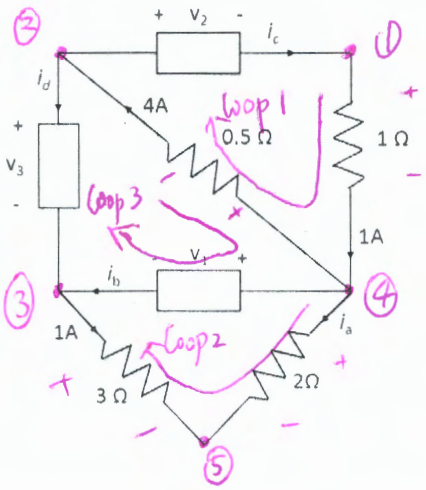
Homework 3

Problem 1 (7 pt)

In the circuit below, you are given numerical values for some of the branch voltages and branch currents. (The box indicates an unknown active device). Use KCL and KVL to find the missing branch voltages (v_1, v_2, v_3) and currents (i_a, i_b, i_c, i_d). Please show your detailed work.



KCL: @ ① : $i_c - 1 = 0 \Rightarrow i_c = 1\ A$

② : $-i_c - i_d + 4 = 0 \Rightarrow i_d = 3\ A$

③ : $i_d + i_b - 1 = 0 \Rightarrow i_b = -2\ A$

④ : $-i_b - i_a - 4 + 1 = 0 \Rightarrow i_a = -1\ A$

or: ⑤ : $i_a + 1 = 0$

KVL:

loop 1 : $-(1\times1) - (4\times0.5) - V_2 = 0 \Rightarrow V_2 = -3\ V$

loop 2 : $-(-1\times2) + (1\times3) + V_1 = 0 \Rightarrow V_1 = -5\ V$

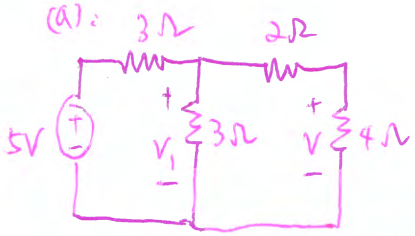
loop 3 : $+(4\times0.5) - V_1 + V_3 = 0 \Rightarrow V_3 = -7\ V$

Problem 2 (6 pt)

In the following circuits, use the concepts of voltage divider and equivalent resistance to determine the branch voltage v in each case. Please show your detailed work.

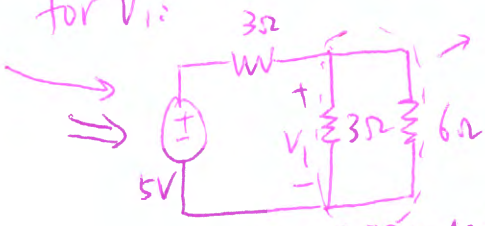
Problem 2

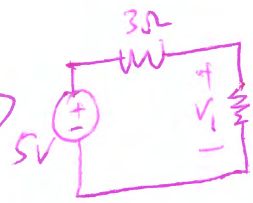
(a):



⇒ If I know V_1, then: $V = \frac{4}{4+2} \cdot V_1$ (voltage divider) ; So key is to find V_1

for V_1:



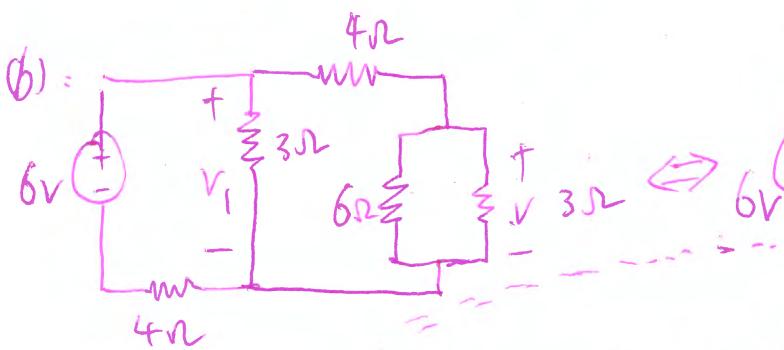


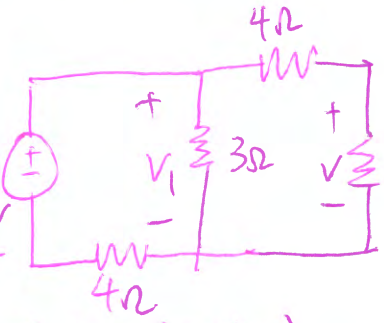
$Req = \frac{3\times6}{3+6} = 2\Omega$

So: $V_1 = \frac{Req}{Req+3} \times 5V = \frac{2}{2+3} \cdot 5V = 2(V)$ (Voltage Divider)

So: $V = \frac{4}{4+2} \cdot V_1 = \frac{2}{3} \times 2(V) = \underline{\frac{4}{3}(V)}$

(b):

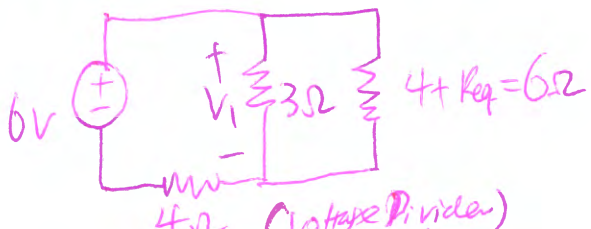




$Req = \frac{6\times3}{6+3} = 2\Omega$

If I know V_1, then $V = \frac{Req}{Req+4} \cdot V_1$ (Voltage Divider) ; So the key is to find V_1

for V_1:



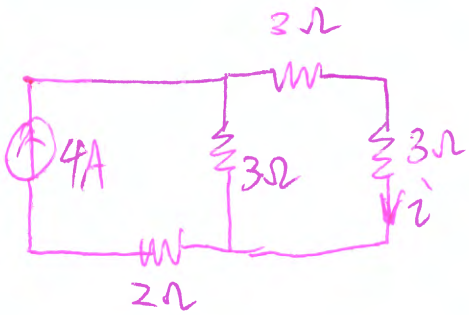
$4 + Req = 6\Omega$ ⇒

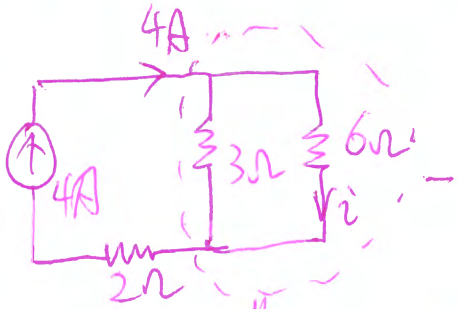
$Req' = \frac{3\times6}{3+6} = 2\Omega$

So: $V_1 = \frac{Req'}{Req'+4\Omega} \cdot 6V = \frac{2}{2+4} \times 6 = \underline{2(V)}$ (Voltage Divider)

Problem 3

(a):

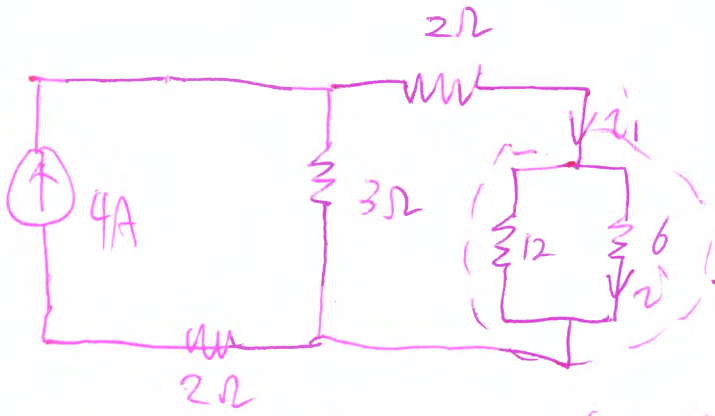




Current Divider:

$$i = \frac{3}{3+6} \times 4A = \frac{4}{3}(A)$$

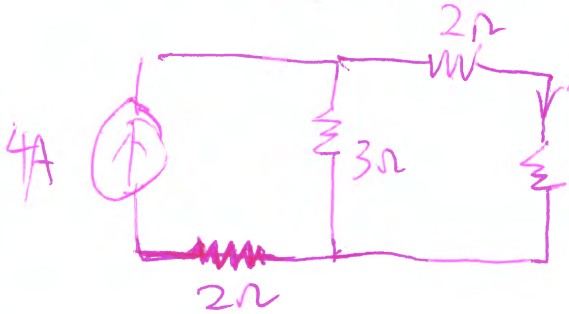
(b)

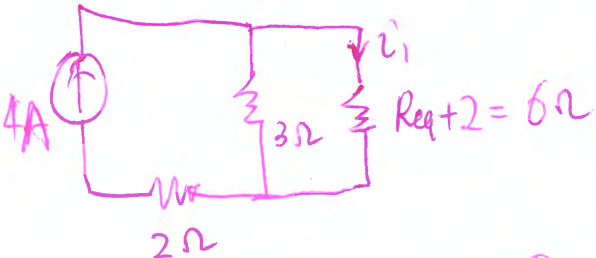


I can use current Divier when I get value i_1

$$i = \frac{12}{12+6} \cdot i_1$$

to get i_1





So $i_1 = \frac{3}{3+6} \times 4A = \frac{4}{3}(A)$

So:

(b) $i = \frac{12}{12+6} \times \frac{4}{3}(A) = \frac{8}{9}(A)$