

# HW#3 solutions

①

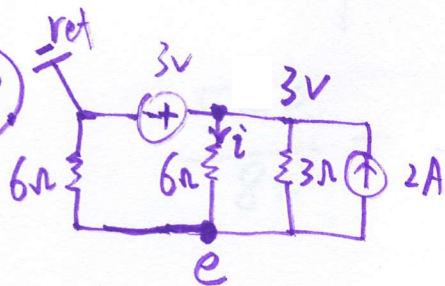
$$kcl @ e_1 : \frac{10-e_1}{4} + \frac{e_2-e_1}{8} + \frac{0-e_1}{2} = 0$$



$$kcl @ e_2 : \frac{10-e_2}{10} + \frac{0-e_2}{4} - \frac{e_2-e_1}{8} = 0$$

$$\Rightarrow e_1 = 3.28; e_2 = 2.96 V$$

②



(1)

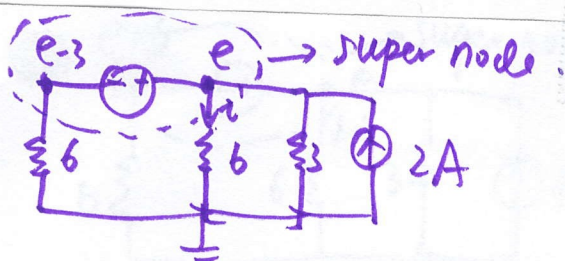
kcl @ "e"

$$\frac{0-e}{6} + \frac{3-e}{6} + \frac{3-e}{3} - 2 = 0$$

$$\Rightarrow e = -\frac{3}{4} V$$

$$\Rightarrow i = \frac{3 - (-\frac{3}{4} V)}{6 \Omega} = 0.625 (A)$$

(0v)



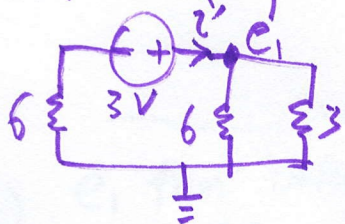
kcl @ super node:

$$\frac{0-e}{6} + \frac{0-e}{3} + 2 + \frac{0-(e-3)}{6} = 0$$

$$\Rightarrow e = \frac{15}{4} (V) \Rightarrow i = \frac{\frac{15}{4}}{6 \Omega} = 0.625 (A)$$

(2) Superposition:

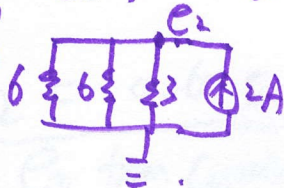
$e_1$  from Voltage source:



$$i' = \frac{3V}{6\Omega + (3\Omega || 6\Omega)} = \frac{3}{8} (A)$$

$$e_1 = i' \cdot (6\Omega || 3\Omega) = \frac{3}{8} A \cdot 2\Omega = \frac{3}{4} (V)$$

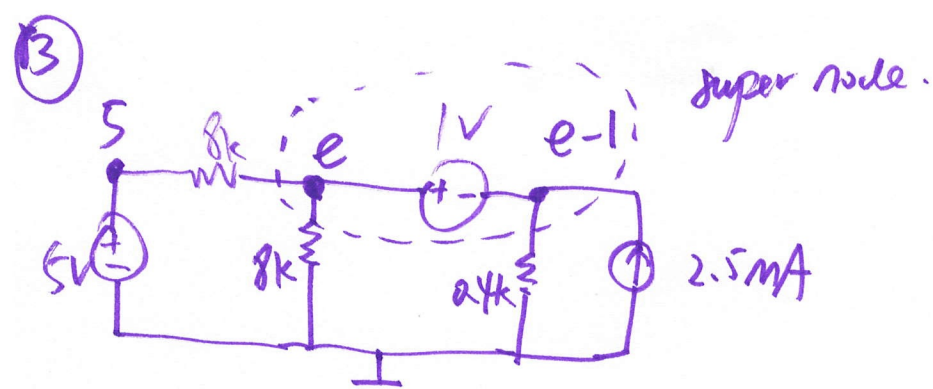
$e_2$  from Current source:



$$e_2 = 1 \cdot (3\Omega || 6\Omega || 6\Omega) = 2(A) \cdot 1.5\Omega = 3V$$

$$So, e = e_1 + e_2 = \frac{3}{4} + 3 = 3.75 (V)$$

$$i = \frac{e}{6\Omega} = \frac{3.75}{6\Omega} = 0.625 (A)$$



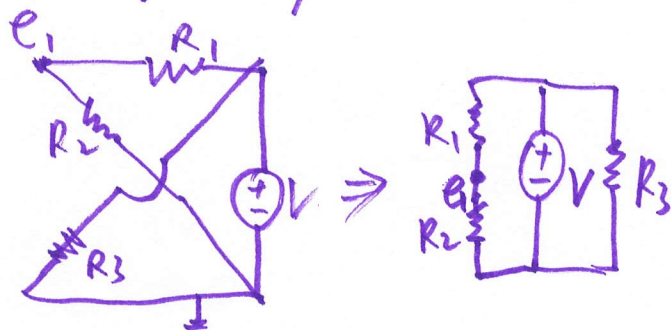
Kcl @ super node:

$$\frac{5-e}{8k} + \frac{0-e}{8k} + \frac{0-(e-1)}{0.4k} + 2.5mA = 0$$

$$\Rightarrow \frac{5-e}{8} + \frac{-e}{8} + \frac{1-e}{0.4} + 2.5 = 0$$

$$\Rightarrow 5.625 - 2.75e = 0 \quad \Rightarrow e = 2.04 \text{ (V)}$$

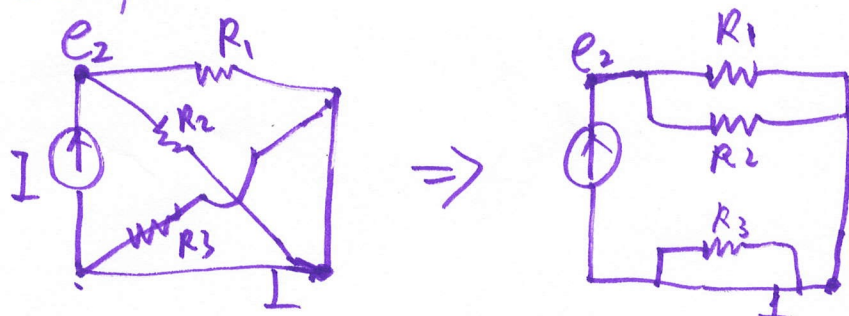
④  $e_1$  from voltage source:



Voltage Divider:

$$\Rightarrow e_1 = \frac{R_2}{R_1 + R_2} \cdot V$$

$e_2$  from current source:



$$e_2 = \frac{R_1 R_2}{R_1 + R_2} \cdot I$$

$$\text{So: } e = e_1 + e_2 = \frac{R_2 V}{R_1 + R_2} + \frac{R_1 R_2 I}{R_1 + R_2}$$