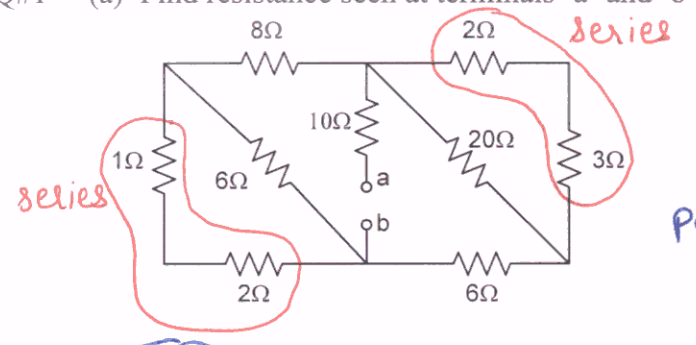
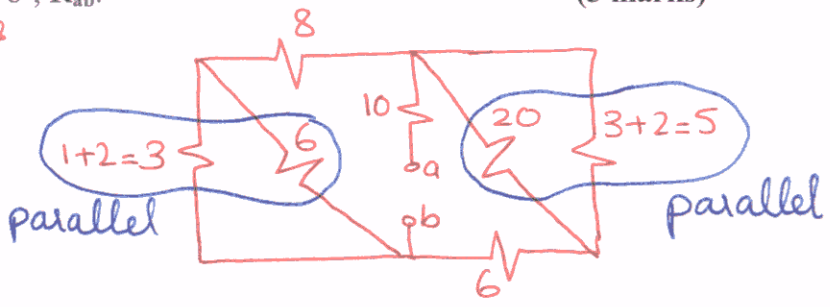
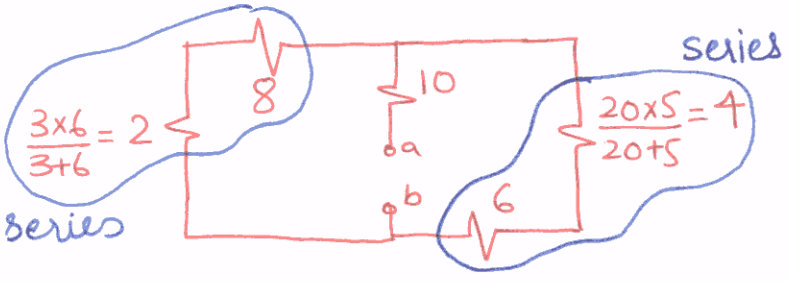
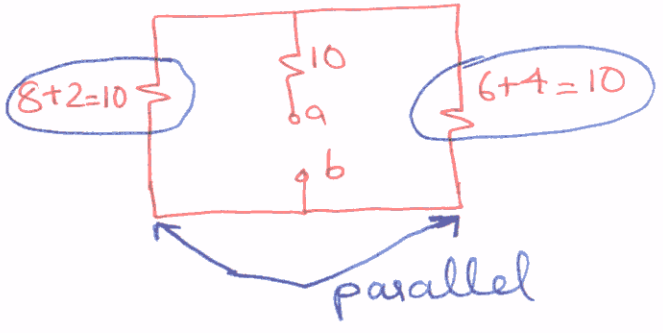
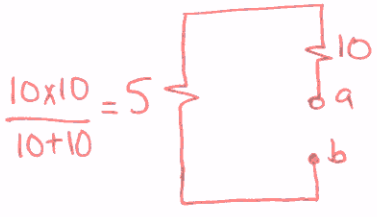
Q#1 (a) Find resistance seen at terminals 'a' and 'b', R_{ab}. **(5 marks)**





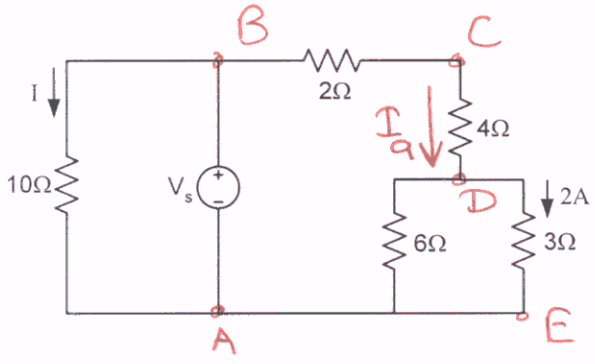






$R_{ab} = 10 + 5 = 15\,\Omega$

(b) If the current through 3Ω resistor is 2A, using current division, KCL and KVL, find the value of **Vs** and **I** **(3 marks)**



Using current division,

$2 = \frac{6}{6+3} \times I_a \Rightarrow I_a = 3A$

Apply KVL in ABCDEA loop

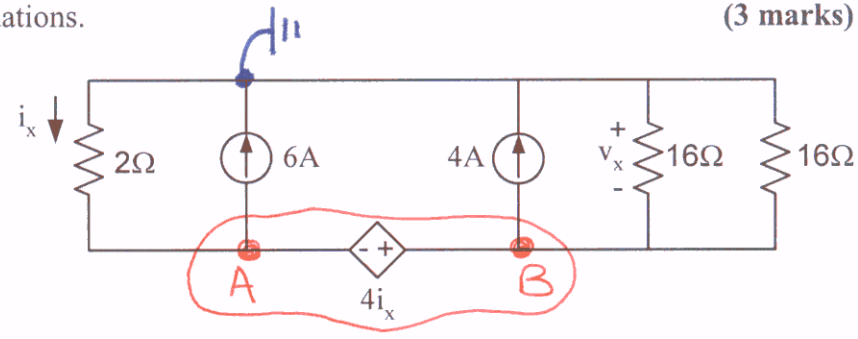
$-V_s + 2I_a + 4I_a + (3)(2) = 0$

$\Rightarrow V_s = 6I_a + 6 \Rightarrow \boxed{V_s = 24 \text{ Volt}}$

$I = \frac{V_s}{10} = \frac{24}{10}$

$\Rightarrow \boxed{I = 2.4\ A}$

Q#2 (a) Identify the nodes and write nodal equations **(5 marks)**
(b) Find v_x and i_x using nodal equations. **(3 marks)**



(a) Identify the nodes

Using supernode at nodes A, B.

$$\frac{V_A}{2} + 6 + 4 + \frac{V_B}{16} + \frac{V_B}{16} = 0$$

$$\Rightarrow 8V_A + 160 + 2V_B = 0 \Rightarrow 8V_A + 2V_B = -160 \quad \text{—— (1)}$$

One more equation is for dependent source.

$$V_B - V_A = 4i_x \quad \text{But } i_x = -\frac{V_A}{2}$$

$$\Rightarrow V_B - V_A = -2V_A \Rightarrow V_A + V_B = 0 \quad \text{—— (2)}$$

(b) Solve eq (1) & (2) simultaneously.

$$(1) \times 1 \Rightarrow 8V_A + 2V_B = -160$$

$$(2) \times 2 \Rightarrow -2V_A - 2V_B = 0$$

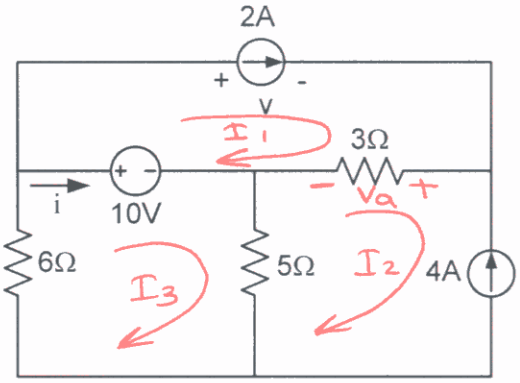
$$6V_A = -160 \Rightarrow V_A = -\frac{80}{3} = -26.67$$

$$\therefore V_B = +\frac{80}{3} = +26.67$$

$$v_x = -V_B = -26.67\ V$$

$$i_x = -\frac{V_A}{2} = +13.34\ A$$

Q#3 (a) Write mesh equations for the following circuit. **(5 marks)**
(b) Find power of 2A and 10V sources. Indicate if the power is absorbed or delivered. **(3 marks)**



(a) $I_1 = 2A$; $I_2 = -4A$.

KVL in mesh I_3

$+10+5(I_3-I_2)+6I_3=0$

$\Rightarrow 10+5(I_3+4)+6I_3=0$

$\Rightarrow 11I_3 = -30 \Rightarrow I_3 = \frac{-30}{11} = -2.72\ A$.

(b) Apply KVL in loop I_1

$+V+V_a-10=0 \Rightarrow V+3(I_1-I_2)-10=0$

$\Rightarrow V = 10-3(2+4) \Rightarrow \boxed{V=-8\ V}$

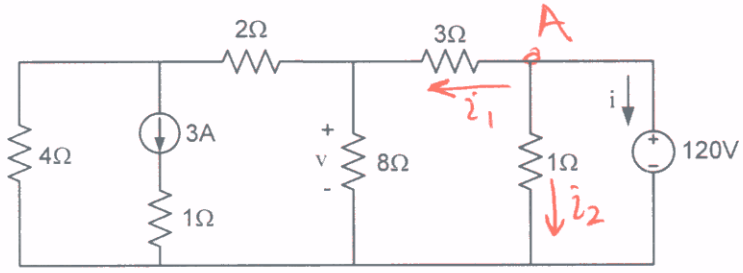
$\therefore P_{2A} = +(2)(V) = -16\ W$ (delivered).

$P_{10V} = +(10)(i) = +(10)(I_3-I_1)$

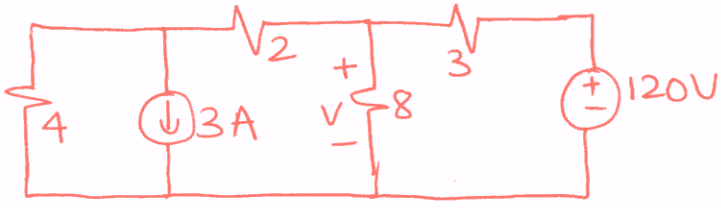
$= +(10)(-2.72-2) = -47.2\ W$ (delivered)

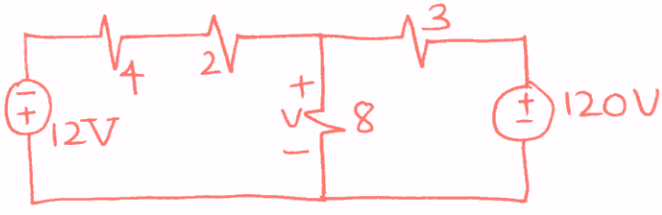
Q#4 (a) Use source transformation to reduce the following circuit as much as possible and find **v** from the reduced circuit **(4 marks)**

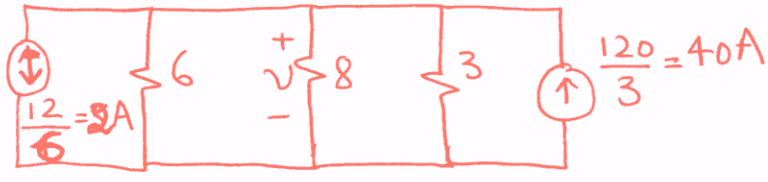
(b) After finding **v** use the original circuit, given below, to find **i**. **(2 marks)**



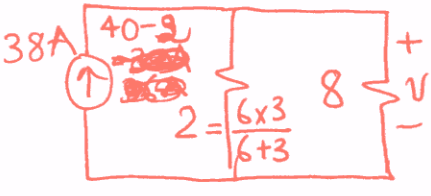
(a) Resistance in series with current source & resistance in parallel with voltage source can be removed.







Combine two current source in parallel & 6 & 3Ω in parallel



$V = \left[\frac{2}{2+8}\times 38\right]\times 8 = 60.8\,V$.

(b) From original circuit

$i_1 = \frac{120-V}{3} = \frac{120-60.8}{3}$

$i_1 = 19.73\,A$

$i_2 = \frac{120}{1} = 120\,A$.

Apply KCL at A.

$i_1 + i_2 + i = 0$

$\Rightarrow i = -i_1 - i_2$

$\Rightarrow \boxed{i = -139.73\,A}$