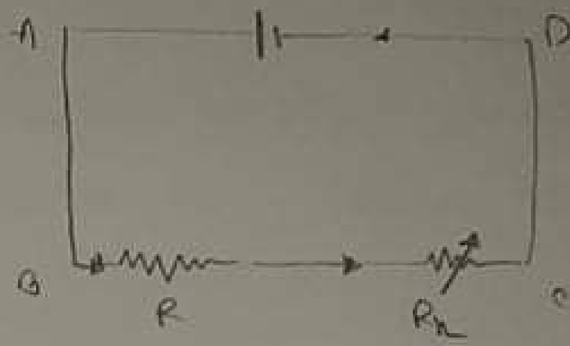
Ans. to the Qno- 'a'

Here, given is,

fixed resistance, $R = 10\Omega$

variable " , $R_h = 2\Omega$



Now,

Current flow of the circuit, $I = \frac{V}{R+R_h}$

$= \left(\frac{12}{10+2}\right) A$

$\therefore I = 1 A.$

$\therefore$ Flow of current in the circuit of fig-1 is 1 A.

Ans. to the Qno- 'b'

Given, variable resistance, $R_h = 2\Omega$

fixed " , $R = 10\Omega$.

Voltage, $V = 12V$

Flow of current, $I = 1 A$ [From 'a']

Now,

Potential drop across R, $V_R = I \cdot R$

$= (1 \times 10) V$

$\therefore V_R = 10 V.$

$\therefore$ Potential drop across R is 10 volts.

Ans. to the Q no-'C'

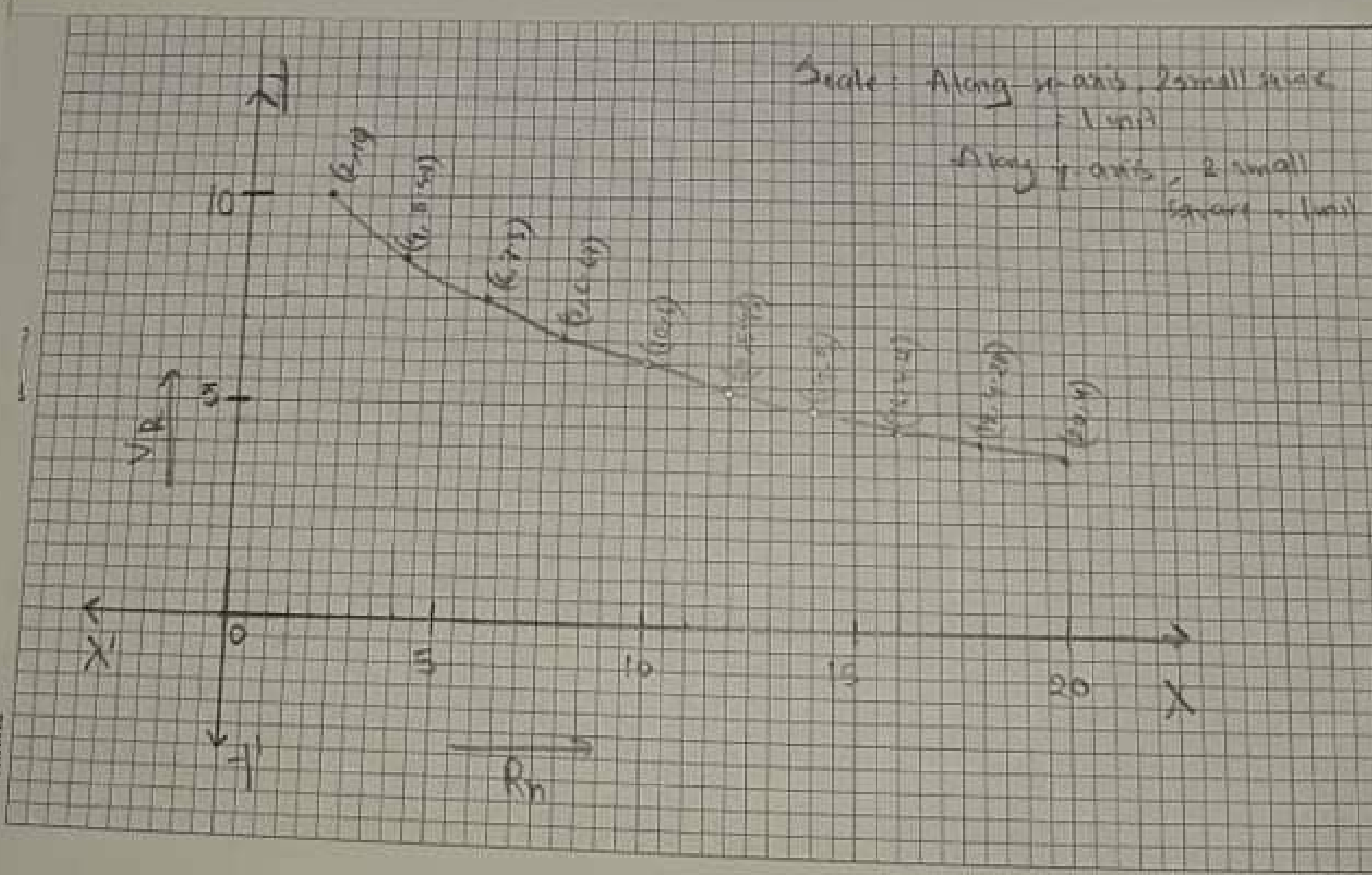
Let, potential drop across R is V_R.

For different values of R_n (from 2 to 20), graph of potential drop across R vs variable resistance R_n is drawn as follows:

We know, Potential drop across R,

$$V_R = \frac{R}{R + R_n} \times V$$

R_n (Ω)	2	4	6	8	10	12	14	16	18	20
V_R (V)	10	8.57	7.5	6.67	6	5.45	5	4.61	4.28	4



Here, XOX' and YOY' represent x-axis and y-axis respectively. Along x-axis and y-axis, 2 small squares = 1 unit. We plot the values of R_h along x-axis and values of V_R along y-axis. Thus required graph is drawn.

In the graph we can see that when the variable resistance R_h is equal to 2Ω, then potential drop across ~~along~~ R is maximum.

$\therefore$ Maximum potential drop across, $R = 10V$.

<u>Ans. to the Qno-'d'</u>

Given, Voltage, $V = 12V$

Fixed Resistance, $R = 10\Omega$

Variable resistance, $R_h = 2\Omega$

Time, $t = 1s$.

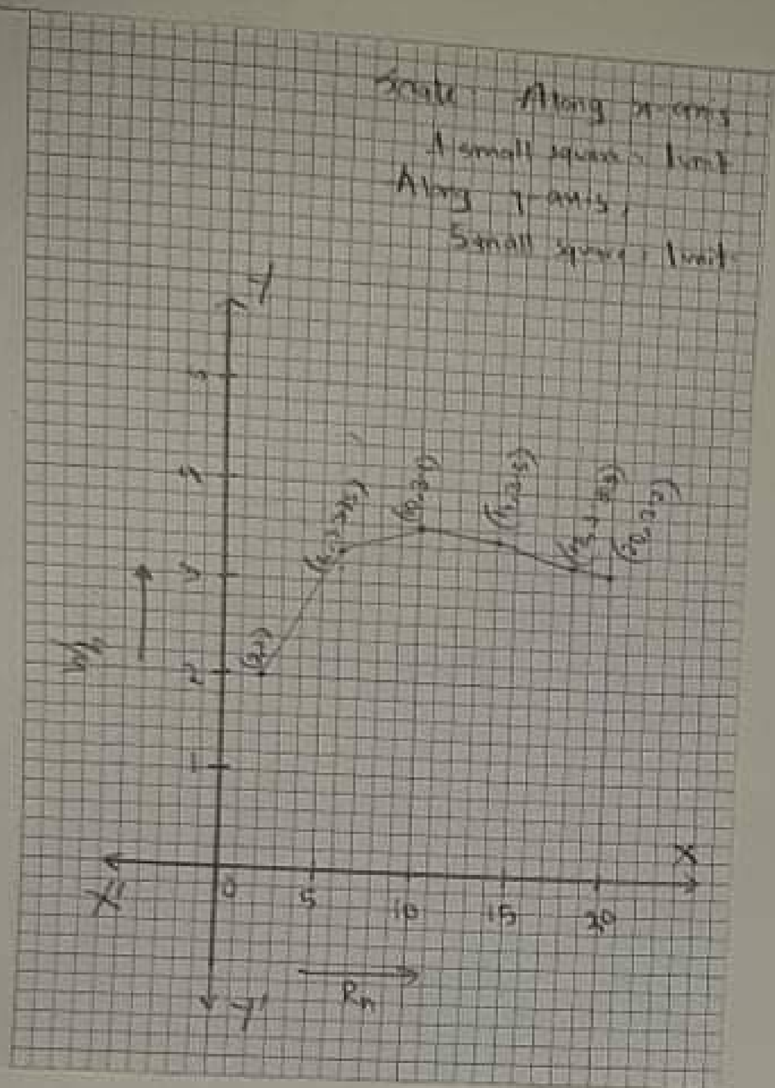
$\therefore$ Current flow, $I = \frac{V}{R+R_h}$.

Again, Heat produced, $W = I^2Rt$

$\therefore$ Heat produced across R_h, $W_h = I^2R_ht$.

Now, for different values of R_h we will find out the values of I then the values of W_h and plot them. The table for the values:

$R_h (\Omega)$	2	6	10	14	18	20
I (A)	1	0.75	0.6	0.5	0.429	0.4
W_h (J)	2	3.375	3.6	3.5	3.313	3.2



Here, XOX' and YOY' represent x-axis and y-axis respectively. O is the origin. Along x-axis, 1 small square = 1 unit and along y-axis, 5 small square = 1 unit. We plot the values of R_h along x-axis and values of W_h along y-axis.

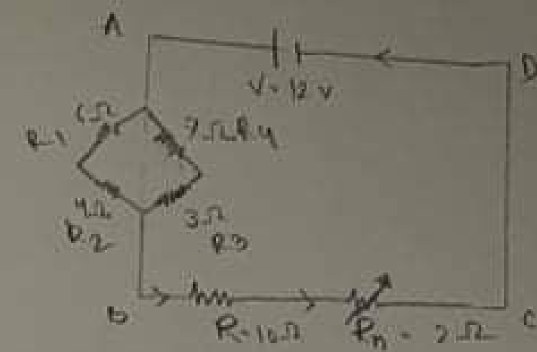
Thus our required graph is drawn.

In the graph, we can see that, when the value of R_h is 10Ω, maximum heat is produced then which is 3.6 J.

∴ Maximum heat produced across R_h Q. per second = 3.6 J.

Ans. to the Qn's 'e'

According to the condition, the circuit of fig-2 is connected with AB part of fig-1.



Here, let,

$R_1 = 6\Omega$

$R_2 = 4\Omega$

$R_3 = \cancel{7\Omega}\ 3\Omega$

$R_4 = 7\Omega$ and $R = 10\Omega$, $R_h = 2\Omega$.

Now, as R_1 and R_2 are connected in series,

$\therefore R_{s_1} = R_1 + R_2$

$= (6+4)\ \Omega$

$\therefore R_{s_1} = 10\Omega$.

Again, R_3 and R_4 are connected in series,

$\therefore R_{s_2} = R_3 + R_4$

$= (7+3)\ \Omega$

$\therefore R_{s_2} = 10\Omega$.

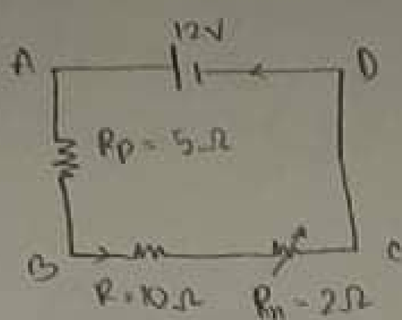
Now, R_{s_1} and R_{s_2} are in parallel connection.

$$\therefore \frac{1}{R_p} = \frac{1}{R_{s_1}} + \frac{1}{R_{s_2}}$$

$$= \frac{1}{10} + \frac{1}{10} = \frac{\cancel{2}}{\cancel{10}}\frac{1}{5}$$

$\therefore R_p = 5\Omega$.

If we draw the circuit again with R_p an equivalent resistance,



Now, Potential drop across R, $V_R' = \frac{R}{R_p + R + R_h} \times V$

$$= \left(\frac{10}{5+10+2} \times 12\right) V.$$

$$= 7.06 \text{ V}.$$

$\therefore$ Potential drop across R, $V_R' = 7.06$ V.

From 'b' we got that, potential difference across R is 10V.

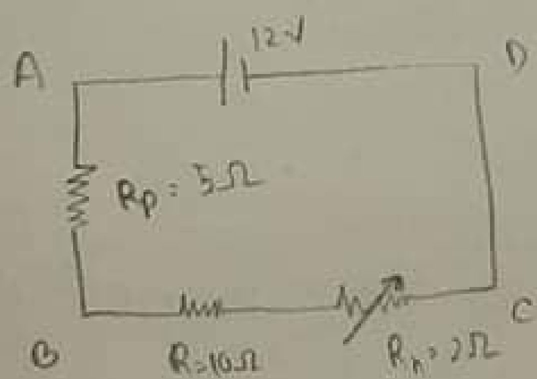
So, we can see that potential difference across R has decreased when circuit of fig. 2 has been added.

So, potential difference will change and the amount of change of potential drop across R $= (10 - 7.06)$ V

$$= 2.94 \text{ V}.$$

Ans. to the Q no. 'f'

From 'e' we get,



Equivalent resistance of the circuit drawn,

$$R_E = R_p + R + R_n$$
$$= (5 + 10 + 2)\ \Omega$$
$$= 17\ \Omega$$

We know, current flow, $I = \frac{V}{R_E}$

$$= \frac{12}{17} = 0.706\ A$$

Produced heat, $W = I^2 R_E t$ [Here, $t = 5s$, $I = 0.706\ A$, $R_E = 17\ \Omega$]

$$= (0.706^2 \times 17 \times 5)\ J$$
$$\therefore W = 42.36\ J$$

Now, mass of water, $m = 5\ kg$.
Specific heat " ", $S = 4200\ J\ kg^{-1} K^{-1}$.

Amount of heat produced, $W = H = 42.36\ J$.

We know,

Heat absorbed by water, $H = ms\Delta\theta$ [where θ is temperature]

$$\text{or, } 42.36 = 5 \times 4200 \times \Delta\theta$$

$$\text{or, } \Delta\theta = \frac{42.36}{5 \times 4200}$$

$$= 2.01 \times 10^{-3}\ K.$$

Again to increase the same amount of temperature in half the time, amount of resistance needed is R.

Time, $t' = \frac{t}{2} = \frac{5}{2} = 2.5\,s$.

Now,

$I^2 R' t' = 42.36$

or, $R' = \frac{42.36}{0.706^2 \times 2.5}$

$= 33.99\ \Omega$

$\therefore R' \approx 34\,\Omega$.

$\therefore$ To increase the same amount of temp. of water in half the time, i.e, in 2.5 s the resistance has to be $34\,\Omega$.

$\therefore$ Change in resistance $= (34-17)\,\Omega$

$= 17\,\Omega$.