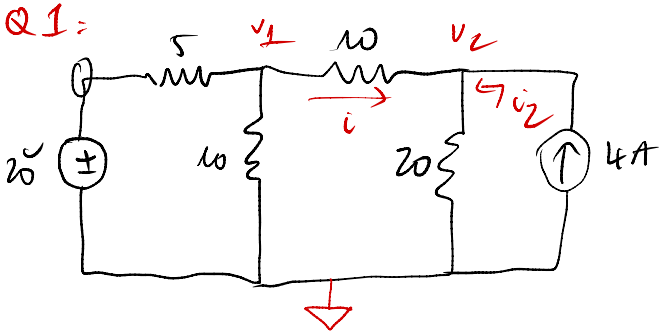
Time : 90 minutes

Note A 4

Content : All

Q1:



$$\frac{v_1 - 20}{5} + \frac{v_1 - v_2}{10} + \frac{v_1}{10} = 0$$

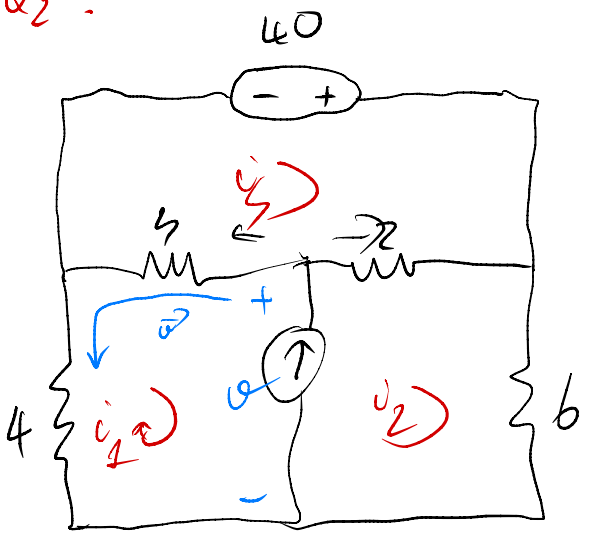
$$\frac{v_2 - v_1}{10} + \frac{v_2}{20} - 4 = 0$$

$$\Rightarrow \begin{cases} v_1 = 20 \text{ V} \\ v_2 = 40 \text{ V} \end{cases}$$

b) $I = \frac{v_1 - v_2}{10} = 2 \text{ A}$

c) $P_{4A} = -v_I = (40)(-4) = -160 \text{ W}$

Q_2 :

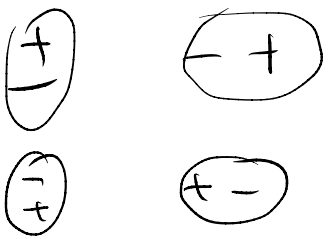


a) Mesh

b) P_{40V}

c) $v = ?$

$i_2 - i_1 = 16^A$ (4)



a) Loop 3: $2(i_3 - i_2) + 3(i_3 - i_1) = 40$ (1)

Loop (1)(2): $4i_1 + 3(i_1 - i_3) + 2(i_2 - i_3) + 6 = 0$ (2)

(1)(2)(4) $\Rightarrow$

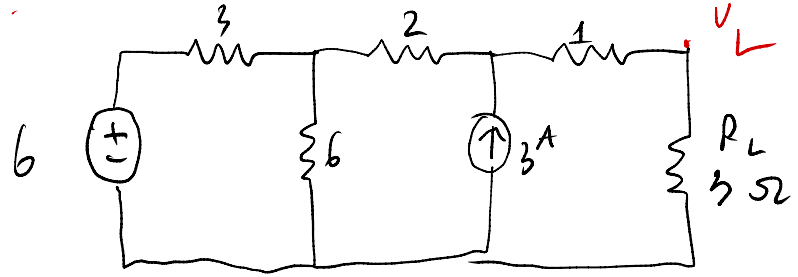
$$\begin{cases} i_1 = -5.6^A \\ i_2 = 10.4^A \\ i_3 = 8.8 \end{cases}$$

b) $P_{40V} = -IV = (-8.8)(40) = -352\ W$

c) $v = 3(i_3 - i_1) - 4i_1 =$

or $v = 2(i_2 - i_3) + 6i_2 =$

Q5:

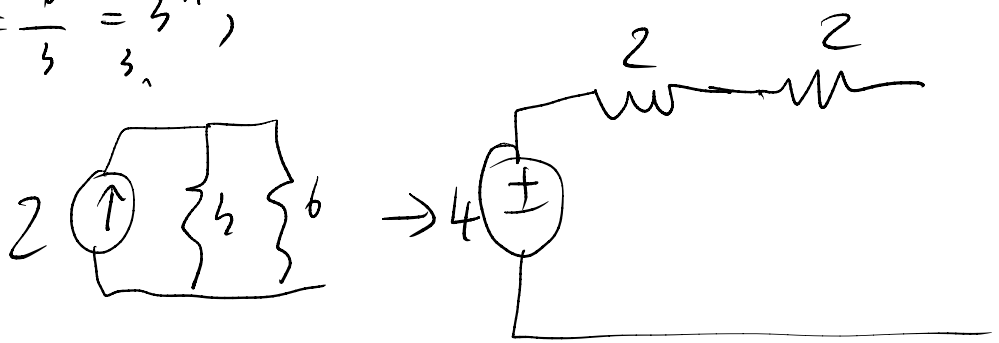


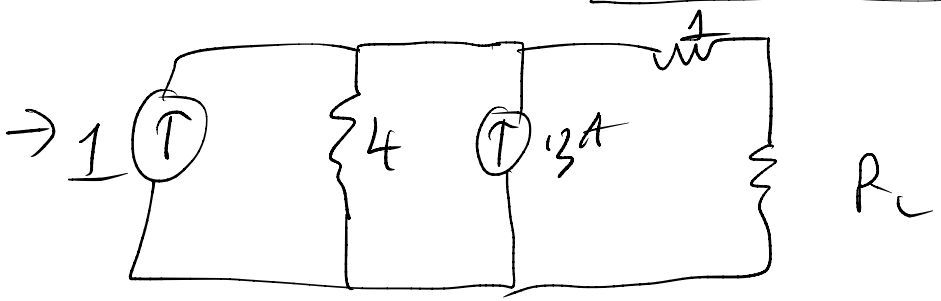
V_L

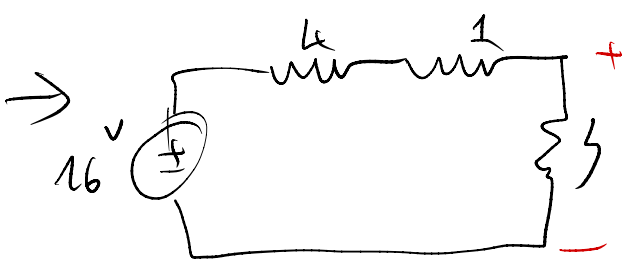
a) v_{R_L} =

b) P_{3A} =

$$I = \frac{6}{3} = 3^A$$





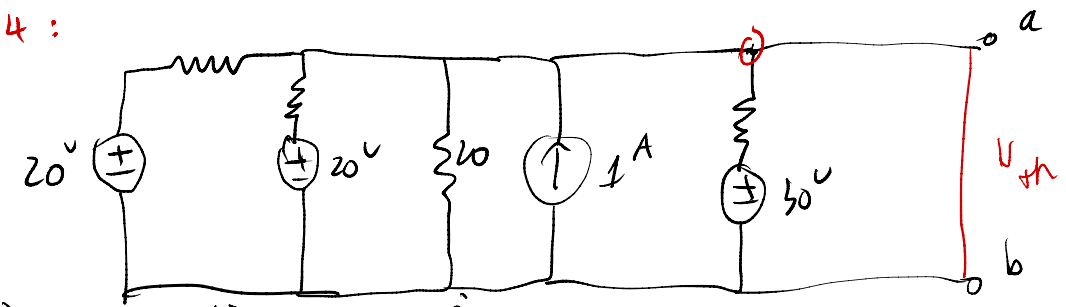


$$V_L = 16 \frac{3}{4+1+3} = 6^V$$

$$P_{3A} = -3^A \times 8 = -24^W$$

$$v = 2(1+3) = 8^V$$

Q 4 :

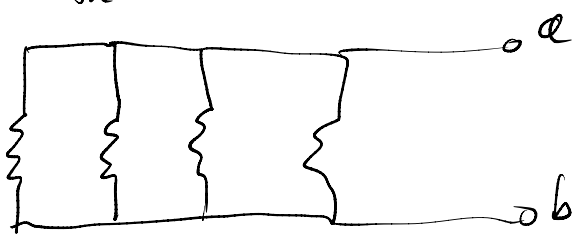


a) V_{th} b) P_{max} R_L ?

$$\frac{V_{th}-20}{20}+\frac{V_{th}-20}{10}+\frac{V_{th}}{10}-1+\frac{V_{th}-30}{10}=0$$

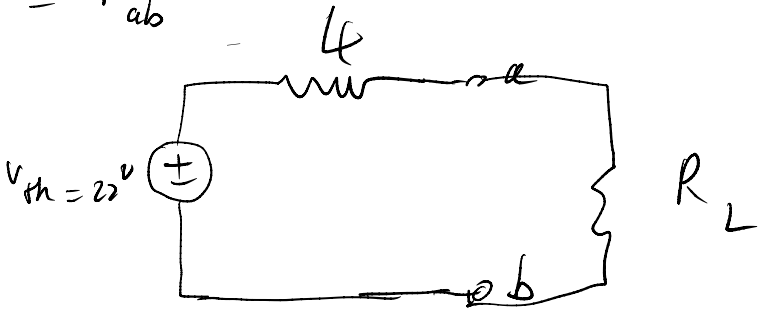
$$\Rightarrow V_{th}=22\,V$$

b)



$$R_{th}=R_{ab}=4\,\Omega$$

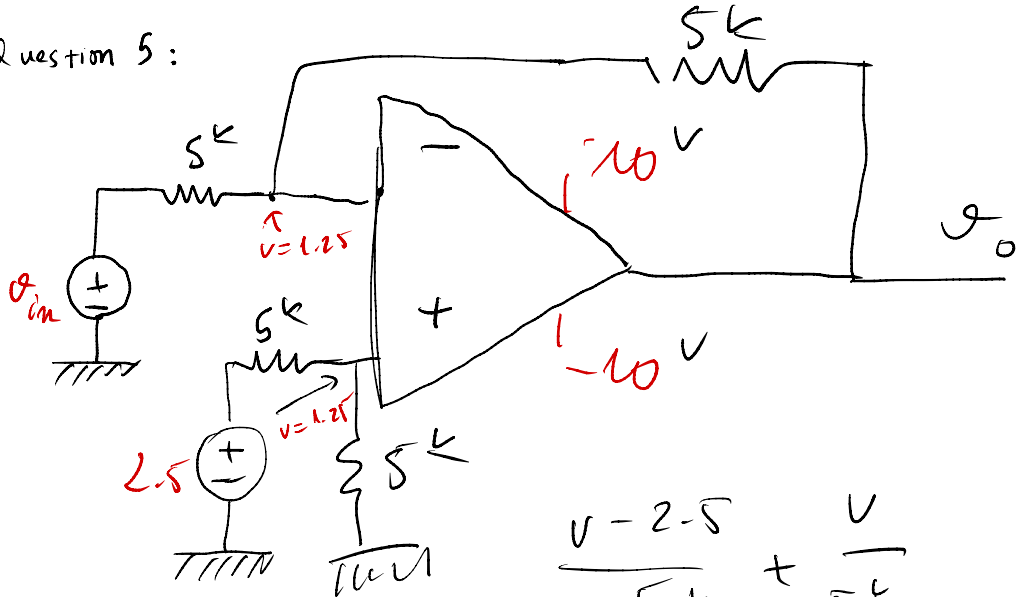
c)



When $R_L=R_{th}=4\,\Omega$

$$P_{R_L\,max}=\frac{V_{th}^2}{4R_L}=30.25\,W$$

Question 5 :



$$\frac{V - 2.5}{5k} + \frac{V}{5k}$$

$$\Rightarrow V = 1.25$$

$$v_o = \frac{5k \times 10k}{5k \times 10k} \times 2.5 - \frac{5k}{5k} v_A$$

(2) $v_o = 2.5 - v_A$

(=) $2.5 - v_A = 10 \Rightarrow v_A = -7.5$ V

$2.5 - v_A = -10 \Rightarrow v_A = 12.5$ V

Difference Amplifier Circuit

$$-19 + i_a(4+6) + i_2(2.5+7.5) + i_3(2+8) + 0.8v_0 + 0.8(-7.5i_b) - 6i_b$$

$$= 10i_a + 4i_b + 10i_c = 19 \quad (1)$$

$v_0 = 2i_c$

$$0.4v_0 = i_b - i_a$$

$$\Leftrightarrow 0.8i_c = i_b - i_a$$

$$\Leftrightarrow -i_a + i_b - 0.8i_c = 0 \quad (2)$$

$$0.5 = i_c - i_a \quad (4)$$

$$\Rightarrow \begin{cases} i_1 = 2 \\ i_2 = 4 \\ i_3 = 2.5 \end{cases}$$

a)

$$v_o = -\left(\frac{250}{5} \times 0.1 + \frac{250}{25} \times 0.25\right) = -7.5\ V$$

b) If $v_b = 0.25\ V$, how large be v_a before saturation:

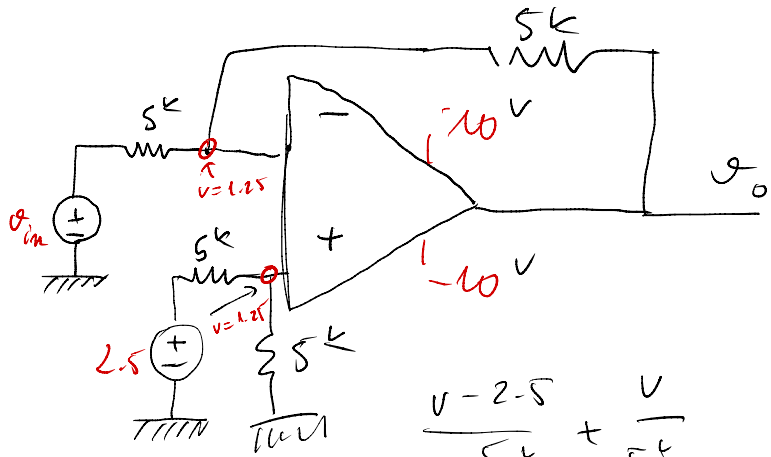
$$v_o = -\left(\frac{250}{5} v_a + \frac{250}{25} \times 0.25\right) = \begin{cases} -10 \\ 15 \end{cases}$$

$$\rightarrow v_a = 0.15\ V$$

$$v_a = -0.35 \qquad \Rightarrow 0.15 \leq v_a \leq 0.15\ V$$

$$\frac{v_b - 1.5}{25k} + \frac{v_b - (-10)}{100k} = -0.8\ V$$

$$v_o = 10 \rightarrow v_b = 2.2\ V$$



$$\frac{v - 2.5}{5k} + \frac{v}{5k} = 0 \Rightarrow v = 1.25^{k}$$

$$\frac{v_b - 2.5}{5k} + \frac{v_b}{5k} = 0 \Rightarrow v_b = 1.25^{V}$$

Node I: $\frac{1.25 - v_a}{5k} + \frac{1.25 - (-10)}{5k} = 0$

$$\Rightarrow v_a = -7.5^{V}$$

$v_o = 10 \rightarrow v_2 = 12.5^{V}$