(B) m=8, n=3

(C) m=2, n=2

(D) m=3, n=8

---

CORRECT ANSWER: A

---

SOLUTION:

N=24=mn

For current to be maximum

$$R_{Internal} = R_{external}$$
$$\Rightarrow \frac{mr}{n} = 3$$
$$\Rightarrow \frac{m}{n}(0.5) = 3$$
$$\Rightarrow \frac{m}{n} = 6$$

m=6n, substituting the values, we get

$$24 = 6n^2$$
$$\Rightarrow n = 2 \Rightarrow m = 12$$

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Q-22 - 11309323

To get maximum current through a resistance of $2.5\Omega$, one can use m rows of cells, each row having n cells. The internal resistance of each cell is $0.5\Omega$ what are the values of n and m, if the total number of cells is 45.

(A) 3,15

(B) 5,6

(C) 9,5

(D) 15,3

---

CORRECT ANSWER: D

---

SOLUTION:

Since total number of cell is 45.

mm = 45 (i)

Now n cells are in series, then resistance in $n \times 0.5\Omega$

Now there are m rows with such series, then

$$\frac{1}{R_{eq}} = \frac{1}{n \times 0.5}$$

$$+ \frac{1}{n \times 0.5} +$$

$$. (m \quad \text{times})$$

$$R_{eq} = \frac{n \times 0.5}{m} = 2.5$$

$$\Omega\left[\therefore I = \frac{nE}{R + r_{eq}}\right]$$

n = 5m (ii)

Using Eqs.(i) and (ii), m =3 and n = 15

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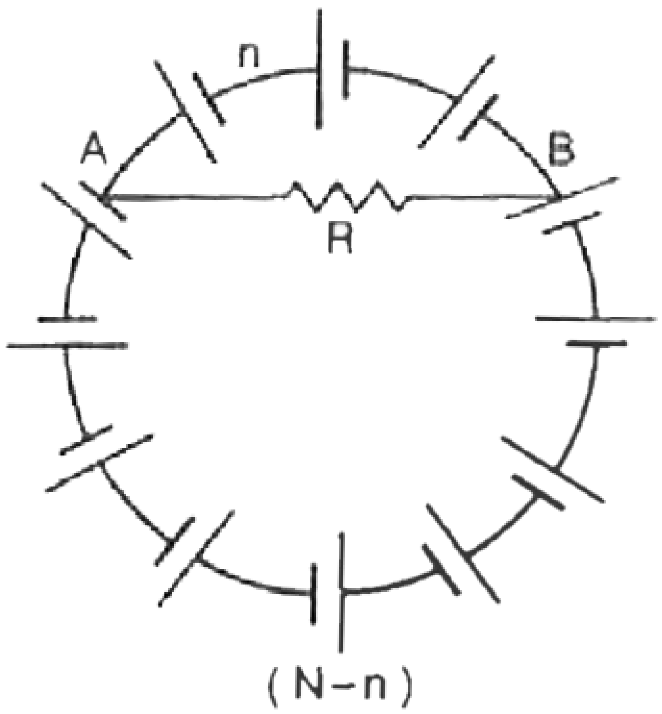
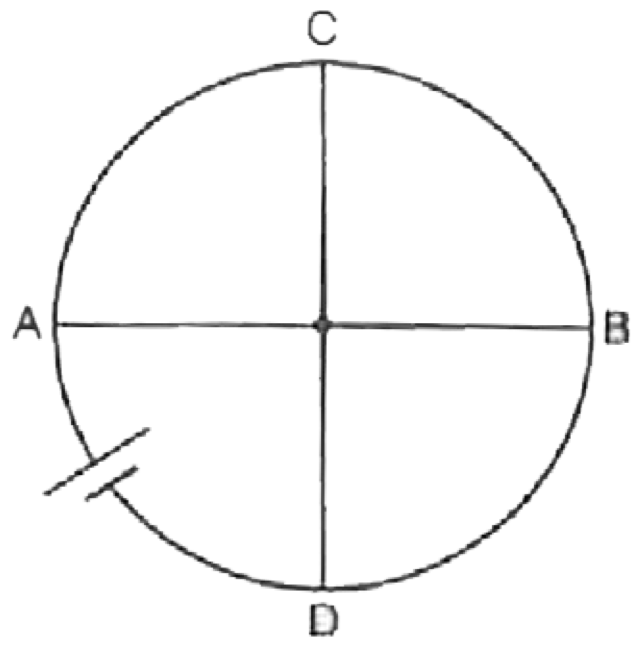
Q-23 - 17237840

N cells, each of emf $\varepsilon$ and internal resistance r, are arranged in a ring in series. Two points including n cells on one side and N-n cells on the other side are connected to a resistor R. Calcualte the current through R (figure)




CORRECT ANSWER: ZERO

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Q-24 - 14928378

In the series combination of n cells each cell having emf $\varepsilon$ and internal resistance r. If three cells are wrongly connected, then total emf and internal resistance of this combination will be

(A) $n\varepsilon, (nr - 3r)$

(B) $(n\varepsilon - 2\varepsilon)nr$

(C) $(n\varepsilon - 4\varepsilon), nr$

(D) $(n\varepsilon - 6\varepsilon), nr$



Q-25 - 19037593

A box with two terminals is connected in series with a 2 V battery, an ammeter and a switch. When the switch is closed the needle of the ammeter moves quickly across the scale and drops back to zero. The box contains

(A) $20\Omega$ resistor

(B) a strip of copper

(C) a diode

(D) a short length of fuse wire

CORRECT ANSWER: D

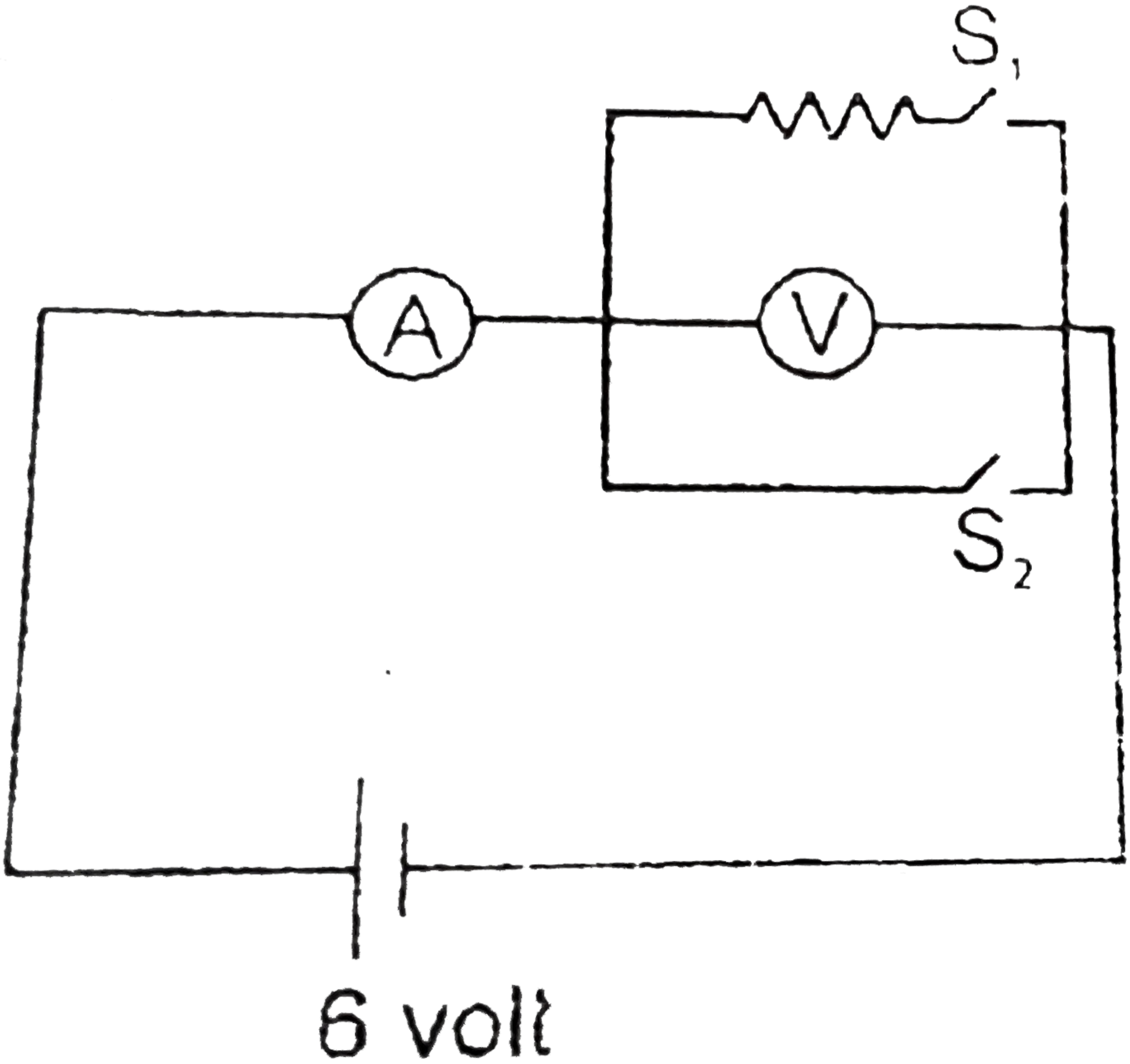
SOLUTION:

When a box contains fuse wire, a strong current flows through fuse when circuit is closed. Due to which a very strong heating effect takes place, resisting the breakage of fuse wire.



Q-26 - 14279713

An ammeter and a voltmeter are initially connected in series to a battery of zero internal resistance. When switch $S_1$ is closed the reading of the voltmeter becomes half of the initial, whereas the reading of the ammeter becomes double. If now switch $S_2$ is also closed, then reading of ammeter becomes :




(A) 3/2 times the initial value

(B) 3/2 times the value after closing $S_1$

(C) 3/4 times the value after closing $S_1$

(D) 3/4 times the initial value

---

CORRECT ANSWER: B

---

SOLUTION:

Initially :-

$V_v + V_A = 6$.(1)

$V_v$ & $V_A$ being the potential across voltmeter & ammeter respectively

after closing $S_1$

$\frac{V_v}{2} + 2V_A = 6$...(2)

Solving (1) & (2)

$V_v = 4, V_A = 2$

after closing $S_2$ :-

$V_v = 0$

$V_A = 6$

So that value after closing $S_2$ is $3/2$ times the value after closing $S_1$

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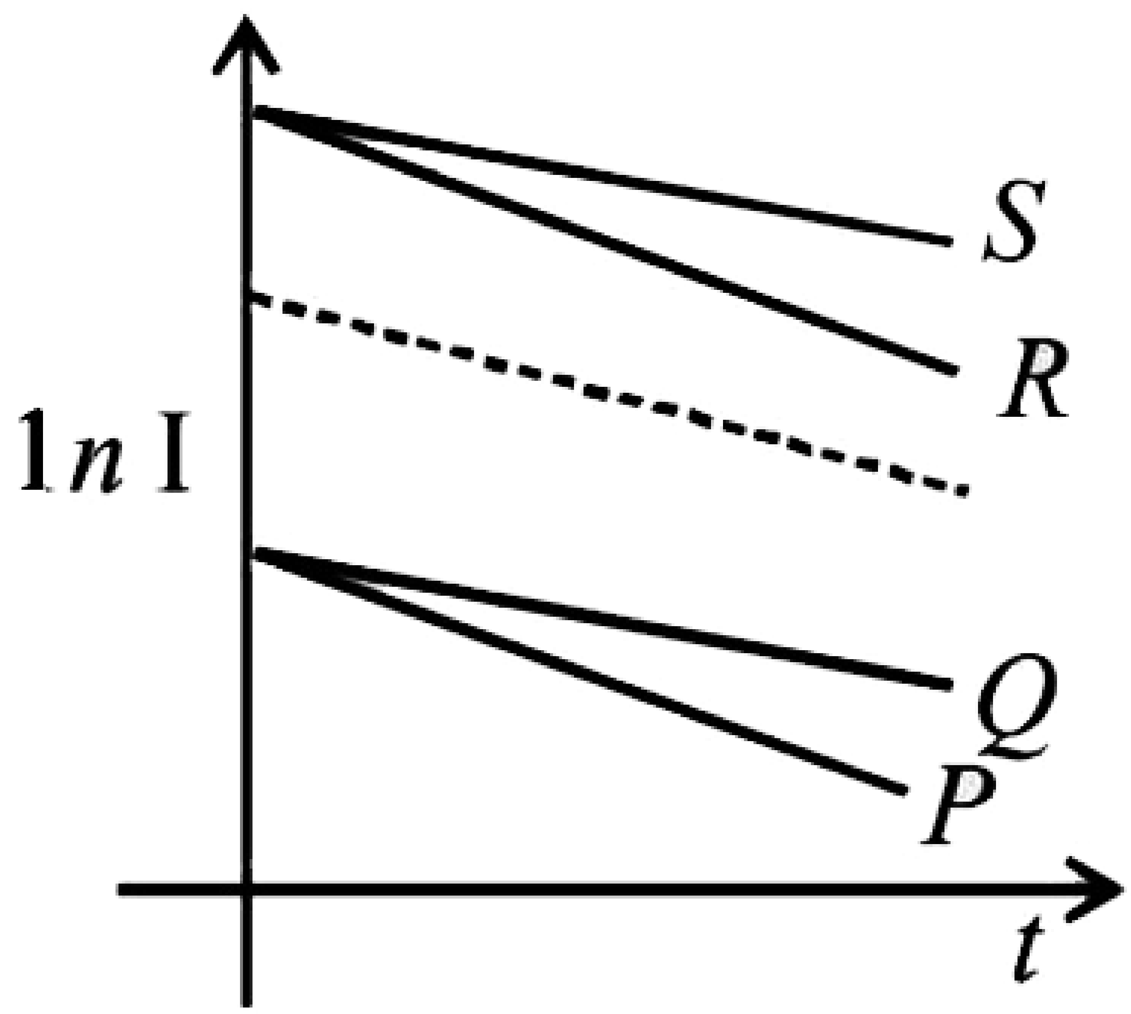
Q-27 - 10059739

A capacitor is charged using an external battery with a resistance x in series. The dashed line showns the variation of In I with respect to time. If the resistance is changed to 2x, the new graph will be




(A) P

(B) Q

(C) R

(D) S

---

CORRECT ANSWER: B

---

SOLUTION:

(b) KEY CONCEPT : The current in RC circuit is given

by

$I = I_0 e^{-t/RC}$

or

$$\ln I = \ln I_0 - \frac{t}{RC} \text{ or}$$

$$\ln I = \left(-\frac{t}{RC}\right)$$

$$+ \ln I_0$$

$$\ln I = \left(-\frac{t}{RC}\right)$$

$$+ \ln\left(\frac{E_0}{R}\right)$$

On comparing with $y = mx + C$

Intercept =

$\ln\left(\frac{E_0}{R}\right)$ and $slope$

$= -\frac{1}{RC}$

When R is changedto 2R then slope increases and current becomes less. New graph is Q.

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Q-28 - 11964801

An ammeter gives full deflection when a current of $2amp$. Flows through it. The resistance of ammeter is $12ohms$. If the same ammeter is to be used for measuring a maximum current of $5amp$, then the ammeter must be connected with a resistance of

(A) $8ohms$ in series

(B) $18ohms$ in series

(C) $8 ohms$ in parallel

(D) $18 ohms$ inparallel

---

CORRECT ANSWER: C

---

SOLUTION:

(c )

$$\frac{i}{i_g} = 1 + \frac{G}{S} \Rightarrow \frac{5}{2}$$

$$= 1 + \frac{12}{S} \Rightarrow S = 8\Omega$$

(In parallel)



Q-29 - 16121006

A galvanometer of 10 ohm resistance gives full scale deflection with 0.01 ampere of current. It is to be converted into an ammeter for measuring 10 ampere current. The value of shunt resistance required will be

(A) $\frac{10}{999}$ ohm

(B) 0.1 ohm

(C) 0.5 ohm

(D) 1.0 ohm

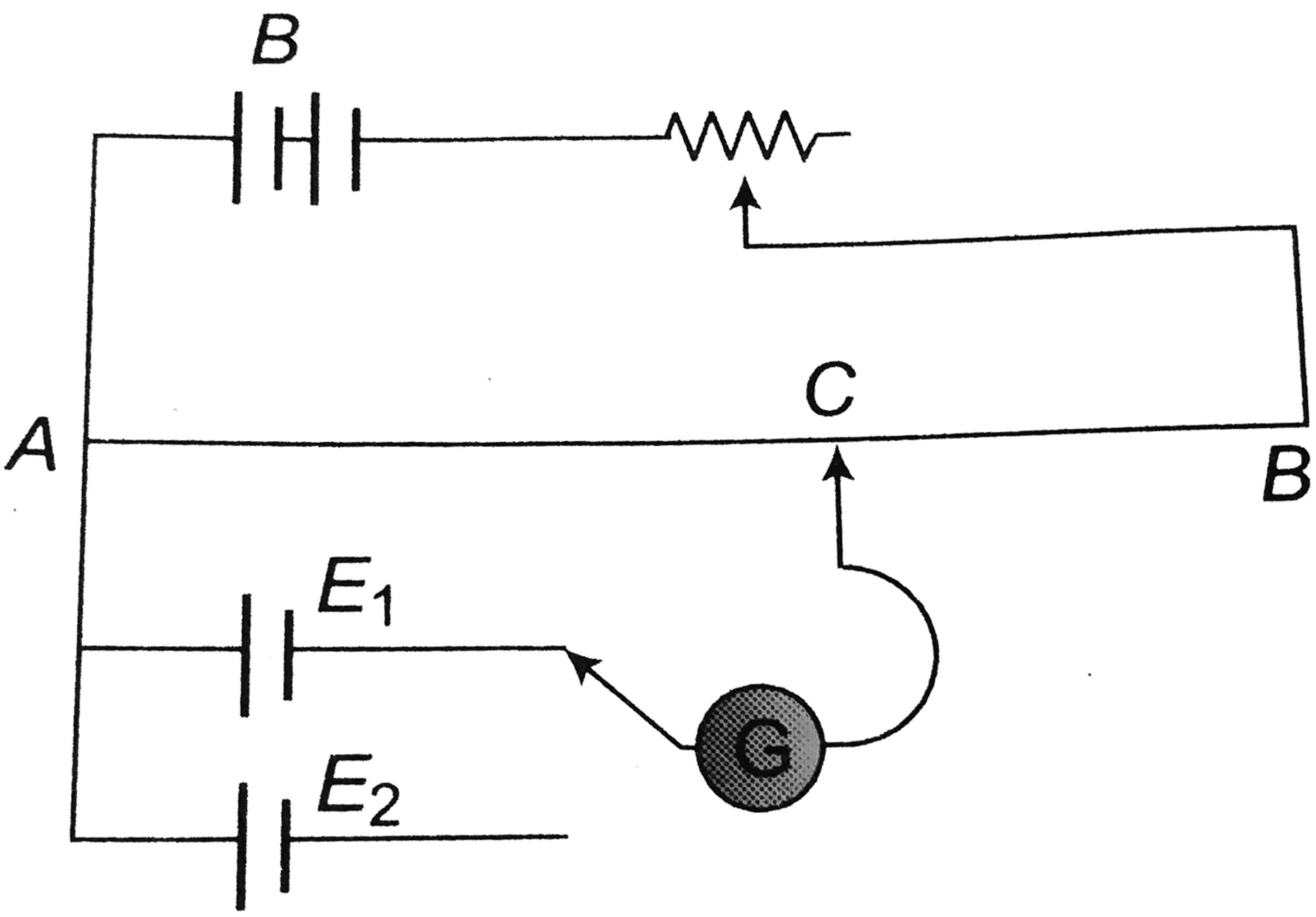
---

CORRECT ANSWER: A



Q-30 - 11964868

The circuit shown here is used to compare the e.m.f. of the two cells $E_2(E)_1 > E_2$. The null point is at $C$ when the galvanometer is connected to $E_1$. When the galvanometer is connected to $E_2$, the null point will be




(A) To the left of $C$

(B) To the right of $C$

(C) At $C$ itself

(D) Nonehere on $AB$

---

CORRECT ANSWER: A

---

SOLUTION:

(a) $E \propto l$ (balancing length)

Q-31 - 17817680

A resistor of resistance R is connected to a cell internal resistance $5\Omega$. The value of R is varied from $1\Omega$ to $5\Omega$. The power consumed by R

(A) increases continuously

(B) decreases continuously

(C) first decreases then increases

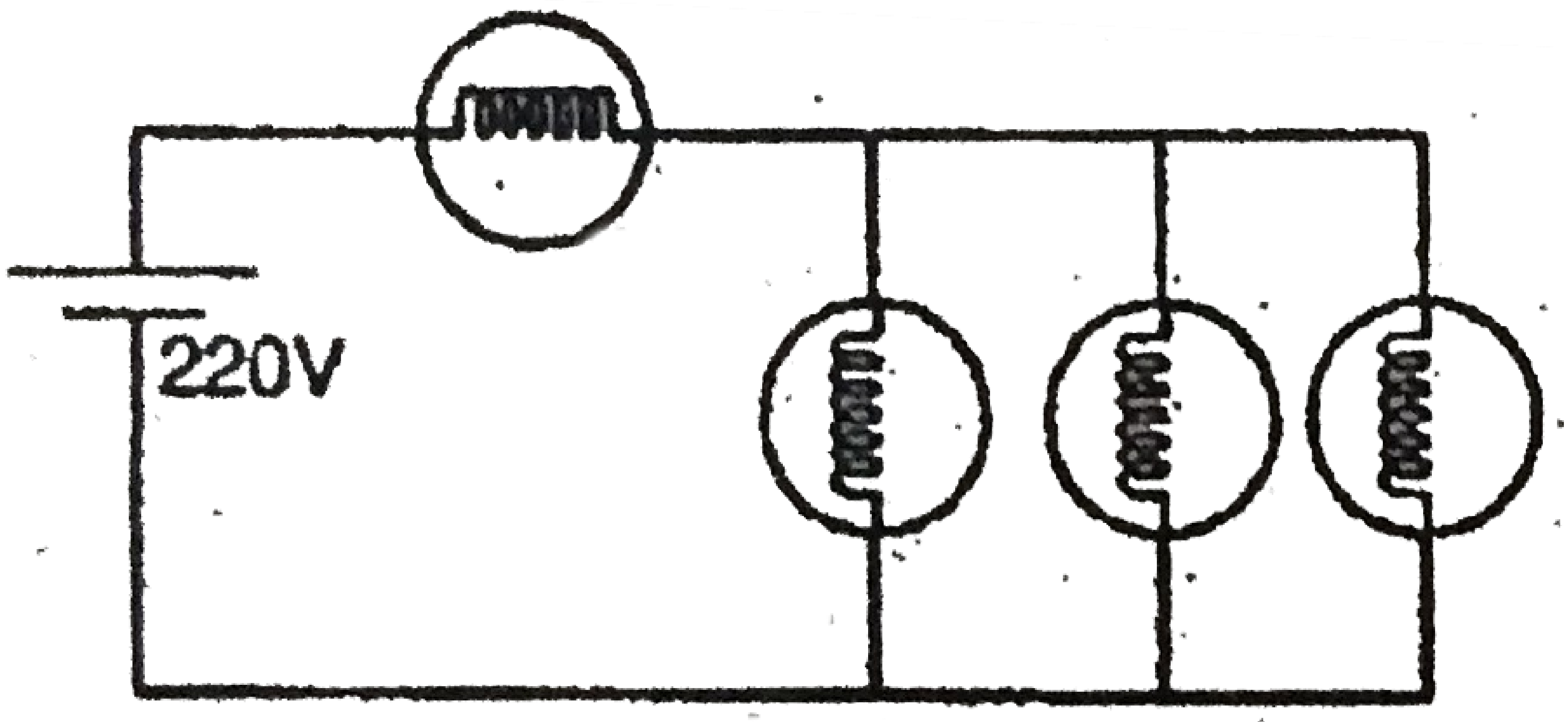
(D) first increases then decreases

CORRECT ANSWER: A



Q-32 - 14528787

Four identical bulbs each rated 100 watt, 220 volts are connected across a battery as shown. The total electric power consumed by the bulbs is:




(A) 75 watt

(B) 400 watt

(C) 300 watt

(D) 400/3 watt

---

CORRECT ANSWER: A

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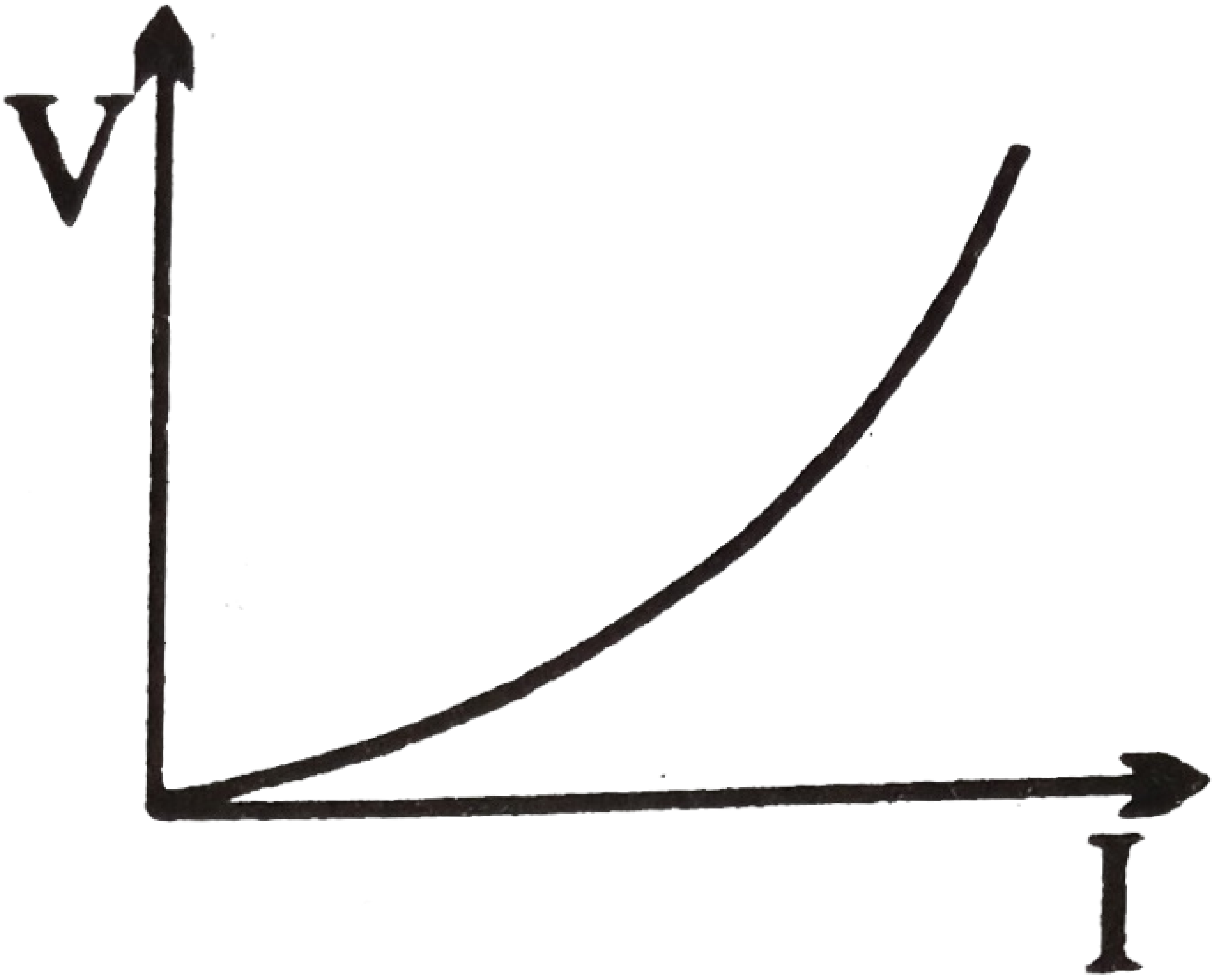
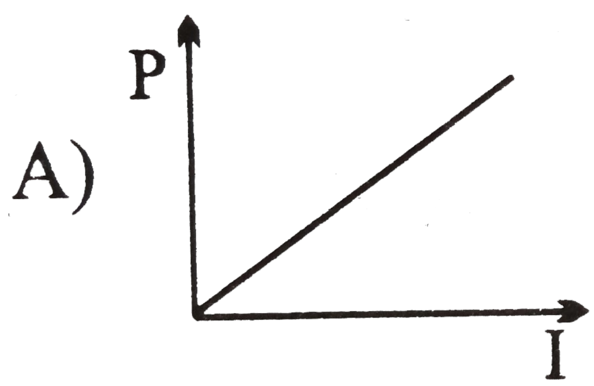
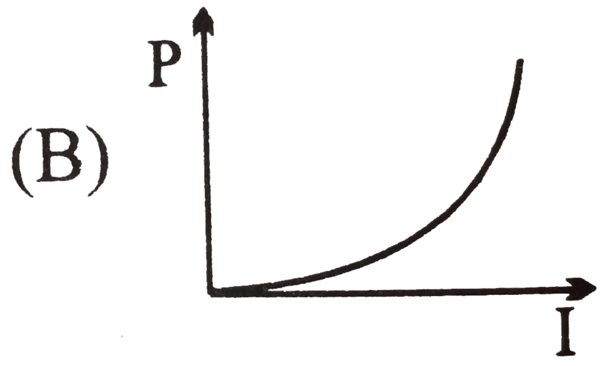
Q-33 - 12228879

The variation of current $(I)$ and voltage $(V)$ is as shown in figure $A$. The variation of power $P$ with current $I$ is best shown by which of the following graph

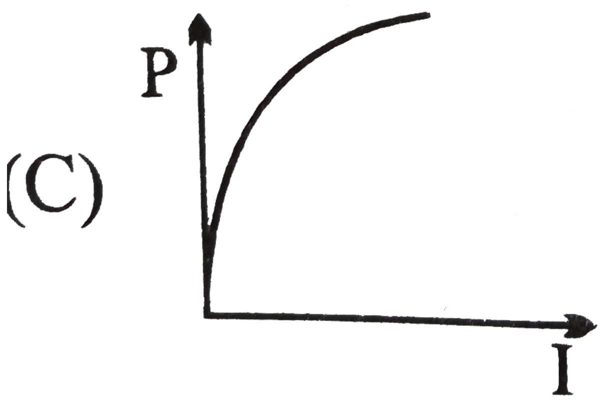



(A)

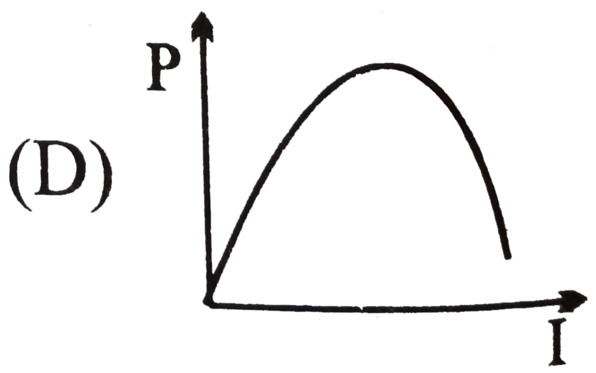


(B) 



(C) 



(D) 



---

CORRECT ANSWER: B

---

SOLUTION:

From graph $V = KI^2$

We know $P = VI \Rightarrow P = KI^3$

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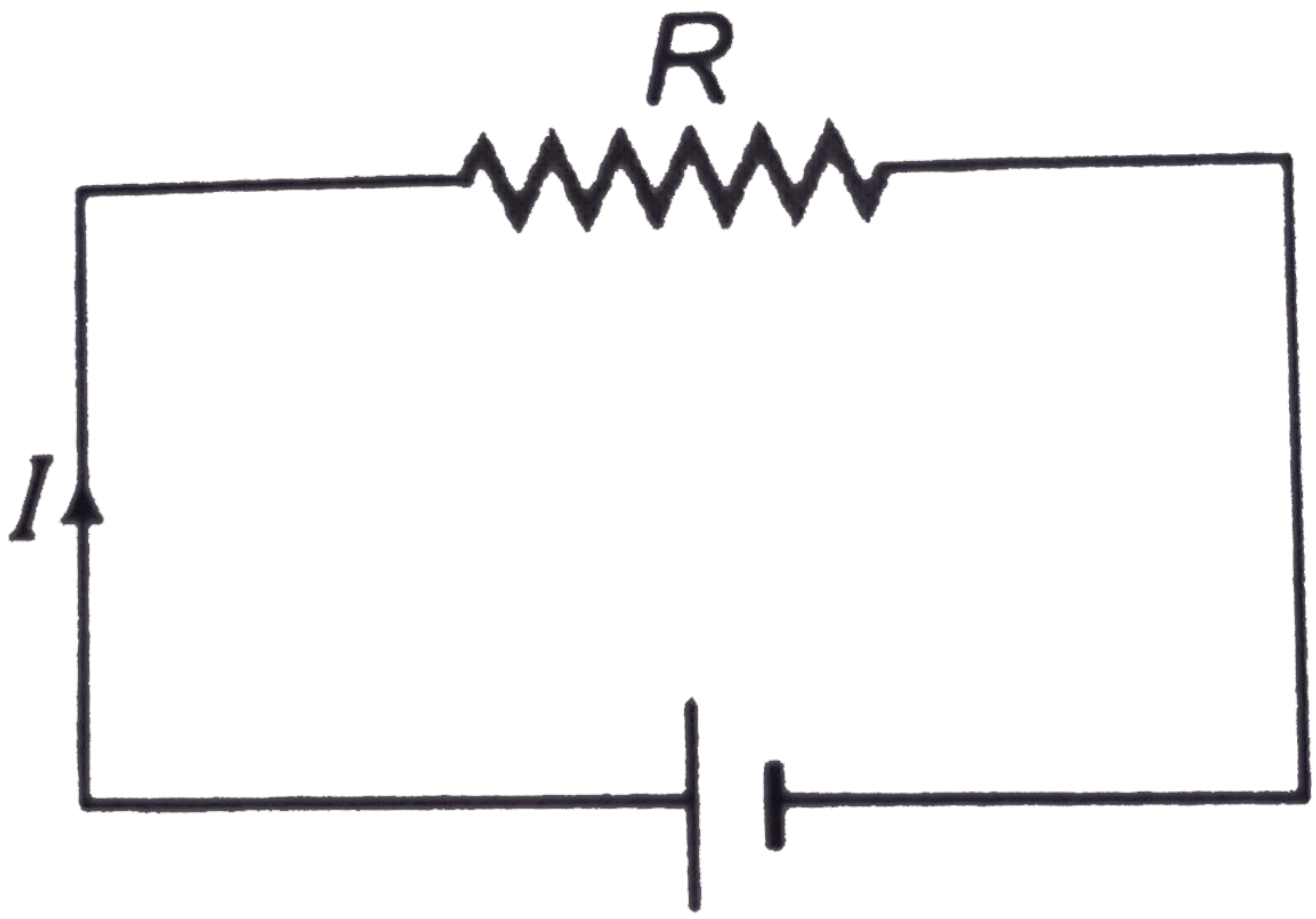
Q-34 - 10966715




Assertion: If variation in resistance due to temperature is taken into consideration, then current in the circuit I and power produced across the resistance P both will decrease with time.

Reason: $V = IR$ is ohm's law.

(A) If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

(B) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(C) If Assertion is true, but the Reason is false.

(D) If Assertion is false but the Reason is true.

---

CORRECT ANSWER: C

---

SOLUTION:

Resistance will increase with temperature on heating.

Hence current will decrease.

further $P = \frac{V^2}{R}$ or $P \propto \frac{1}{R}$

Resistance in increasing. Hence, power consumed across $R$ should decrease.

$V = IR$ is just an equation between $PD$ across a resistance current passing through it and irt resistance.

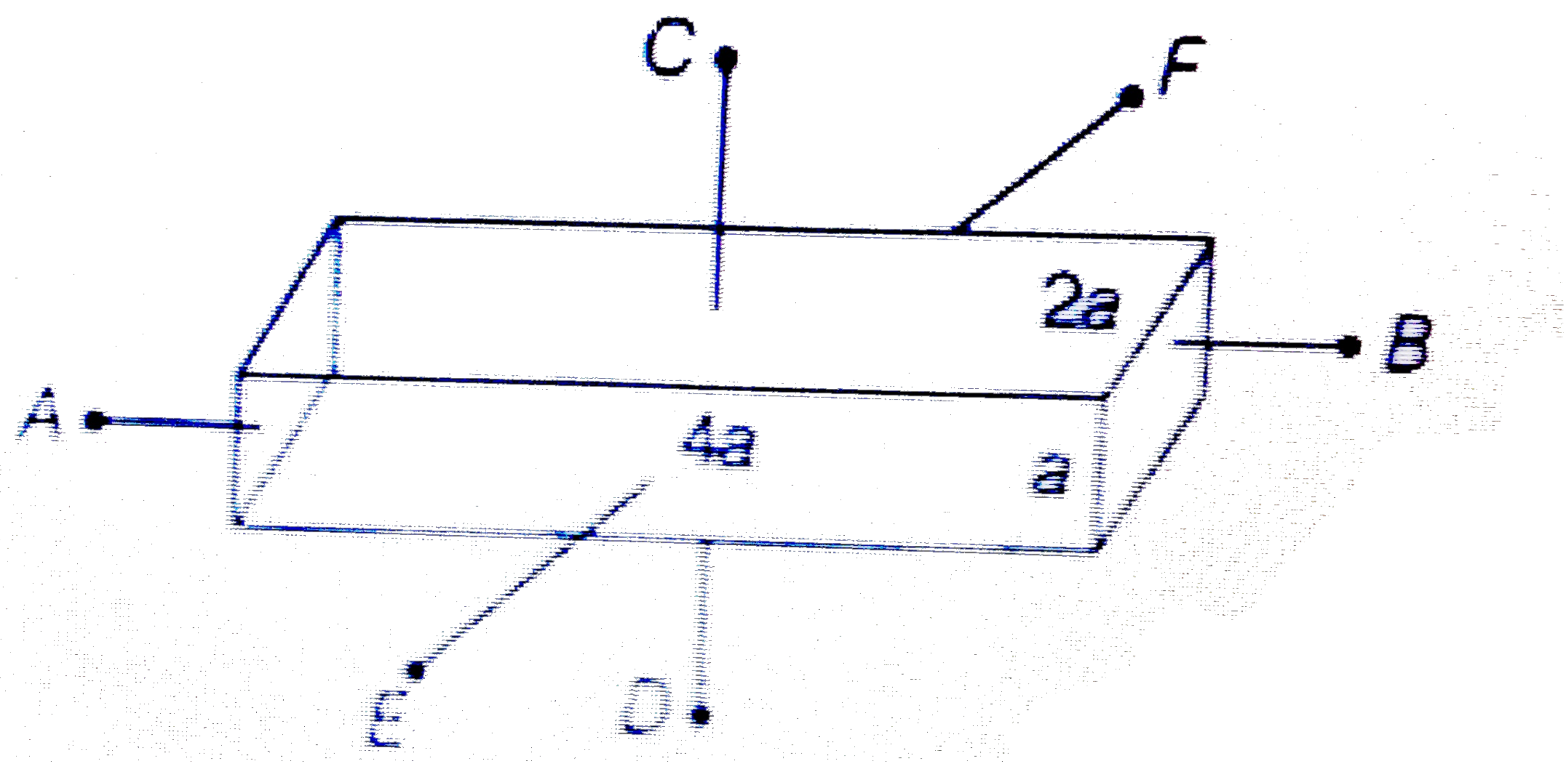
This not Ohm's law.



Q-35 - 17817706

A conductor with rectangular cross section has dimensions

$(a \times 2a \times 4a)$ as shown in figure. Resistance across AB is x, across CD is y and across EF is z. Then




(A) $x = y = z$

(B) $x > y > z$

(C) $y > z > x$

(D) $x > z > y$

---

CORRECT ANSWER: D

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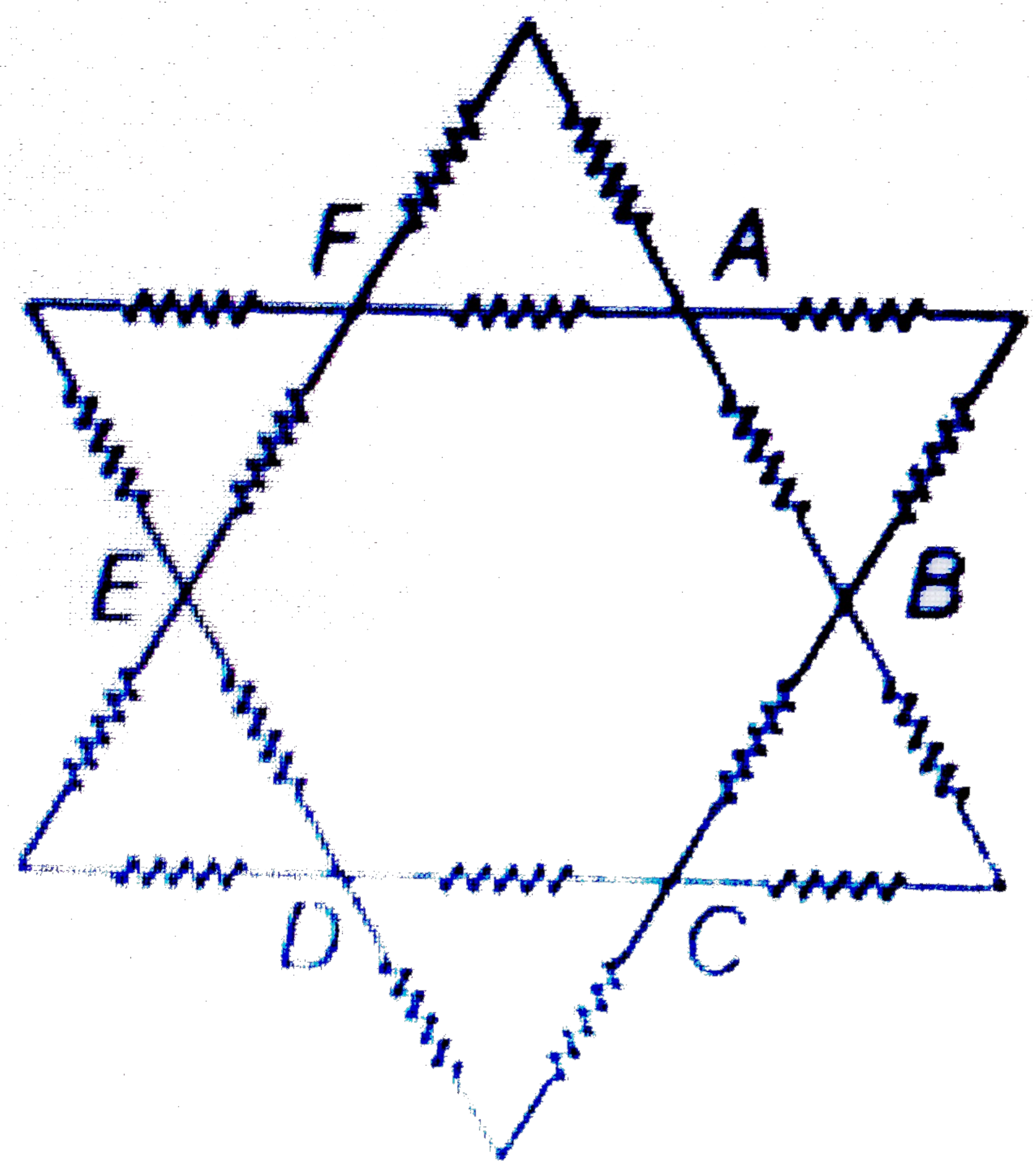
Q-36 - 17817730

Resistance of each resistor is R. Then the equivalent resistance across A and B is




(A) $\frac{5}{9}R$

(B) $\frac{4}{9}R$

(C) $\frac{R}{9}$

(D) $\frac{7}{9}R$

CORRECT ANSWER: A

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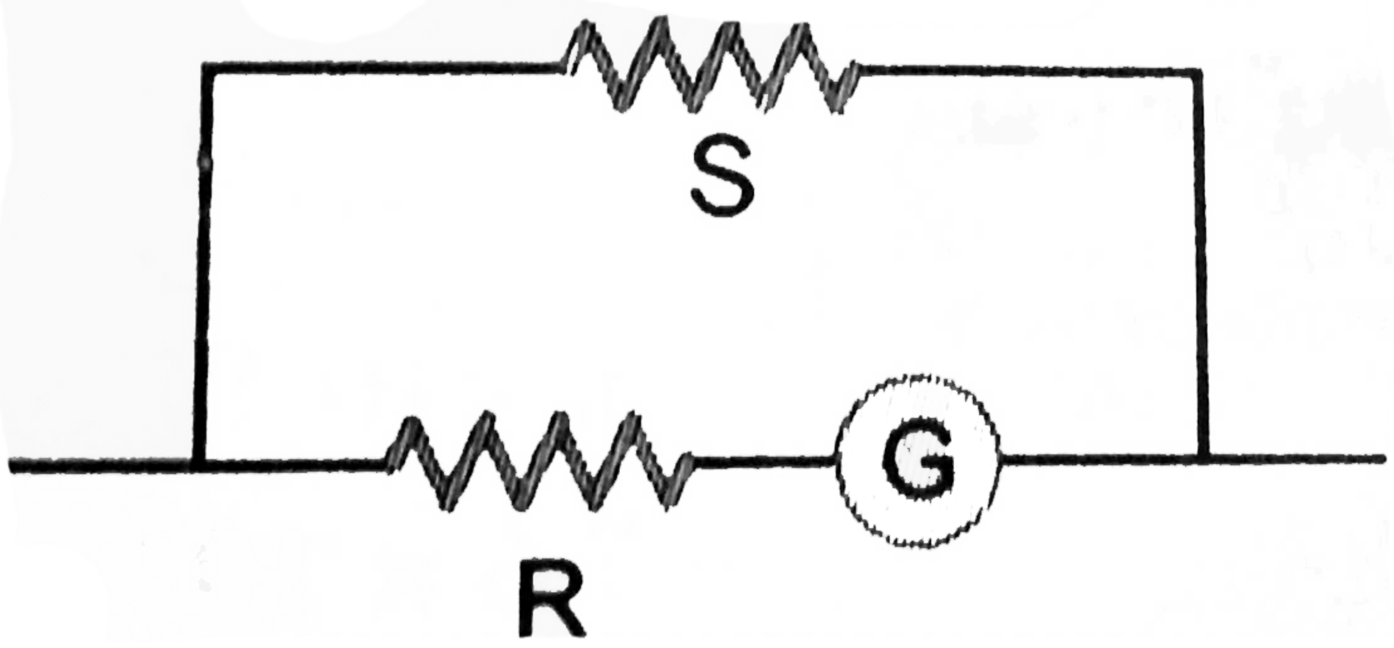
Q-37 - 12012362

The resistance of a pivoted type galvanometer is $8\Omega$ and current for full scale deflection on it is $0 \cdot 01A$. This galvanometer is to be converted into an ammeter of $5A$ range. The only shunt available is $0 \cdot 02\Omega$. Find the value of R to be connected in series with the galvanometer coil, figure.




CORRECT ANSWER: $1 \cdot 98OMEGA$

SOLUTION:

$$I_{g(G+R)} = (I - I_g)S$$

or

$$0 \cdot 01(8 + R) = (5 - 0 \cdot 01)0 \cdot 02 = 4 \cdot 99 \times 0 \cdot 02$$

or

$$R = \frac{4.99 \times 0.02}{0.01} - 8$$
$$= 9.98 - 8$$

$$= 1.98\Omega$$

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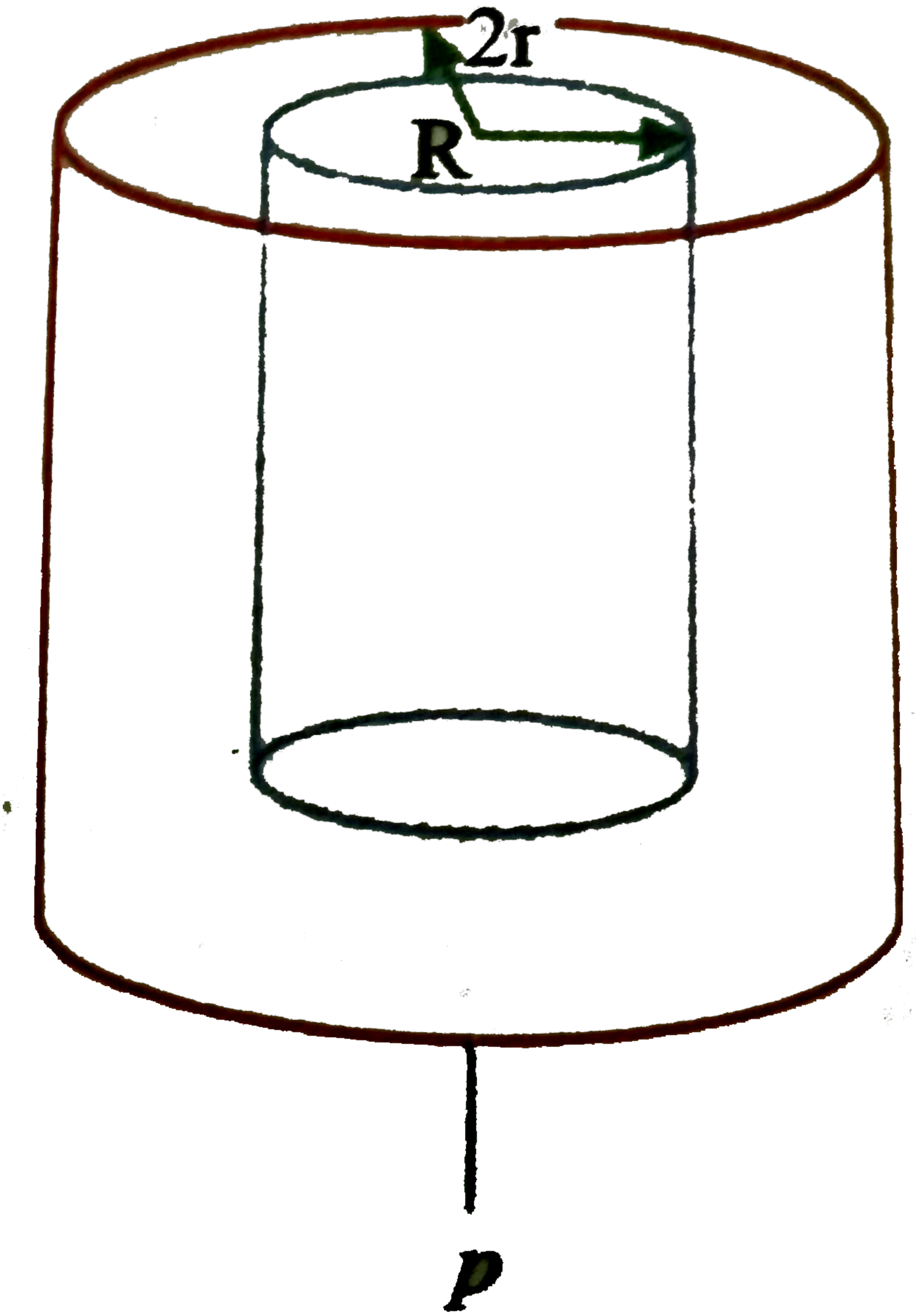
Q-38 - 13165832

A hollow cylinder of specific resistance $\rho$, inner radius $R$, outer radius $2R$ and length 1 is as shown in figure. What is the net resistance between the inner and outer surfaces?

---

SOLUTION:



Consider a ring of width $dr$ and radius $r$

Resistance across the ring is

$$dR = \frac{\rho dr}{dA} = \frac{\rho dr}{2\pi rl}$$

Net resistance

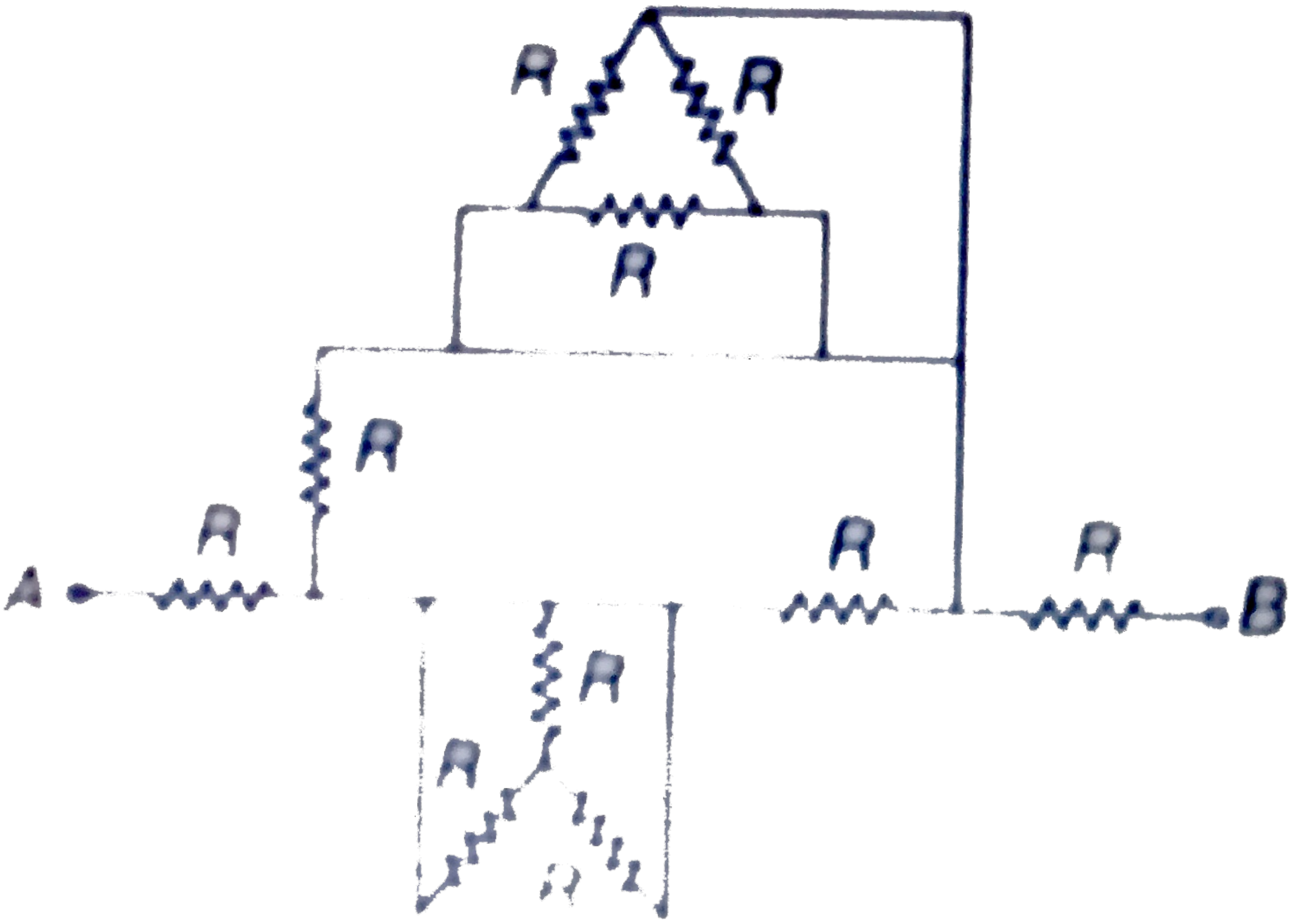
$$= \int_R^{2R} \frac{\rho(dr)}{(2\pi rl)}$$

$$= \left(\frac{\rho}{2\pi l}\right)\ln(2)$$



Q-39 - 17817865

Equivalent resistance between points A and B is $0.5xR$. Find value of x.




CORRECT ANSWER: 5



Q-40 - 17817778

A galvanometer has resistance G and full scale deflection current i. To convert this galvanometer into an ammeter of range 10 I, a shunt $S = \frac{G}{9}$ is connected in parallel with G. Now we want to measure potential difference with the help of this ammeter. What is the maximum value of potential difference which can be measured with the help of this?

(A) $10IG$

(B) $IG$

(C) $9IG$

(D) $\frac{10}{9}IG$

---

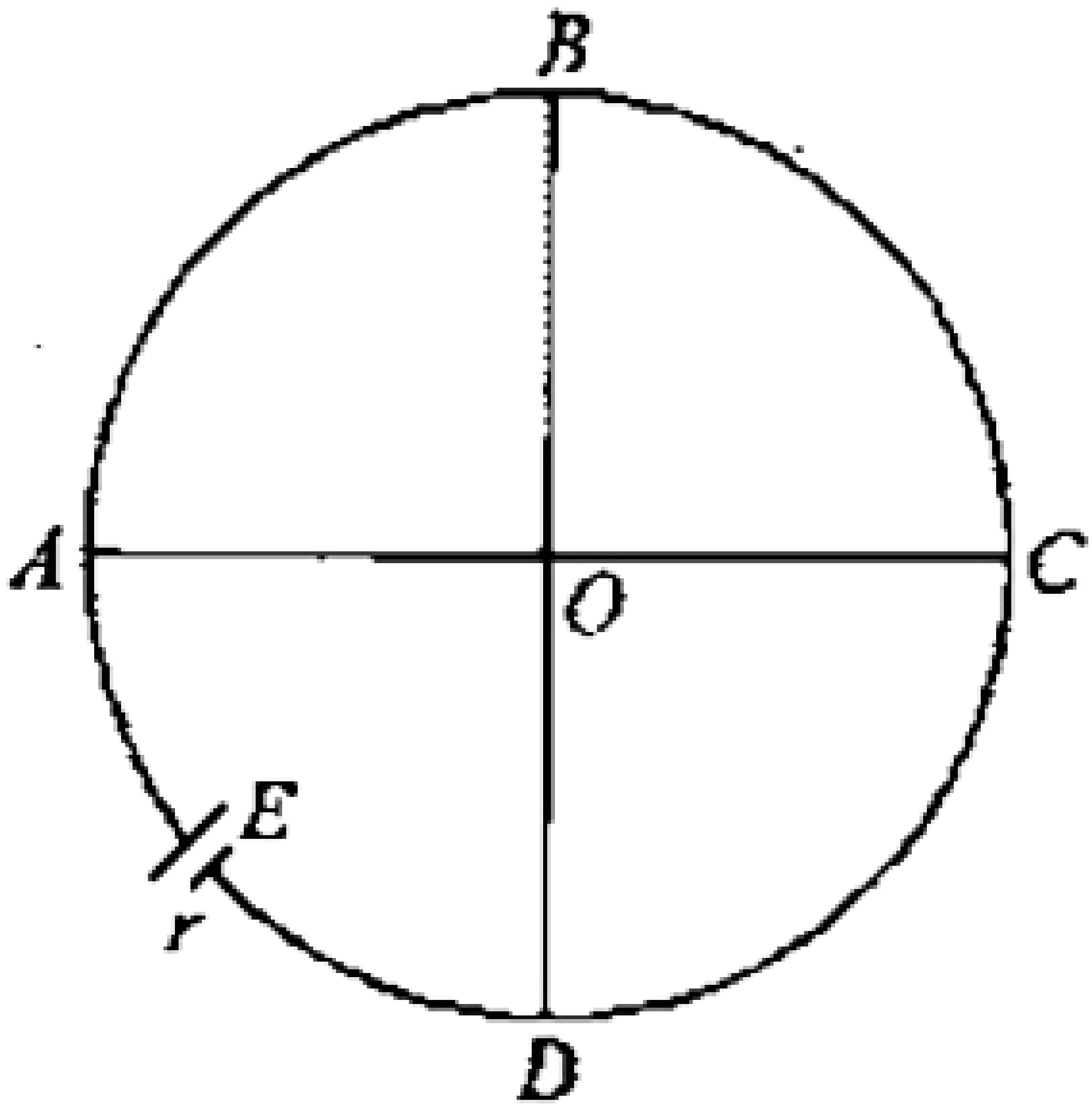
CORRECT ANSWER: B



Q-41 - 16591232

In the network of resistances shown in figure-3.88. ABCDA is a uniform circular wire of resistance $2\Omega$, $AOC$ and BOD are two wires along two perpendicular diameters of the circle, each having same resistance $1\Omega$. A battery of-voltage E is inserted in one in one quadrant of the network as shown in figure. Calculate the equivalent

resistance of thenetwrok across the battery.

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Q-42 - 15196227

A conductor has density $d$ and molar mass $M$. A wire made of this

conductor has cross sectional radius $r$. Calculate the drift speed of electrons in this conductor when current through it is $I$. Assume that each atom contributes one free electron.

CORRECT ANSWER: $\frac{IM}{PIR^2 E. D. N_A}$

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Q-43 - 11309058

(a) Estimate the average drift speed of conductin electrons in a copper wire of cross sectional area $1.0 \times 10^{-7} m^2$ carrying a current of 1.5 A. Assume that each copper atom contributes roughly one conduction electron. The density of copper is $9.0 \times 10^3 kgm^{-3}$ and its atomic mass is $63.5u$. (b) Compare the drift speed obtained with the speed of propagation of electric field along the conductor, which causes the drift motion.

SOLUTION:

(a) The direction of dirft velocity of conduction electrons

is

opposite to the electric field direction, i.e., the electrons

drift in the direction of increasing potential. The drift

speed $v_d$ is given by $v_d = (I / \mathrm{ne} A)$.

Now,

$$e = 1.6 \times 10^{10} C, A = 1.0 \times 10^{-7} m^2, I = 1.5 A,$$

the

density fo n conduction electrons is equal to the number

of atoms per cubic meter (assuming one conduction

electrons per Cu atom is reasonable from its valence

electron count of one). A cubic meter of copper has a

mass of $9.0 \times 10^3 kg$. Since $6.0 \times 10^{23}$ copper atoms

have

a mass of 63.5g,

$$n = \frac{6.0 \times 10^{23}}{63.5} \times 9.0$$
$$\times 10^6 = 8.5 \times 10^{28}$$

which gives

$v_d$

$$= \frac{1.5}{8.5 \times 10(28) \times 1.6}$$
$$\times 10^{-19} \times 1.0 \times 10^{-7}$$

$$= 1.1 \times 10^{-3} ms^{-1}$$
$$= 1.1 mms^{-1}$$

(b ) An electric field traveling along the conductor has a

speed

of an electromagnetic wave, i.e. equal to

$3.0 \times 10^8 ms^{-1}$

The drift speed is, in comparison, extermely small,

smaller by a fector of $10^{-11}$

---

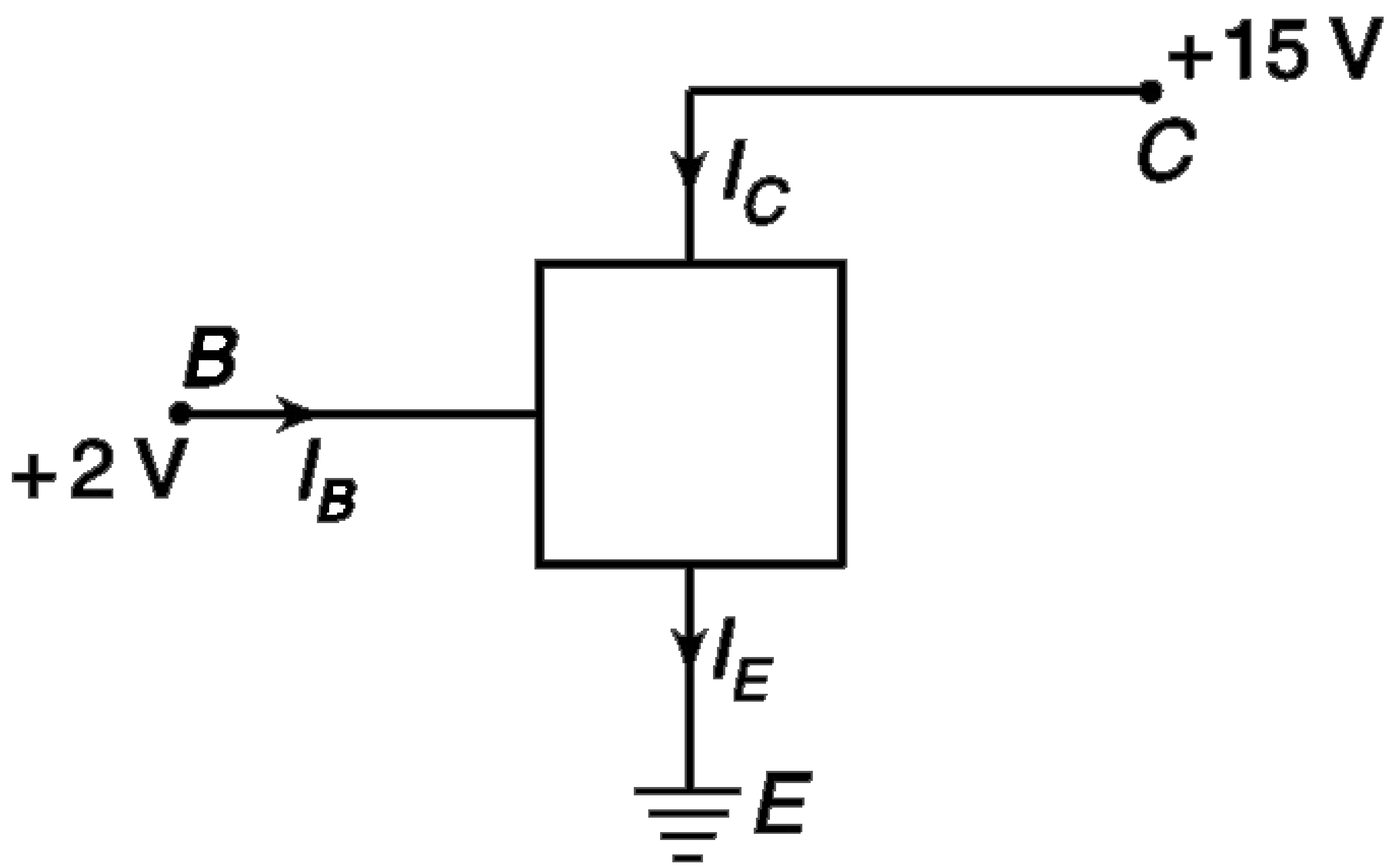
Q-44 - 15196251

The box shown in the figure has a device which ensures that

$I_C = 0.9 I_E$.

If a small change $(\Delta ? I_B)$ is made in $I_B$, calculate the

corresponding change in $I_C$.

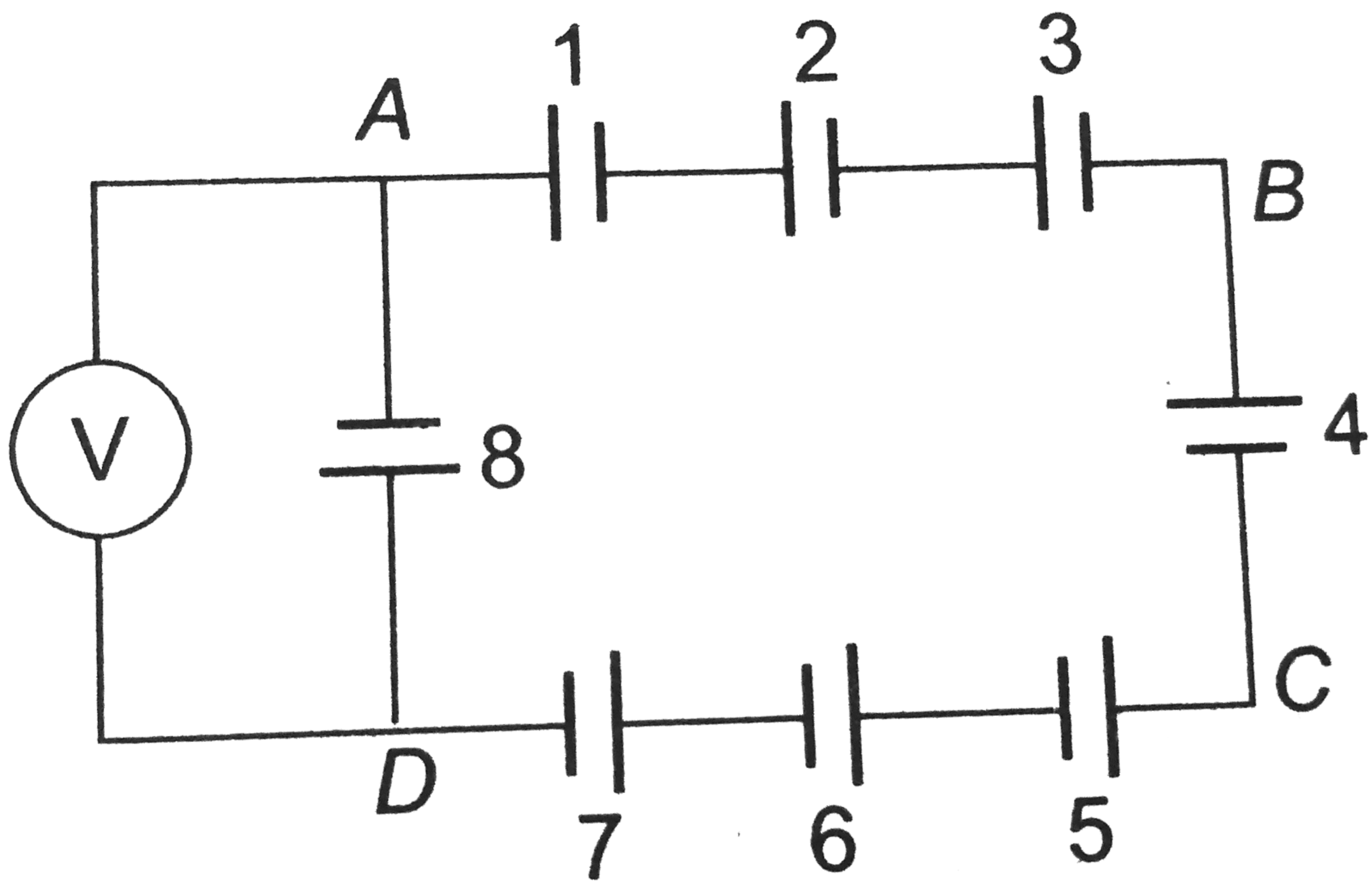



CORRECT ANSWER:

$DELTAI_C$
$= 9DELTAI_B$

Q-45 - 11964712

Eight cells marked 1 to 8, each of emf $5V$ and internal resistance $0.2\Omega$ are connected as shown. What is the reading of ideal voltmeter ?




(A) $40V$

(B) $20V$

(C) $5V$

(D) Zero

---

CORRECT ANSWER: D

---

SOLUTION:

(d) Current flowing in circuit

$$i = \frac{nE}{nr} = \frac{5}{0.2}$$
$$= 25A$$

Terminal potential difference across the terminals of

battery numbered 8,

$$V = E - ir = 5 - 25$$
$$\times 0.2 = 0$$

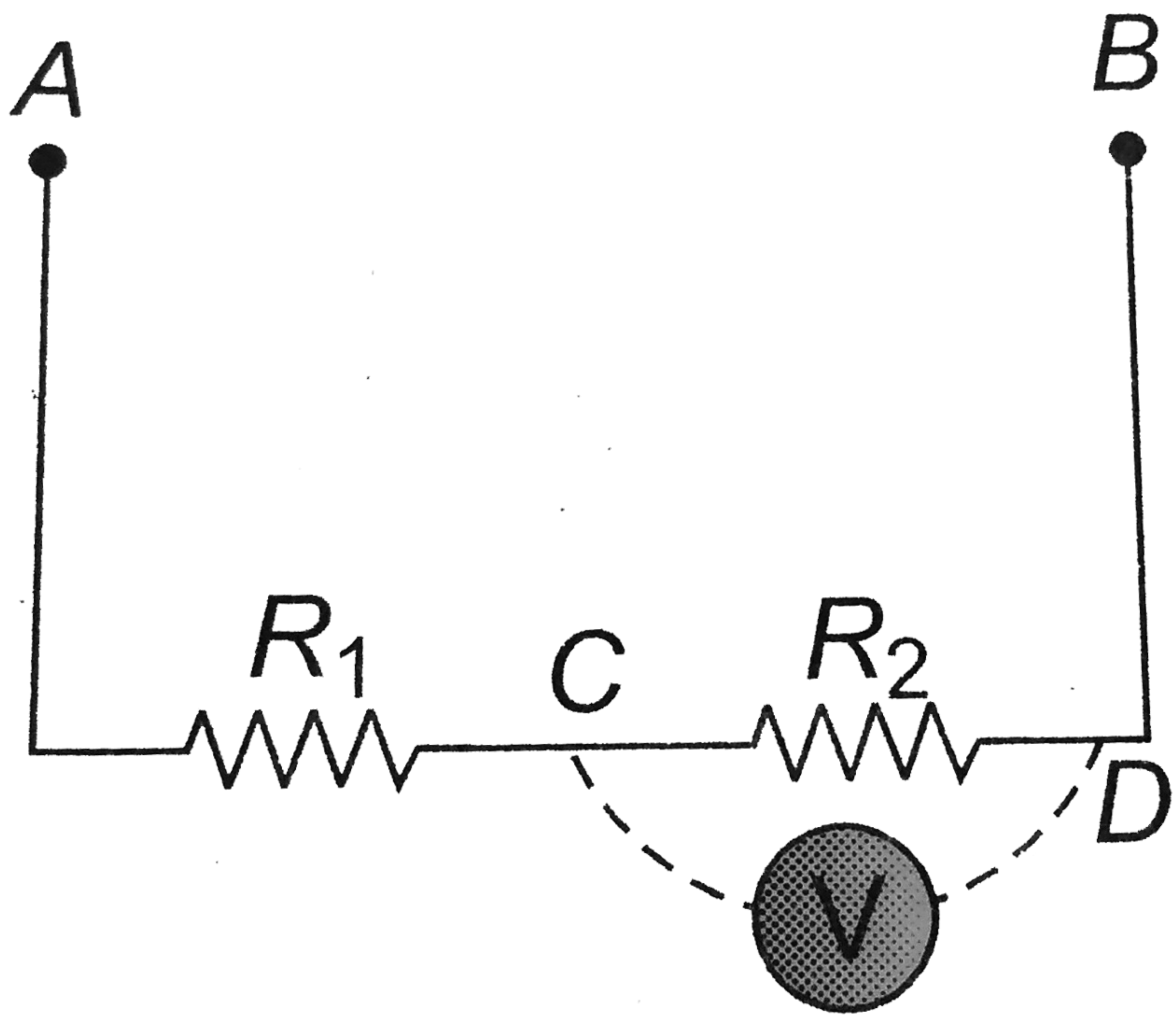
$$V = 0$$

Hence, voltmeter reading is zero. So, choice (d) is

correct

Q-46 - 11964832

Resistances $R_1$ and $R_2$ each 60 are connected in series as shown in figure. The potential difference between $A$ and $B$ is kept 120 volt. Then what will be tha reading of voltmeter connected between thapoint $C$ and $D$ if resistance of voltmeter is $120\Omega$ ?




(A) $48V$

(B) $24V$

(C) $40V$

(D) None

---

CORRECT ANSWER: A

---

SOLUTION:

(a) $R_1$, $R_2$ and $R_V$ are in parallel, their equivalent is

$$R'_2 = \frac{R_2 R_v}{R_2 + R_V}$$
$$= \frac{60 \times 120}{620 + 120} = 40\Omega$$

Now

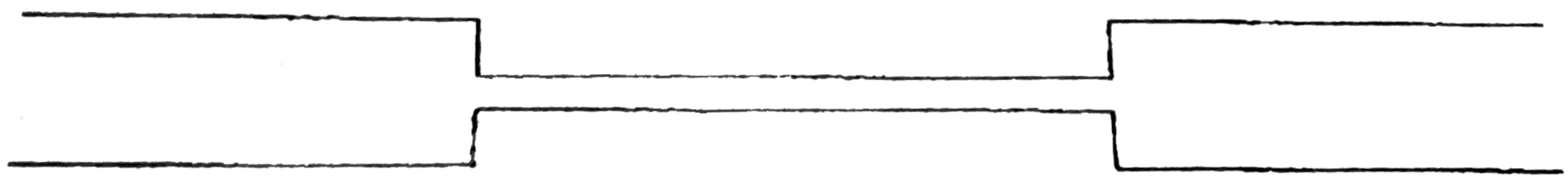
$$I = \frac{120}{R_1 + R'_2}$$
$$= \frac{120}{60 + 40} = 1.2A$$

reading of voltmeter

$$= IR'_2 = 1.2 \times 40$$
$$= 40V$$

Q-47 - 14279813

The figure shows the tungsten filament with constant diameter except a piece of it which has half the diameter of the resy of the wire. Assume the the temperature is constant with in each part and charges suddenly between the parts. If the temperature of thick part is 2000 K, the temperature of the thin part of the filament is



(A) 2000 K

(B) $2^{1/4}(2000)K$

(C) $8^{1/4}(2000)K$

(D) $4^{1/2}(2000)K$

---

CORRECT ANSWER: C

---

SOLUTION:

In steady state

$$I^2R = \sigma T^4 \times \text{ surface area}$$

$$I^2\rho\frac{l}{\pi r^2} = \sigma T^2 2\pi r l$$

$$\Rightarrow T^4 \propto \frac{1}{r^3} \Rightarrow \frac{T_1}{T_2}$$

$$= \left(\frac{r_2}{r_1}\right)^{3/4}$$

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Q-48 - 18252065

(i) At what temperature would the resistance of a copper conductor be double its resistance at $0C$ ?

(ii) Does this temperature hold for all copper conductors regardles of shape and size ? Given $\alpha$ for Cu $= 3.9 \times 10^{-3}. C^{-1}$.

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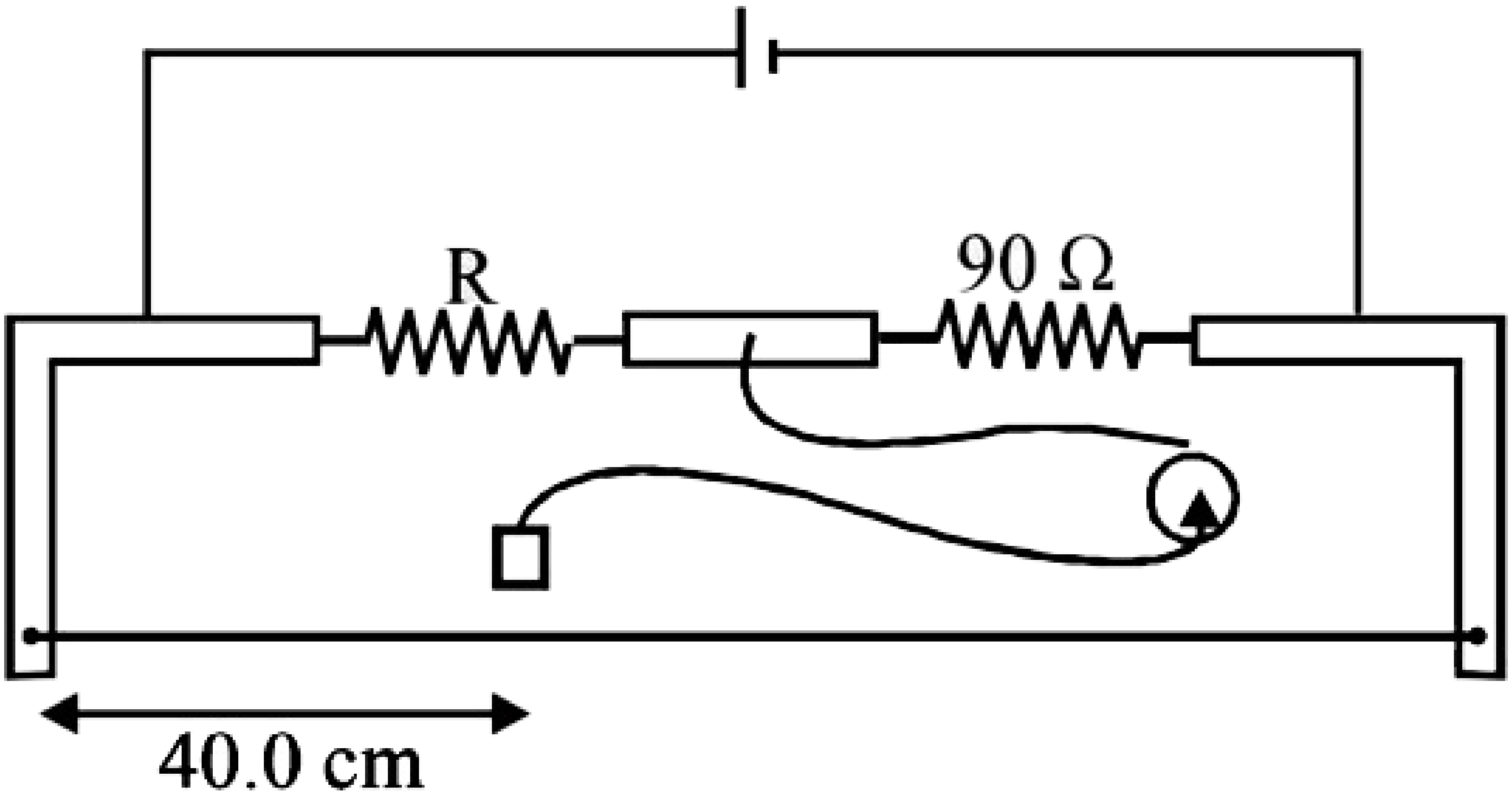
Q-49 - 10059752

During an experiment with a metre bridge, the galvanometer shows a null point when the jockey is pressed at $40.0cm$ using a standard resistance of $90\Omega$, as shown in the figure. The least count of the scale used in the metre bridge is 1mm. The unknown resistance is




(A) $60 \pm 0.15\Omega$

(B) $135 \pm 0.56\Omega$

(C) $60 \pm 0.25\Omega$

(D) $135 \pm 0.23\Omega$

---

CORRECT ANSWER: C

SOLUTION:

(c) In case of a meter bridge

$$\frac{R}{l} = \frac{X}{100 - l} Here X$$
$$= 90\Omega, l = 40.0cm$$

$$\therefore R = \frac{Xl}{100 - l}$$ ,brgt For finding the value of R

$$R = \frac{90 \times 40}{60} = 60\Omega$$

For finding the value of $\Delta R$

$$\frac{\Delta R}{R} = \frac{\Delta l}{l}$$
$$+ \frac{\Delta(100 - l)}{100 - l}$$

$$\therefore \frac{\Delta R}{60} = \frac{0.1}{40} + \frac{0.1}{60}$$
$$\therefore \Delta R = 0.25\Omega$$

Therefore, $R = (60 \pm 0.25)\Omega$.

Q-50 - 13396798

A uniform wire of resistance $R$ is shaped into a regular $n-$ sided polygon ($n$ is even), The equivalent resistance between any two corners can have.

(i) the maximum value $\frac{R}{4}$

(ii) the minimum value $\frac{R}{n}$

(iii) the minimum value $R\left(\frac{n-1}{n^2}\right)$

(iv) the minimum value $\frac{R}{n}$.

(A) (i),(ii)

(B) (i),(iii)

(C) (i) only

(D) (i),(iv)

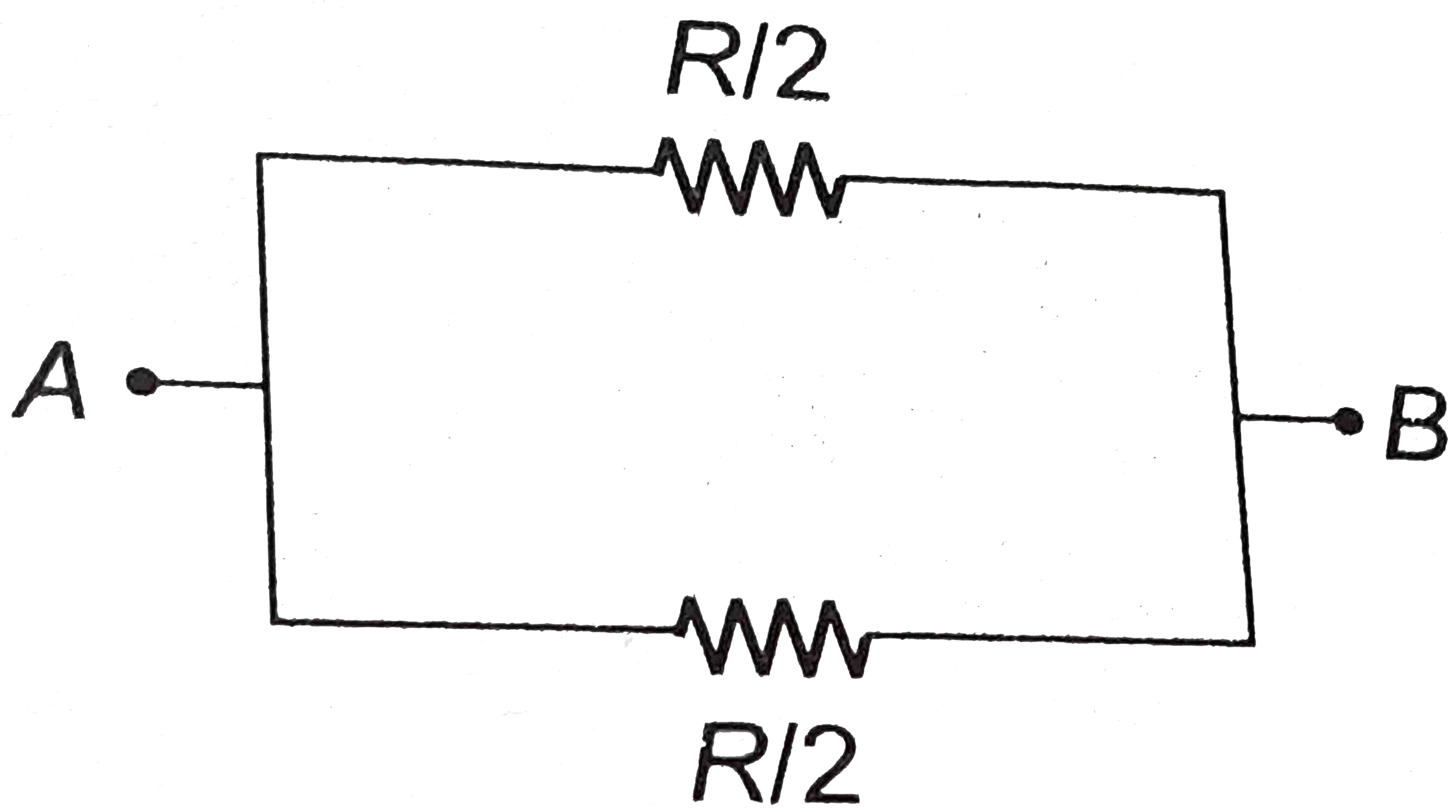
---

CORRECT ANSWER: B

SOLUTION:

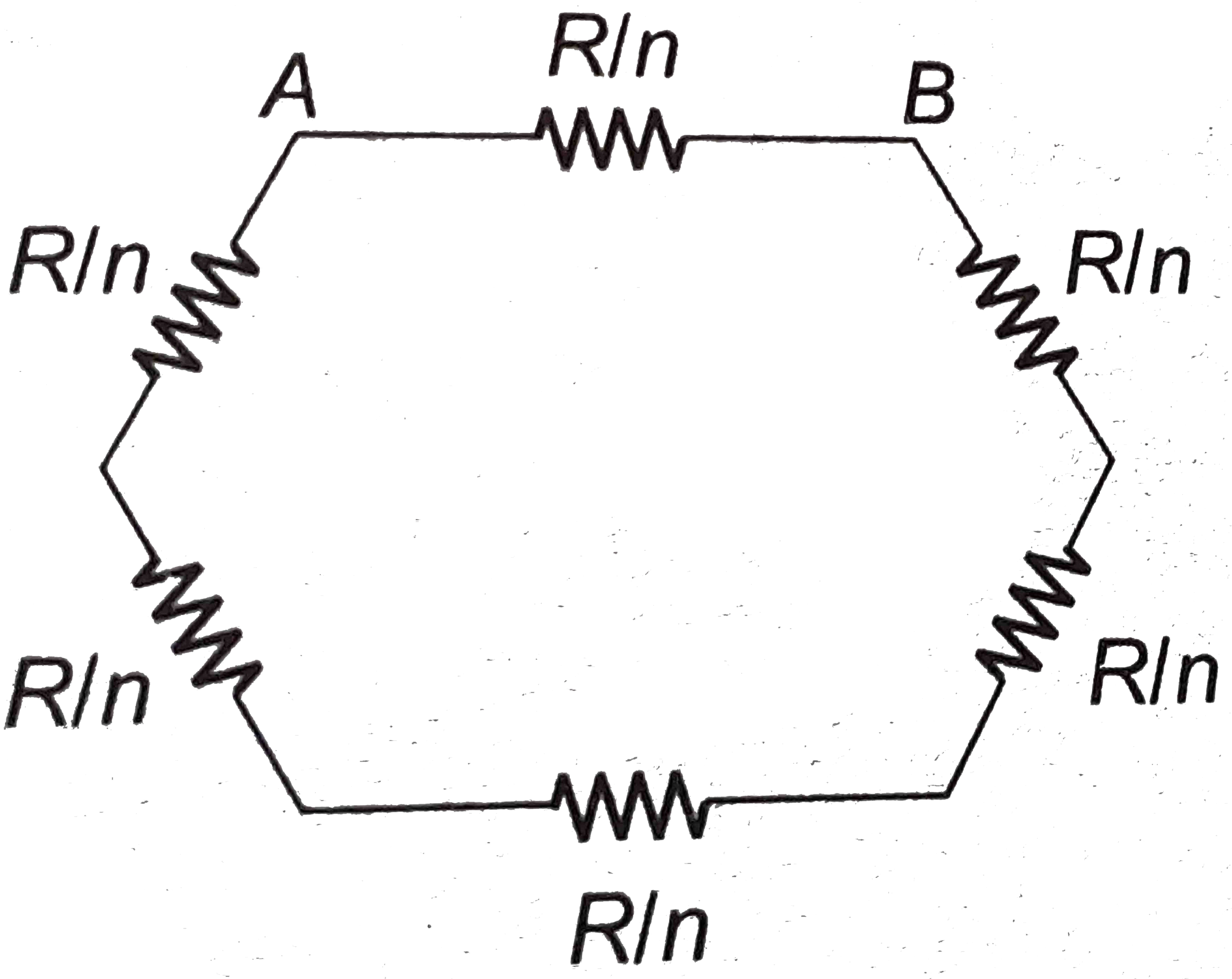
$n = 2, 4, 6, .$

For $R_{\max}$ :




$R_{eq} = R/4$

For $R_{\min}$ :




$$R_{eq}=\frac{\frac{R}{n}.(n-1)\frac{R}{n}}{R}$$
$$=\frac{R(n-1)}{n^2}.$$

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Q-51 - 9726423

Two nonideal batteries are connected in parallel. Consider the following statements:

(A)The equivalent emf is smaller than either of the two emfs.

(B) The equivalent internal resistance is smaller than either of the two internal resistances.

(A) (a)Both A and B are correct

(B) (b)A is correct but B is worng

(C) (c )B is correct but A is worng

(D) (d)Both A and B are worng

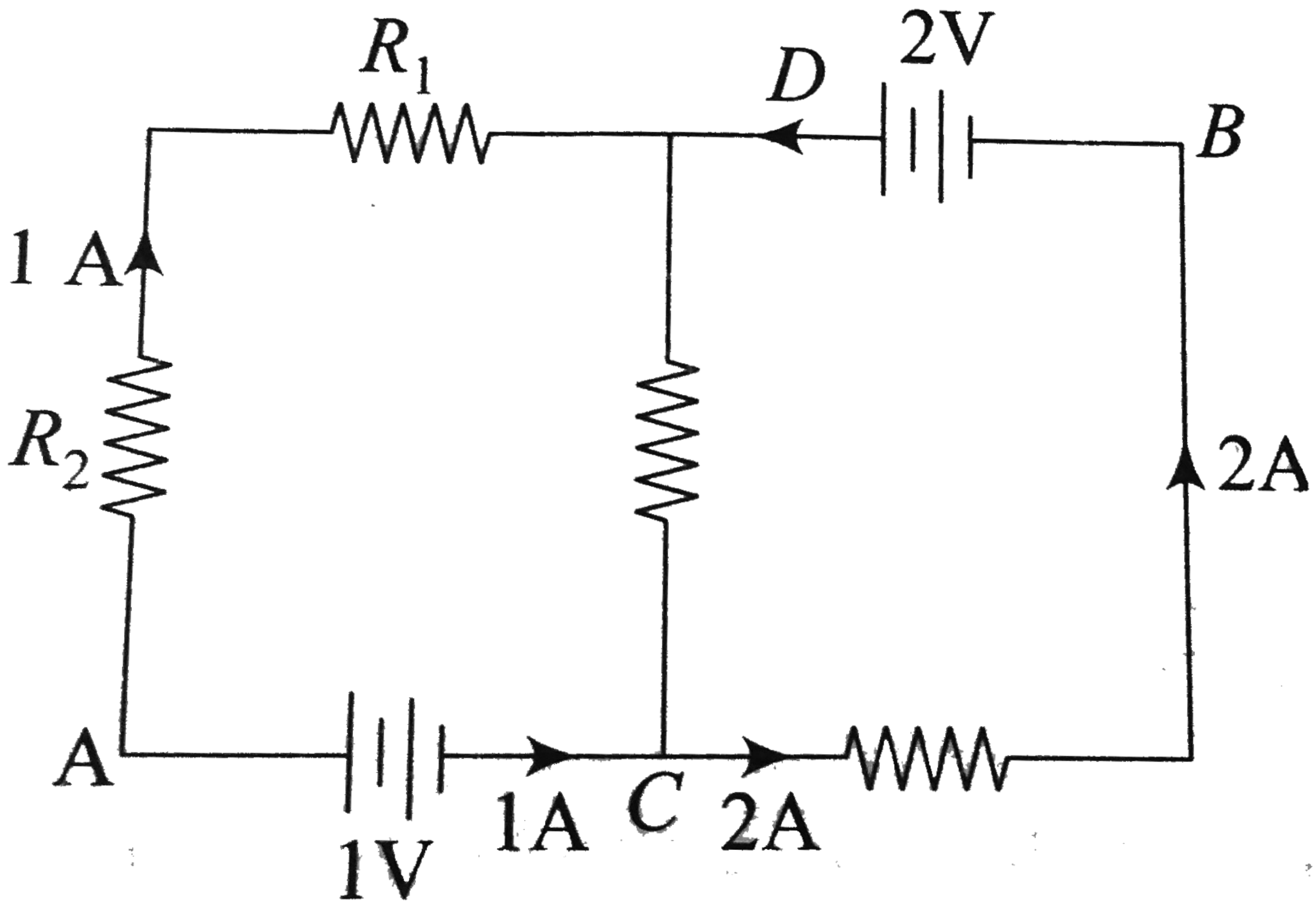
---

CORRECT ANSWER: C



Q-52 - 11965057

In the circuit shown in the figure, if potentail at point $A$ is taken to be zero, the potential at point $B$ is




(A) $-1V$

(B) $+2V$

(C) $-2V$

(D) $+1V$

---

CORRECT ANSWER: D

---

SOLUTION:

(d) By $KVL$ along path $ACDB$

$V_A + 1(1)(2) - 2$
$= V_B$

$0 + 1 = V_B \Rightarrow V_B$
$= 1V$

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Q-53 - 11309654

A voltmeter and an ammeter are connected in series to an ideal cell of $emf E$. The voltmeter reading is $V$, and the ammeter readings is $I$. Then

(i) $V < E$ (ii) the voltmeter resistance is $V / I$

(iii) the potential difference across the ammeter is $E - V$

(iv) Voltmeter resistance + ammeter resistance = E//I`

Correct statements are

(A) $I$ and $ii$

(B) $ii$ and $iii$

(C) $iii$ and $iv$

(D) all

---

CORRECT ANSWER: A::B::C::D

SOLUTION:

Treat all voltmeters and ammeters as resistances. Draw the circuit and find the currents and potential differences for each section.

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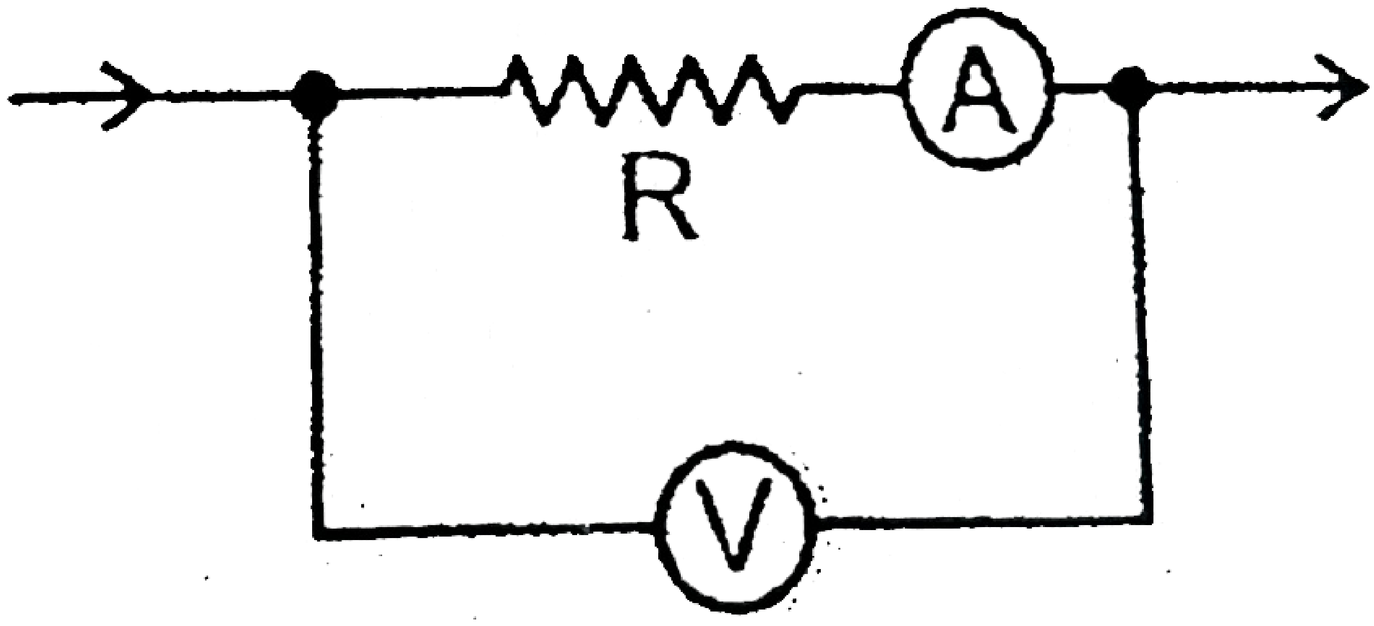
Q-54 - 14626477

In the, Ohm's law experiment ot find resistance of unknown resistor R, the arrangement is as shown. The resistance measured is given by $R_{\text{measured}} = \frac{V}{i} V =$ voltage reading of voltmeter. i=current reading of ammeter. The ammeters and the voltmeter used are not ideal, and have resistance $R_A$ and $R_V$ respectively. For arrangement shown, the meausred resistance is




(A) $R+R_V$

(B) $R+R_A$

(C) $\frac{\mathbb{R}_v}{R+R_v}$

(D) $\frac{\mathbb{R}_V}{R+R_V}+R_A$

---

CORRECT ANSWER: B

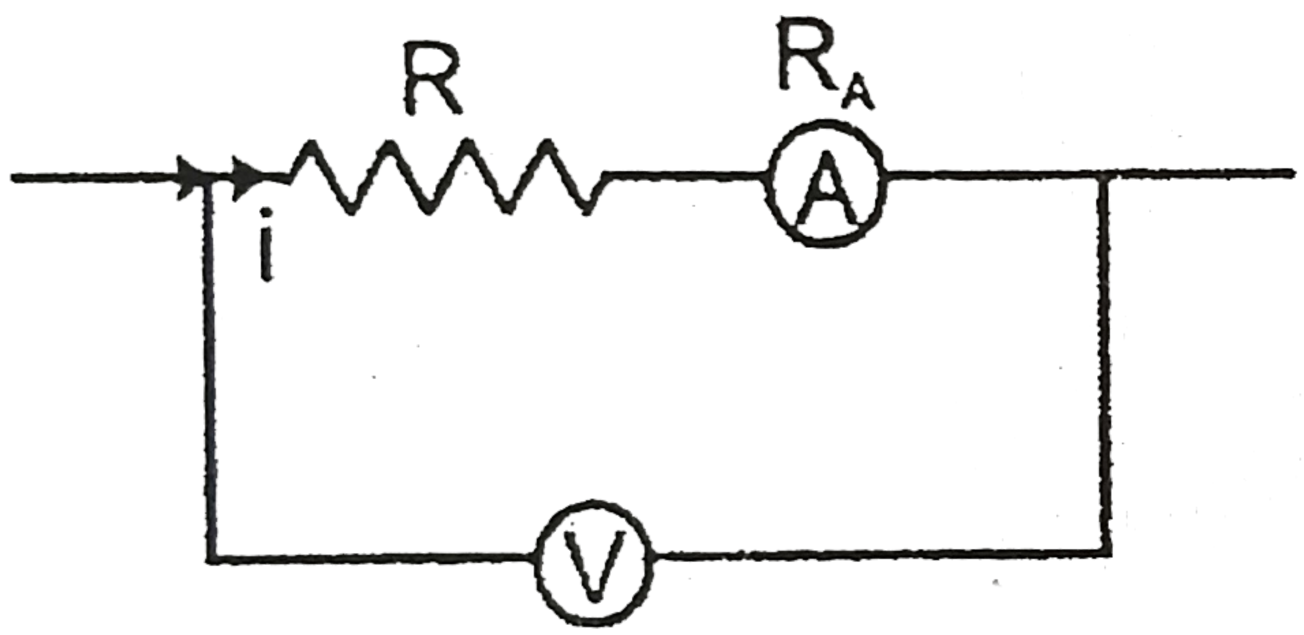
---

SOLUTION:

Potential drop $\rightarrow V=i(R+R_A)$

$\frac{V}{i}=R+R_A$

$=R_{\text{meaured}}$






Q-55 - 11309442

A battery of emf $1.4V$ and internal resistance $2\Omega$ is connected to a resistor of $100\omega$ resistance through an ammeter. This resistance of the ammeter is $4/3\Omega$. A voltmeter has also been connected to find the potential difference across the resistor.

a. Draw the circuit diagram.

b. The ammeter reads $0.02A$. What is the resistance of the voltmeter?

c. The voltmeter reads $1.1V$. What is the error in the reading?

CORRECT ANSWER: (I) THE CIRCUIT SHOWS IN THE DIAGRAM

$(\#\#BMS_V03_C06_E01_{026}\_A01\#\#)$

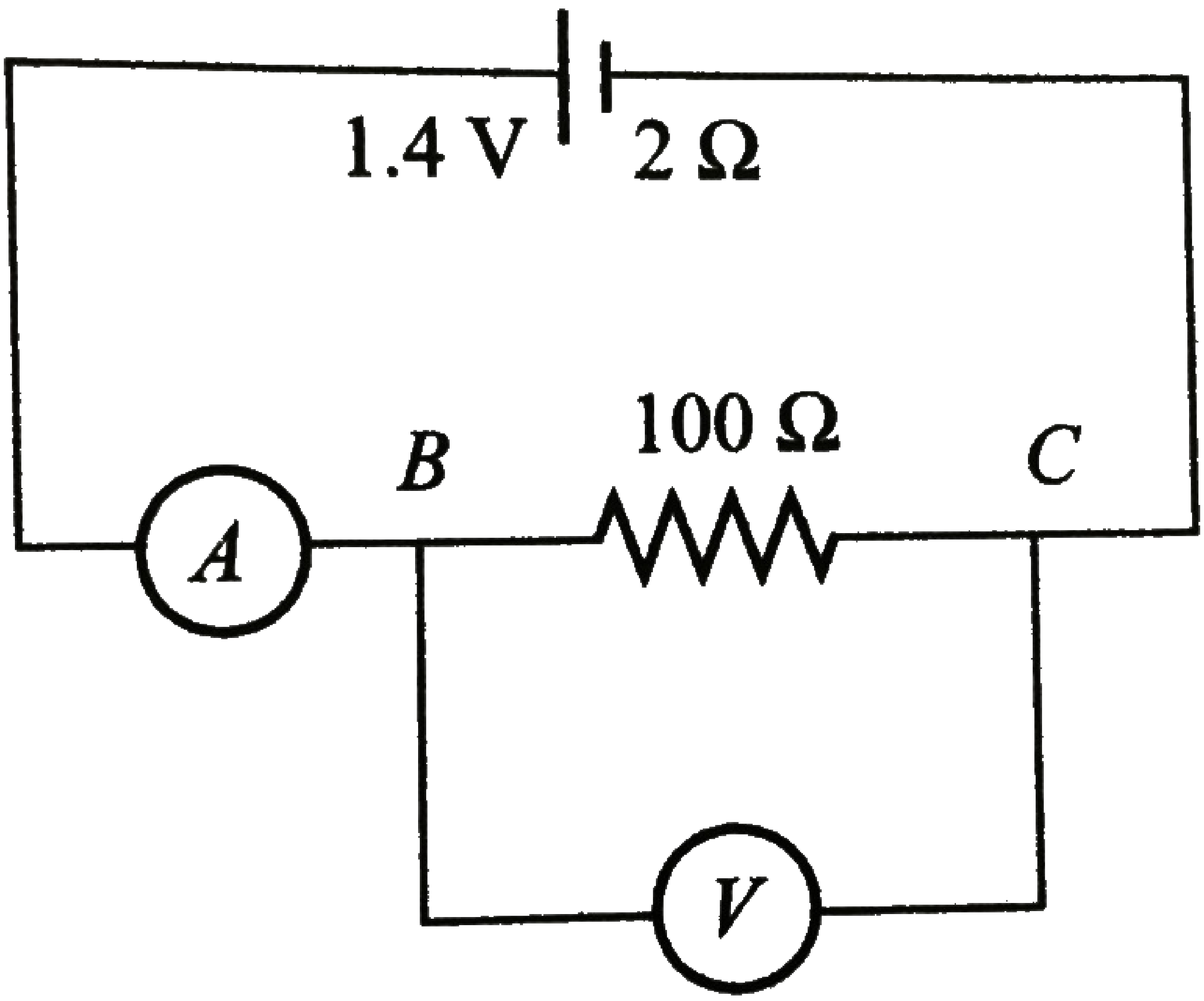
(II) $200OMEGA$

(III) $-0.233V$

---

SOLUTION:

The circuit diagram is as shows.



(ii) Let resistance of the voltmeter be $R$ ohm. The

equivalent resistance of voltmetre (R ohm) and $100\Omega$ in

parellel is

$$\frac{100 \times R}{100 + R} = \frac{100R}{100 + R}$$

Resistance of the ammeter is $4/3\Omega$. Total resistance of

the circuit is

$$\frac{100R}{100 + R} + \frac{4}{3} + 2\Omega$$

Current in the circuit as read by the ammeter is $0.02A$.

Now,

$0.02$

$$= \frac{1.4}{\frac{100R}{100+R} + \frac{4}{3} + 2}$$

$$\left(\therefore I = \frac{V}{R}\right)$$

or $R = 200\Omega$

Therefore, resistance of the voltmeter is $200\Omega$.

(iii) Effective resistance between $B$ and $C$ is

$$\frac{100 \times 200}{100 + 200} = \frac{200}{3}\Omega$$

The potential drop across this resistance is

circuit current

$$\times \frac{200}{3} = 0.02 \times \frac{200}{3}$$

$$= \frac{4}{3}V = 1.333V$$

Reading of the voltmeter is $1.1V$. Error in the reading of

the voltmeter is

$$1.1 - 1.333 =$$
$$- 0.233V$$

.

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Q-56 - 11309451

In a meter bridge experiment, the null point is obtained at $20cm$ from one end of the wire when resistance $X$ is balanced against another resistance $Y$. If $X < Y$, then where will be the new position of the null point from the same end, if one decides to balanced a resistance of $4X$ against $Y$?

(A) $50cm$

(B) $80cm$

(C) $40cm$

(D) $70cm$

---

CORRECT ANSWER: A

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SOLUTION:

$$\frac{X}{Y}=\frac{20}{80}=\frac{1}{4} \text{ or } Y=4X$$
$$\frac{4X}{Y}=\frac{l}{100-l} \text{ or } \frac{4X}{4X}=\frac{l}{100-l} \text{ or } l=50cm$$



Q-57 - 11964849

For comparing the e.m.f.'s of two cells with a potentiometer, a standard cell is used to develop a potential gradient along the wires.

Which of the following possibilities would make the experiment unsuccessful gt

(A) The e.m.f. of the standard cell is larger than the $E$ e.m.f.'s of the two cellss

(B) The diameter of the wires is the same and uniform throughout

(C) The number of wires is ten

(D) The e.m.f. of the standard cell is smaller than the e.m.f's of the two cells

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CORRECT ANSWER: D

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SOLUTION:

(d) The emf of the standard cell must be greater than that of experimental cells, otherwise balance point is not obtained.

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Q-58 - 11965072

A potentiometer circuit has been setup for finding. The internal resistance of a given cell. The main battery used a negligible internal resistance. The potentiometer wire itsefl is $4m$ long. When the resistance, $R$, connected across the given cell, has value of

(i) Infinity $9.5\Omega$,

(ii) the 'balancing length' , on the potentiometer wire are found to be $3m$ and $2.85m$, respectively.

The value of internal resistance of the cell is

(A) $0.25\Omega$

(B) $0.95\Omega$

(C) $0.5\Omega$

(D) $0.75\Omega$

CORRECT ANSWER: C

SOLUTION:

(c ) Internal resistance of the cell, $r = \left(\frac{l_1}{l_2} - 1\right)R$

$= \left(\frac{3}{2.85} - 1\right)9.5\Omega$

$= \frac{0.15}{2.85} \times 9.5\Omega = 0.5$

$\Omega$

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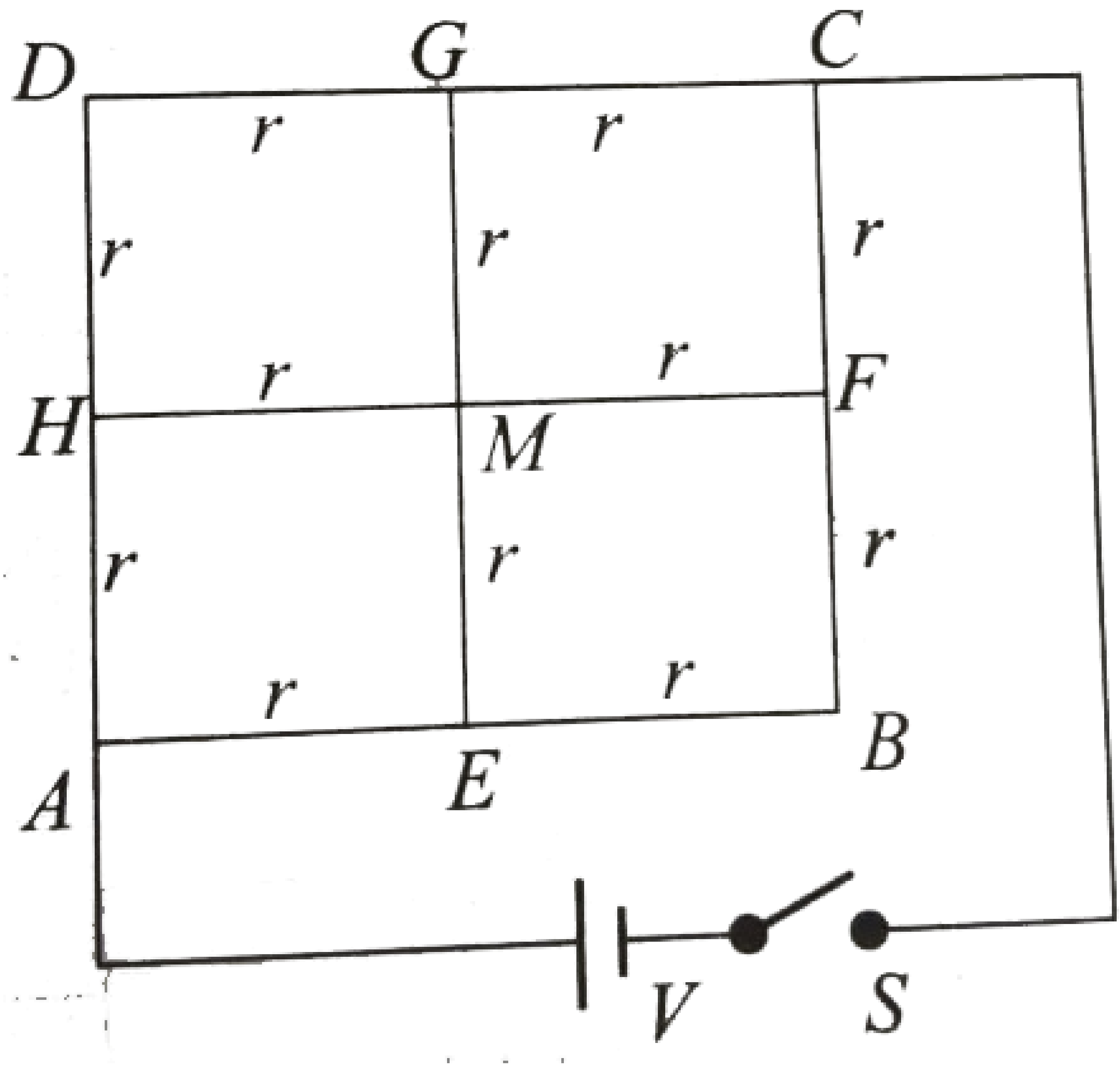
Q-59 - 11309671

In Fig. $7.48$, each of the segments $(e.g., AE, GM, etc.)$ has resistance $r$. A battery of emf $V$ is connected between $A$ and $C$. Internal resistance of the battery is negligible.




If a potentiometer circuit having gradient $k$ is connected across the points $H$ and $C$, the balancing length shown by the potentiometer is

(A) $\dfrac{v}{k}$

(B) $\dfrac{2v}{3k}$

(C) $\dfrac{3v}{2k}$

(D) none of these

CORRECT ANSWER: B

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SOLUTION:

In loop $EBFME$,

$$V_E - ri_1 - ri_1 + r\left(\frac{i}{2} - i_i\right) + r\left(\frac{i}{2} - i_1\right) = V_E$$

or

$$2i_1 = 2\left(\frac{i}{2} - i_1\right) \text{ or }$$
$$i_i = \frac{i}{4}$$

Loop $AEBCSA$,

$$V_A - r\frac{i}{2} - ri_1 - ri_1 - r\frac{i}{2} + V = V_A$$

or

$$V = ri + 2ri_1 = ri + 2r\frac{i}{4} = \frac{3ri}{2}$$

$$R_{eq} = \frac{V}{i} = \frac{3r}{2}$$

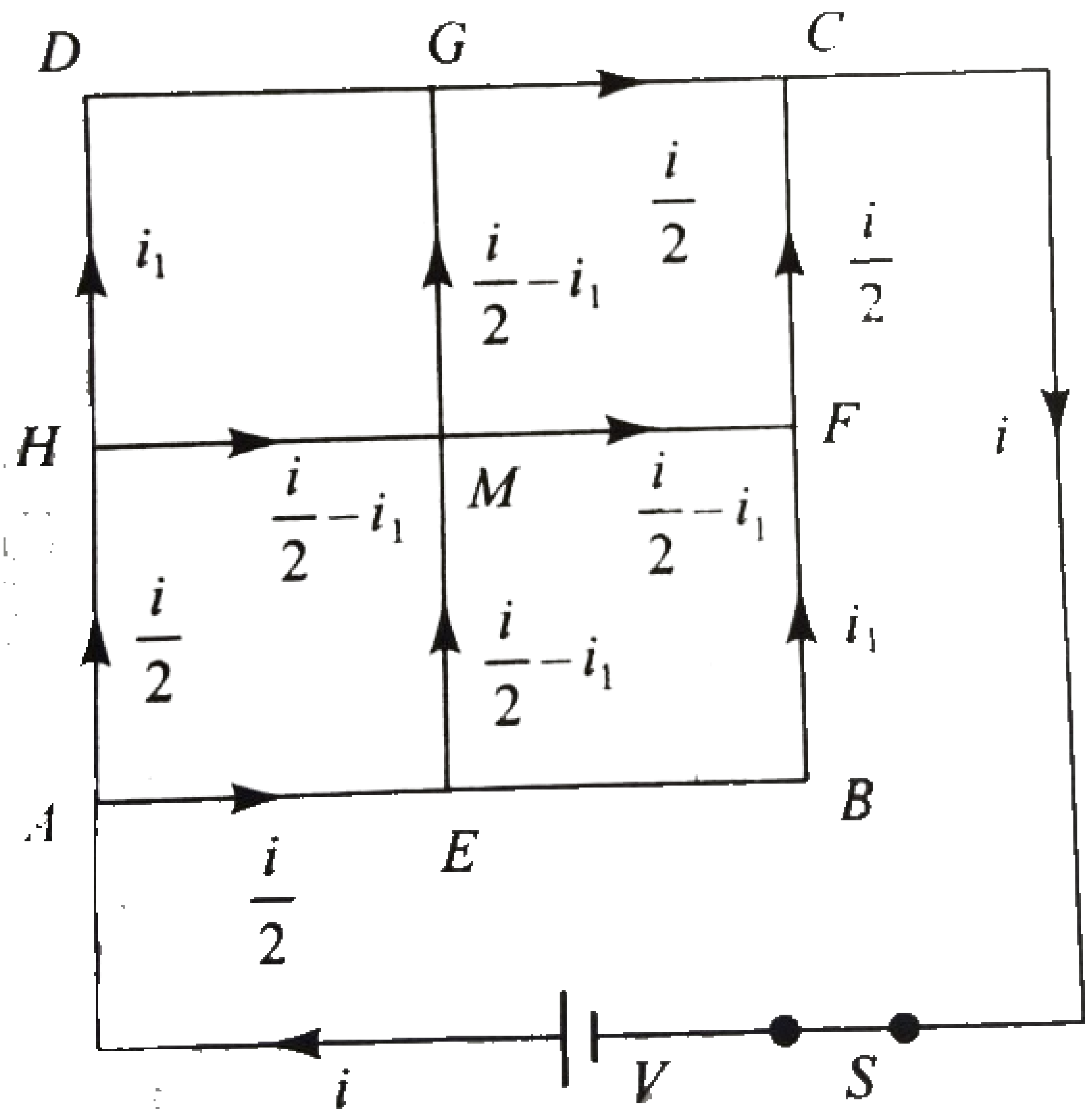
$$\frac{P_1}{P_2} = \frac{\left(\frac{i}{2}\right)^2 r}{\left(\frac{i}{2} - i_1\right)^2 r} = \frac{i^2}{\left(i - 2i_1\right)^2} = 4$$

Let $l$ be the balancing length , then

$$kl = V_H - V_C = \left(\frac{i}{2} - i_1\right)r + \left(\frac{i}{2} - i_1\right)r + \frac{i}{2}r$$

$$= \left(\frac{3i}{2} - 2i_1\right)r = ir$$

or $l = \dfrac{2V}{3k}$

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Q-60 - 11965549

A galvanometer of resistance $G$ is shunted by a resistance $S ohm$. To keep the main current in the circuit uncharged, the resistnace to be put in series with the galvonmeter

(A) $\frac{S^2}{(S+G)}$

(B) $\frac{SG}{(S+G)}$

(C) $\frac{G^2}{(S+G)}$

(D) $\frac{G}{(S+G)}$

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CORRECT ANSWER: C

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SOLUTION:

Current will be uncharged if resistance remain the same,

so

$$G = \frac{GS}{G+S} + R$$
$$R = G - \frac{GS}{G+S}$$
$$\Rightarrow R = \frac{G^2}{G+S}$$