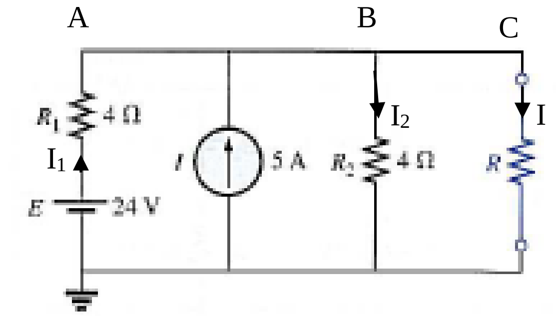
Q- For the network of Figure,

(a) determine the value of R for maximum power to R.

(b) Determine the maximum power to R.



Let the current through the resistance R_1 is I_1, R_2 is I_2 and R is I.

Potential of point A (equal to potential at B and C as well) will be equal to the rise in the potential due to the battery and drop of potential through R_1, hence given by

$V_A = E - I_1R_1 = 24 - 4\ I_1$ ------------------------ (1)

Similarly, the potential at B and C are given by using Ohm's law as

$V_B = V_A = I_2R_2 = 4\ I_2$ ------------------------ (2)

And

$V_C = V_A = IR$ ------------------------ (3)

Applying junction rule to junction B we get

$I_1 + 5 - I_2 - I = 0$ ------------------------ (4)

From equations 1 and 3 we get

$I_1 = (24 - IR)/4$

And from equation 2 and 3 we have

$I_2 = IR/4$

Substituting these values in equation (4) we get

$6 - IR/4 + 5 - IR/4 - I = 0$

Gives $I(1 + R/2) = 11$

Or $I = 22/\ (2+R)$

Hence the power dissipated in R is given by

$$P = I^2R = \left(\frac{22}{2+R}\right)^2 * R = 484 * \frac{R}{(2+R)^2} \text{------ (A)}$$

This power is a function of R and for it to be maximum or minimum

$$\frac{dP}{dR} = 0$$

Or $\frac{(2+R)^2 * 1 - R * 2(2+R)}{(2+R)^4} = 0$

Or $(2 + R)(2 + R - 2R) = 0$

Or $R = 2\Omega$ (negative value of R is not possible)

(b) When resistance R is 2 Ω, the power in it is given by equation A as

$$P = 484 * \frac{2}{(2+2)^2} = 60.5\ W$$