Physicsaholics

DPP – 6 (Current Electricity)

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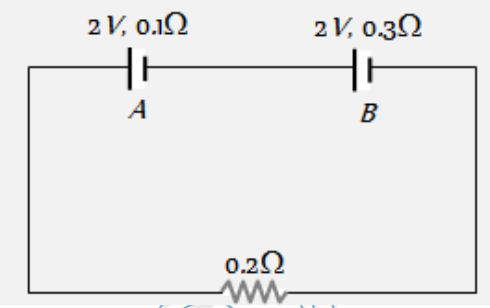
Q 1. A primary cell has an e.m.f. of 1.5 volts, when short-circuited it gives a current of 3 amperes. The internal resistance of the cell is

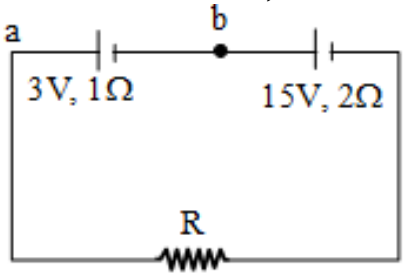
(a) 4.5 (b) 2
(c) 0.5 (d) 1/4.5

Q 2. The internal resistance of two cells shown are 0.1 ohm and 0.3 ohm. If R=0.2 ohm , the potential difference across the cell



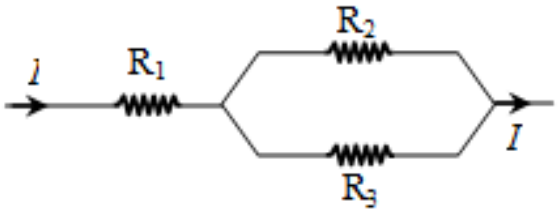
(a) *B* will be zero (c) *A* and *B* will be 2*V*
(b) *A* will be zero (d) *A* will be >2V and *B* will < 2V be

Q 3. Two batteries one of the emf 3 V, internal resistance 1ohm and the other of emf 15V, internal resistance 2 ohm are connected in series with a resistance R as shown. If the potential difference between a and b is zero, the resistance R in ohms is -



(A) 5 (B) 7
(C) 3 (D) 1

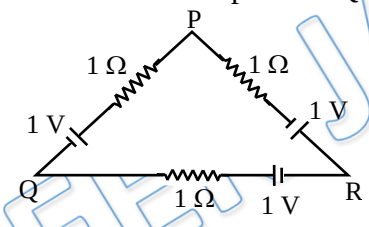
Q 4. For what ratio of R_1, R_2 and R_3, power developed across each resistor is equal -



(A) 1 : 4 : 4 (B) 4 : 4 : 1
(C) 4 : 1 : 1 (D) 1 : 1 : 1

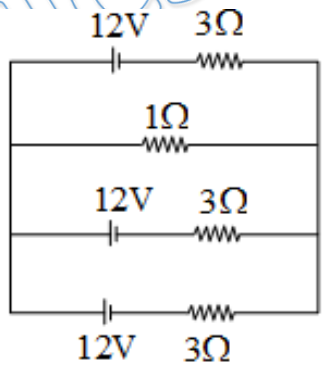
Q 5. A 24 volt battery of internal resistance of 4 ohm is connected to a variable resistance. The rate of heat production in the resistor is maximum when current in the circuit is
(A) 2 A (B) 3 A
(C) 4 A (D) 6 A

Q 6. Three batteries of emf 1V and internal resistance 1 ohm each are connected as shown. Effective emf of combination between the points PQ is –



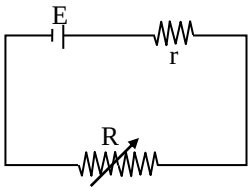
(A) Zero (B) 1V
(C) 2V (D) 2/3 V

Q 7. In adjacent circuit, current flowing in 1ohm resistance will be



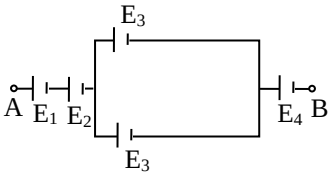
(A) 3A (B) 4A
(C) 5A (D) 6A

Q 8. In the figure shown, a cell of emf E and internal resistance r is connected to a variable resistor R. The (i) current in the circuit and (ii) heat produced in the resistor R will be maximum, respectively for



(A) (i) R = r, (ii) R = 0 (B) (i) R = 0, (ii) R = r
(C) (i) R = r, (ii) R = r (D) (i) R = 0, (ii) R= 0

Q 9. In the following circuit the resultant emf between AB is -

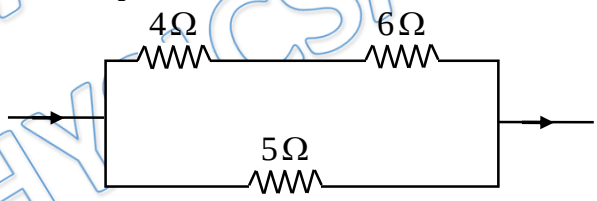


(A) $E_1 + E_2 + E_3 + E_4$ (C) $E_1 + E_2 + (E_3/2) + E_4$
(B) $E_1 + E_2 + 2E_3 + E_4$ (D) $E_1 + E_2 + (E_3/4) + E_4$

Q 10. Five cells each of e.m.f (E) and internal resistance (r) are connected in series. If due to oversight one cell is connected wrongly ,then the equivalent e.m.f and internal resistance of the combination is -

(A) 5E and 5r (B) 3E and 3r
(C) 3E and 5r (D) 5E and 4

Q 11. In the circuit shown in fig. the heat produced in 5 ohm resistor due to a current flowing in it is 10 cal/s. The heat produced in 4 ohm resistor is :



(A) 4 cal/s (B) 1 cal/s
(C) 2 cal/s (D) 3 cal/s

Q 12. 'N' equal resistors connected in series across a source of e.m.f together dissipate 4 watts of power. The power dissipated when the same resistors are connected in parallel across the same source of e.m.f is 64 watts. The number of resistors 'N' is equal to -

(A) 8 (B) 4
(C) 16 (D) 2

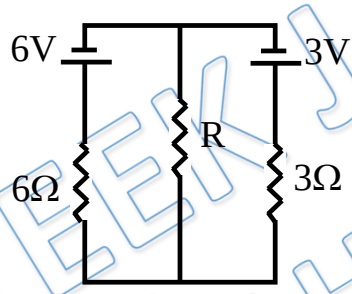
Q 13. A uniform wire connected across a supply produces heat H per second**.** If the wire is cut into n equal parts and all the parts are connected in parallel across the same supply, the heat produced per second will be -

(A) H/n (B) nH
(C) n^2H (D) H/n^2

Q 14. The same mass of copper is drawn into two wires 1 mm thick and 2 mm thick. If the two wires are connected in series and the current is passed, the heat produced in the wires will be in the ratio -

(A) 2 : 1 (B) 4 : 1
(C) 1 : 16 (D) 16 : 1

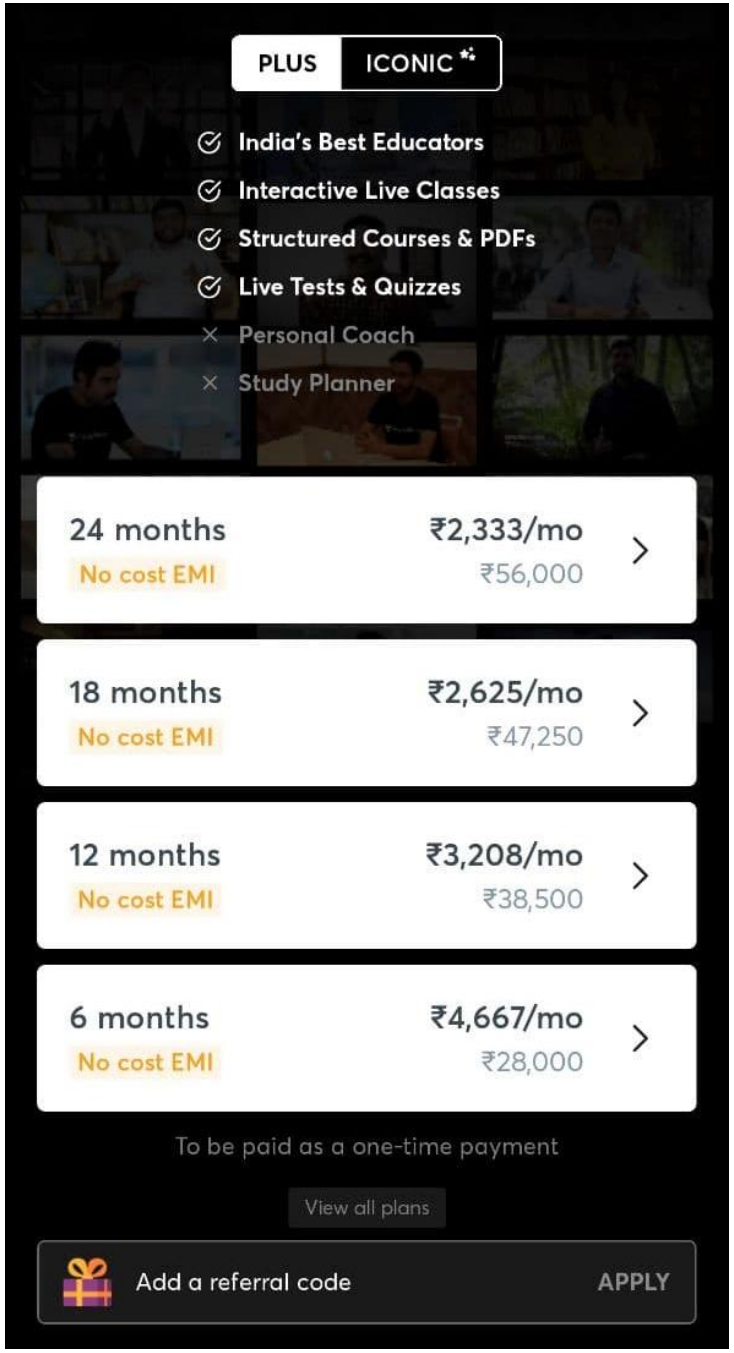
Q 15. In the circuit, the value of R is so chosen that thermal power generated in it is maximum, then value of R is –



(A) 2 ohm (B) 3 ohm
(C) 6 ohm (D) 9 ohm

Answer Key

Q.1 c	**Q.2 a**	**Q.3 c**	**Q.4 a**	**Q.5 b**
Q.6 a	**Q.7 d**	**Q.8 b**	**Q.9 a**	**Q.10 c**
Q.11 c	**Q.12 b**	**Q.13 c**	**Q.14 d**	**Q.15 a**



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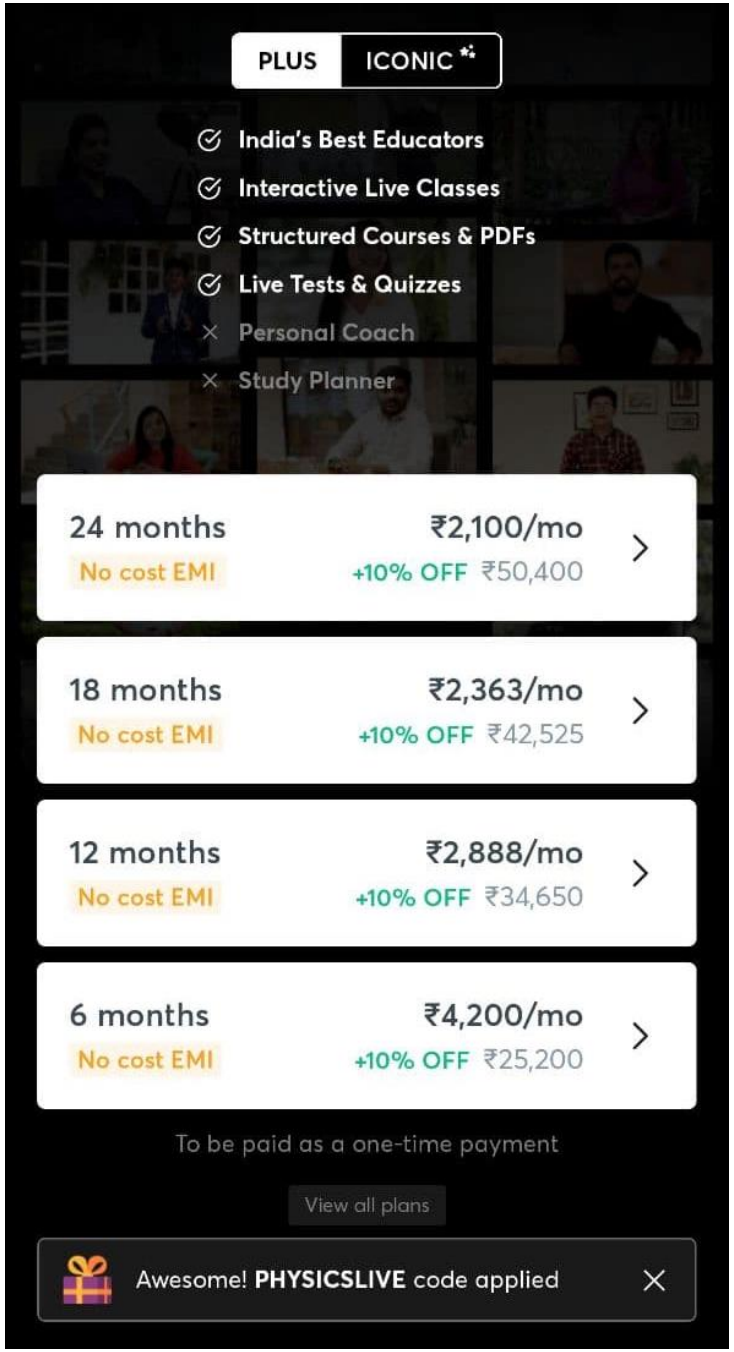
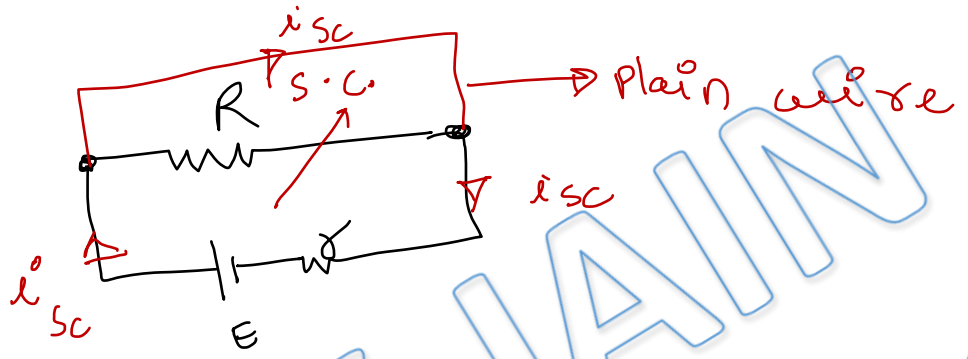


Written Solution

DPP-6 Current Electricity: combination of battery , heat and power across resistance

By Physicsaholics Team

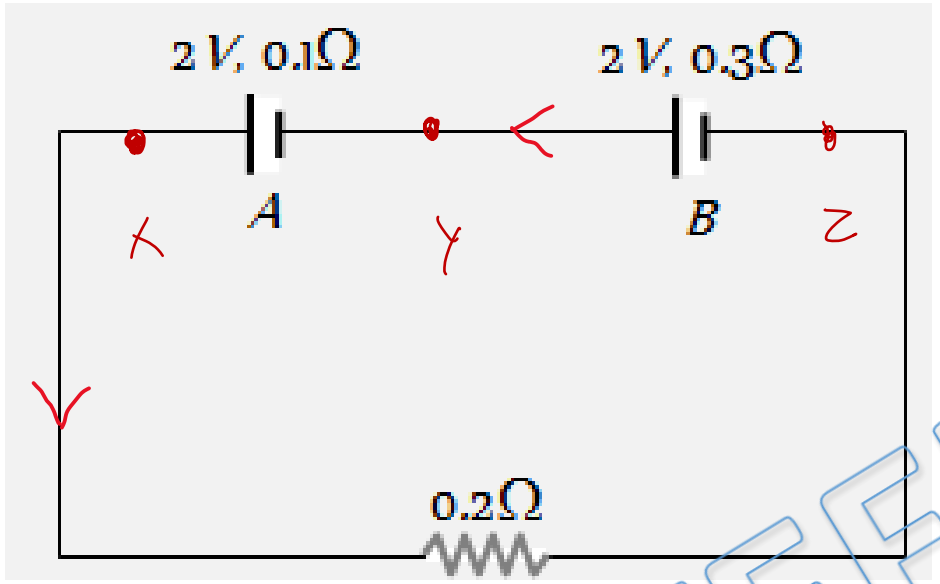
Solution:1



(c) Short circuit current $i_{SC} = \dfrac{E}{r} \Rightarrow 3 = \dfrac{1.5}{r} \Rightarrow r = 0.5\,\Omega$

Ans. c

Solution:2



⇒ current flowing through ckt is :-

$$i = \frac{4}{0.6}\ A = \frac{\text{total EMF}}{\text{total res.}}$$

$$i = \frac{4\times 10}{6} = \frac{40}{6} = \frac{20}{3}\ A$$

for cell A ⇒ $V_x - 2 + 20/3 \times 0.1 = V_y$

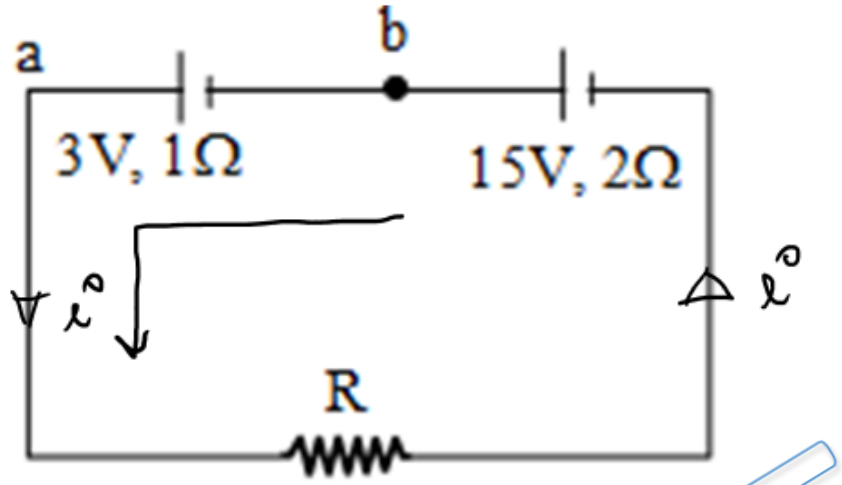
$$V_x - V_y = 2 - 2/3 = 4/3 \text{ volt}$$

for cell B ⇒ $V_y - 2 - 0.3 \times 20/3 = V_z$

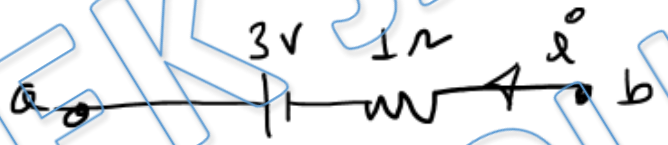
$$V_y - V_z = 0$$

Ans. a

Solution:3



$$i^\circ = \frac{18}{3+R}$$



$$V_b - i^\circ \times 1 + 3 = V_a$$

$$0 = V_b - V_a = i^\circ - 3$$

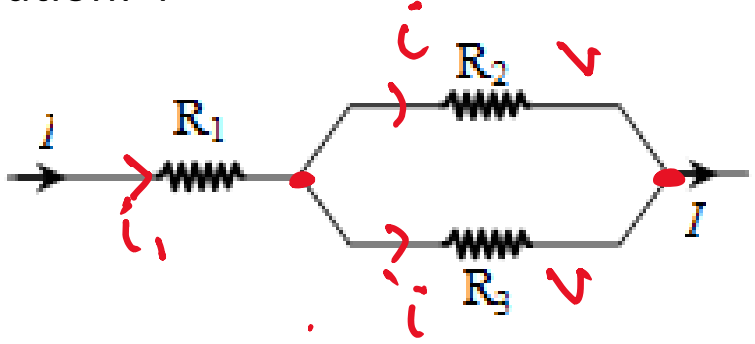
$$0 = \frac{18}{3+R} - 3$$

$$9 + 3R = 18$$

$$\boxed{R = 3\Omega}$$

Ans. c

Solution: 4



$\because R_2$ & R_3 are in parallel

$V_2 = V_3 = V$

And given: $P_1 = P_2 = P_3$

So, $P_2 = \frac{V^2}{R_2} = P_3 = \frac{V^2}{R_3}$

$\Rightarrow \boxed{R_2 = R_3}$

$i_1 = i + i = 2I$

$P_1 = (2i)^2 R_1 = P_2 = i^2 R_3$

$4 R_1 = R_3$

$\boxed{R_1 = \frac{R_3}{4}}$

$\Rightarrow R_1 : R_2 : R_3$

$\frac{R_3}{4} : R_3 : R_3$

$\frac{1}{4} : 1 : 1$

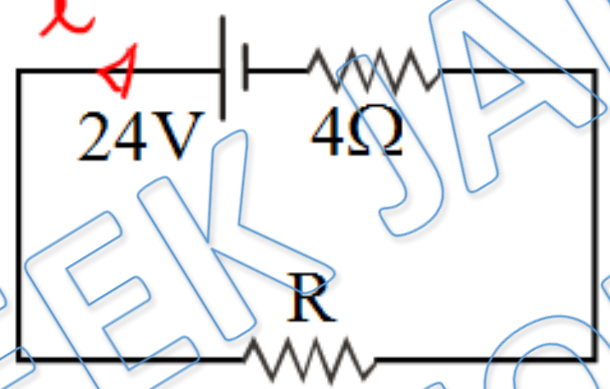
$1 : 4 : 4$

Ans. a

Ans

Solution: 5

When R = r (power dissipated is maximum)



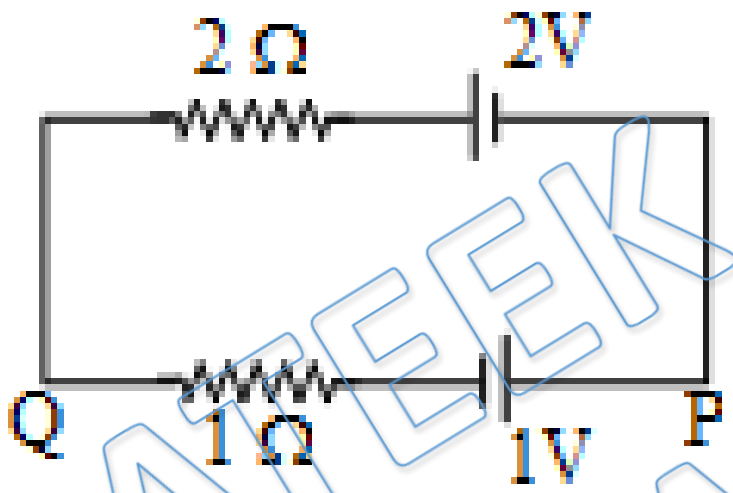
Hence $R = 4\Omega$

$$i^{\circ}_{max} = \frac{24}{8}$$

$$\boxed{i^{\circ}_{max} = 3A}$$

Ans. b

Solution: 6



$$E_{net} = \frac{E_1 r_2 - E_2 r_1}{r_1 + r_2} = \frac{2-2}{2+1} = 0$$

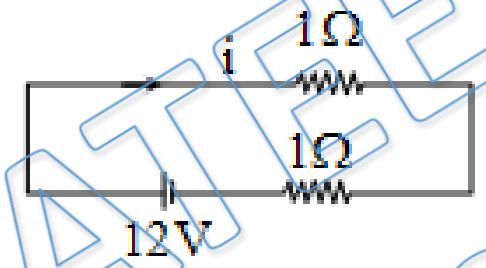
Ans. a

Solution: 7

All the three given cells are in parallel

$$\therefore r_{eq} = \frac{r}{3} = \frac{3}{3} = 1\Omega$$

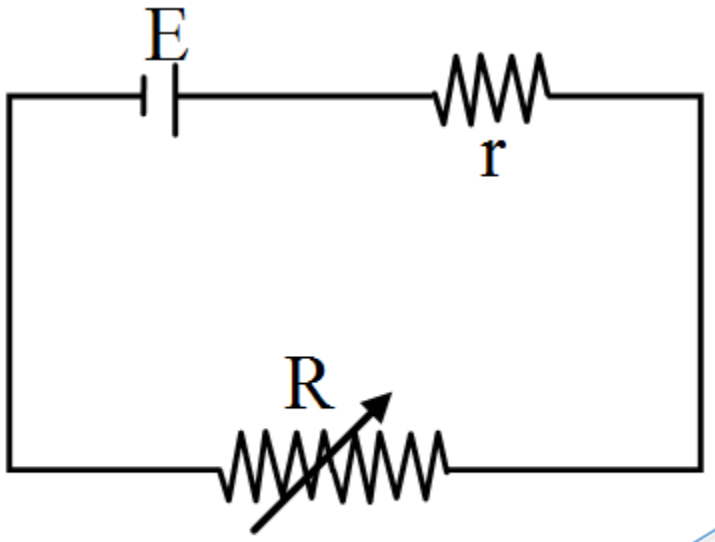
$$E_{eq} = 12V$$



$$i = \frac{12}{1+1} = 6A$$

Ans. d

Solution: 8



① For maxm heat produced we know ($r = R$)

$$P_{max} = \frac{E^2}{2r}$$

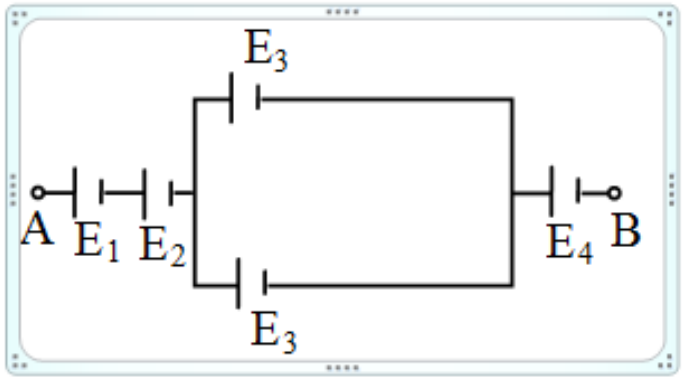
② for current maxm Resistance ($R = 0$)

$$i^o_{max} = E/r$$

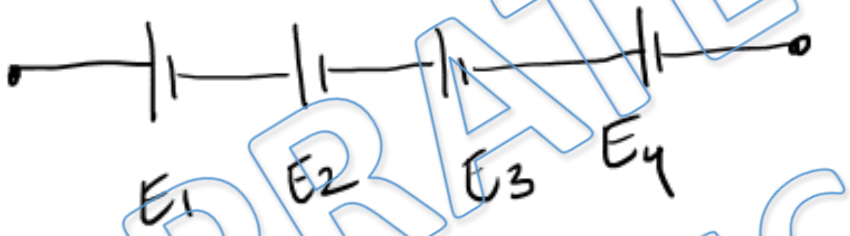
Ans. b

hence B is correct.

Solution: 9



as we know the net emf remains same for identical batteries in parellel hence the setup can be reduced as



$$E_{net} = E_1 + E_2 + E_3 + E_4$$

hence A is correct.

Ans. a

Solution: 10

As given in question :-

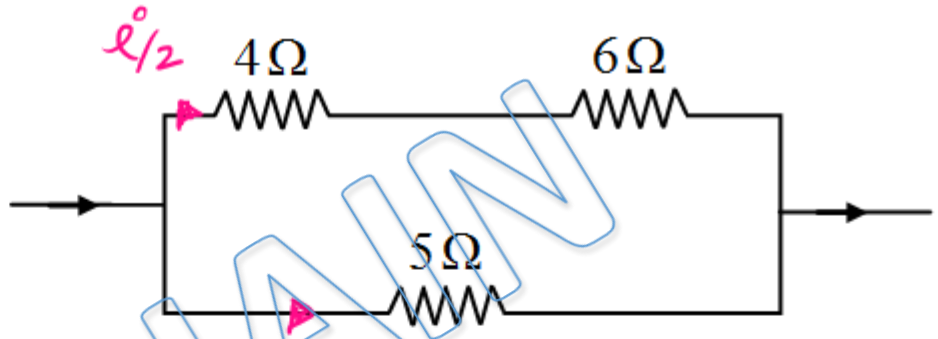
$E_{net} = E + E + E + E - E = 3E$

$r_{net} = 5r$ (all in series)

Hence $3E$ & $5r$ is correct option C.

Ans. c

Solution: 11



$P_{4\Omega} = (i/2)^2 \cdot 4$

$= \left(\frac{\sqrt{2}}{2}\right)^2 \cdot 4$

$= \left(\frac{1}{\sqrt{2}}\right)^2 \cdot 4 = 2$ cal/sec

Hence correct ans is c

$P_5 = 10$ cal/sec

$i^{\circ 2} \times 5 = 10$ cal/sec

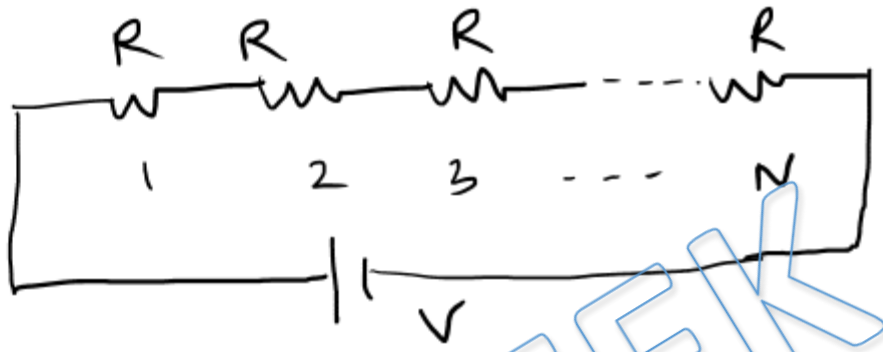
$i^\circ = \sqrt{2}$ unit.

As Res of lower branch is half & hence current in upper branch should be $i^\circ/2$. $\boxed{i \propto 1/R}$ *

Ans. c

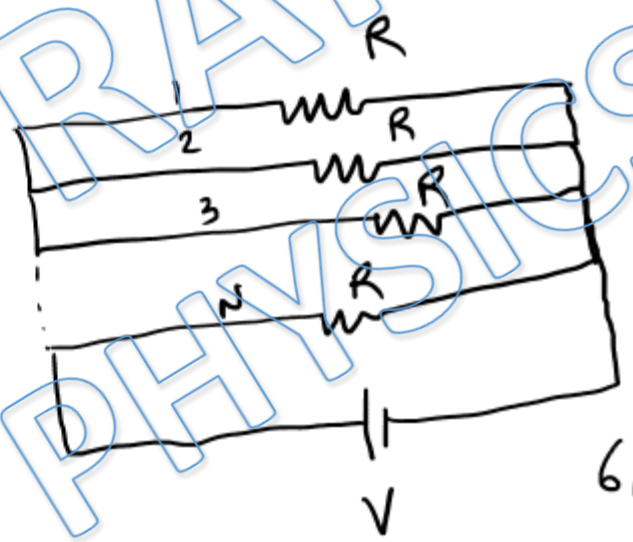
Solution: 12

① case



$$4 = \frac{V^2}{Req} = \frac{V^2}{R/N} \quad -①$$

② case



$$64 = \frac{V^2}{Req} = \frac{V^2}{R/N} \quad -②$$

② ÷ ① → $16 = N^2$

$N = 4$

hence correct option is b.

Ans. b

Solution: 13

$$H = \frac{V^2}{R} \ldots (1)$$

$$H' = n\left(\frac{v^2}{R/n}\right) = n^2\frac{V^2}{R} \ldots (2)$$

From (1) and (2)

$$H' = n^2 H$$

Ans. c

Solution: 14

Ratio of radii = 1 : 2

⇒ " " Area = 1 : 4

⇒ " " length = 4 : 1 (Since volume is same)

⇒ " " Resistance = $\rho \frac{4\ell}{A} : \rho \frac{\ell}{4A}$

$= 4 : \frac{1}{4} = 16 : 1$

now $P = i^2 R$

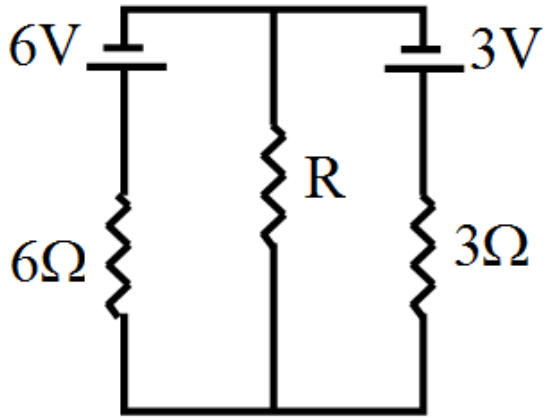
↓

same in both

$\Rightarrow P_1 : P_2 = R_1 : R_2 = 16 : 1$

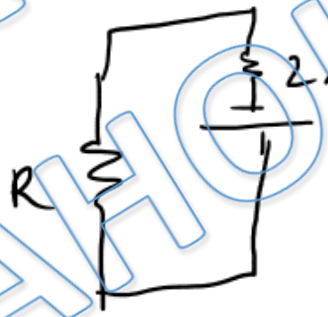
Ans. d

Solution: 15



As batteries are in Parallel combination.

$$E_{net} = \frac{6/6 + 3/3}{1/6 + 1/3} = \frac{2}{1/2} = 4V$$



$$r_{net} = \frac{6 \times 3}{6+3}$$

$$= 2\Omega$$

$$\boxed{R = 2\Omega}$$

⇒ according to maxm power transfer theorem.

Hence A is correct.

Ans. a

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