

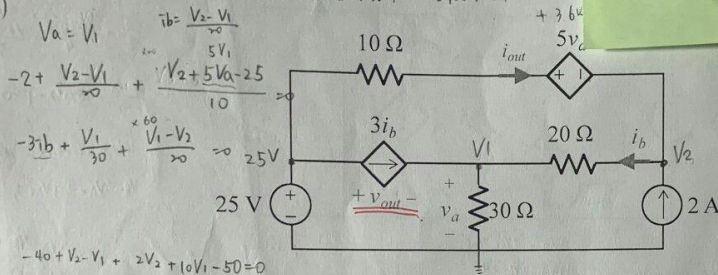
電路學 104
 期中考 (2015 年 11 月 10 日)
 學號:

系級:

1. 求下圖電路的:

- (a) (10%) 輸出電壓 v_{out} 。 ≈ 5.72
 (b) (10%) 輸出電流 i_{out} 。 $-1.94A$
 (c) (10%) 控制電壓源 $5v_a$ 的功率。 $-69.84W$

(a)



$$-40 + v_2 - v_1 + 2v_2 + 10v_1 - 50 = 0$$

$$-180i_b + 2v_1 + 3v_1 - 3v_2 = 0$$

$$9v_1 + 3v_2 = 90$$

$$-9v_2 + 9v_1 + 3v_1 - 3v_2 = 0$$

$$14v_1 - 12v_2 = 0$$

$$36v_1 + 12v_2 = 360$$

$$50v_1 = 360$$

$$v_1 = 7.2$$

$$v_2 = 8.4$$

$$v_{out} = 5.72V$$

$$i_b = \frac{v_2 - v_1}{20} = 0.16A$$

$$3i_b = 0.48A$$

$$i_{out} = 0.48A$$

$$v_a = v_1 = 7.2V$$

$$5v_a = 36V$$

$$P = 5v_a \cdot i_{out} = -69.84W$$

$$v_a = 7.2V$$

$$v_b = -v_c$$

$$-1m + \frac{v_a}{30k} + \frac{v_b - v_c}{6k} = 0$$

$$-30 + v_a + 5v_b - 5v_c = 0 \rightarrow 6v_a - 5v_b = 30$$

$$\frac{v_b - v_a}{6k} + \frac{v_b}{1k} + \frac{v_b - v_c}{36k} - 4m(V_a - V_b) = 0$$

$$6v_b - 6v_a + 36v_b + v_b - v_c - 144v_a + 144v_b = 0$$

$$144v_a - 144v_b + v_c - v_b + 9v_c + 3v_c - 3v_b = 0$$

$$144v_a - 144v_b + v_c - v_b + 9v_c + 3v_c - 3v_b = 0$$

$$144v_a - 144v_b + v_c - v_b + 9v_c + 3v_c - 3v_b = 0$$

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$$144v_a - 144v_b + v_c - v_b + 9v_c + 3v_c - 3v_b = 0$$

$$144v_a - 144v_b + v_c - v_b + 9v_c + 3v_c - 3v_b = 0$$

$$120 - 24v_b + 30 = +v_b$$

$$25v_b = 150$$

$$v_b = 6V$$

$$6k \left(\frac{40 - 144v_a}{1k} + 11.5m \right) = -v_a$$

$$2520 - 864v_a + 69 = -v_a$$

$$863v_a = 2589$$

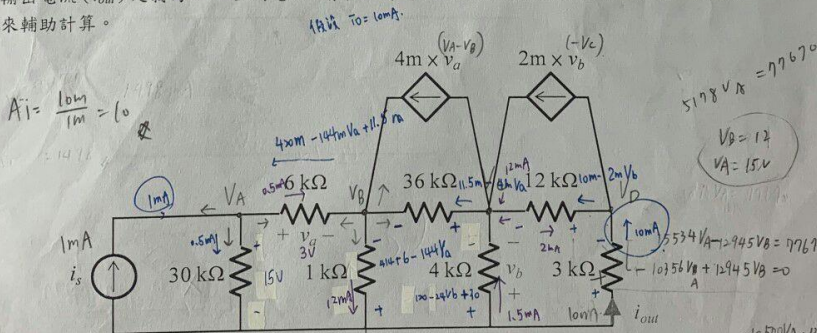
$$v_a = 3$$

$$-1.94 \times 36 = -69.84$$

$$\frac{25 - 36 - 8.4}{10} = -1.94$$

(b)

(20%) 下圖電路為一電流放大器。其電路目的為將獨立電流源的電流 (i_s) 放大 A_i 倍，其中輸出電流 (i_{out}) 定義為 $3k\Omega$ 上的電流。請求出 A_i 。提示：可自行指定 i_s 的數值 (如 $i_s = 1mA$) 來輔助計算。



$$A_i = \frac{10m}{1m} = 10$$

$$v_a = v_A - v_B$$

$$v_b = -v_c$$

$$-1m + \frac{v_a}{30k} + \frac{v_a - v_b}{6k} = 0$$

$$-30 + v_a + 5v_a - 5v_b = 0 \rightarrow 6v_a - 5v_b = 30$$

$$\frac{v_b - v_a}{6k} + \frac{v_b}{1k} + \frac{v_b - v_c}{36k} - 4m(V_a - V_b) = 0$$

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$$144v_a - 144v_b + v_c - v_b + 9v_c + 3v_c - 3v_b = 0$$

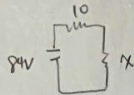
$$144v_a - 144v_b + v_c - v_b + 9v_c + 3v_c - 3v_b = 0$$

$$144v_a - 144v_b + v_c - v_b + 9v_c + 3v_c - 3v_b = 0$$

$$144v_a - 144v_b + v_c - v_b + 9v_c + 3v_c - 3v_b = 0$$

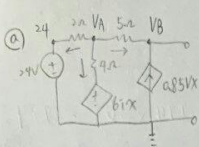
$$144v_a - 144v_b + v_c - v_b + 9v_c + 3v_c - 3v_b = 0$$

$$144v_a - 144v_b + v_c - v_b + 9v_c + 3v_c - 3v_b = 0$$



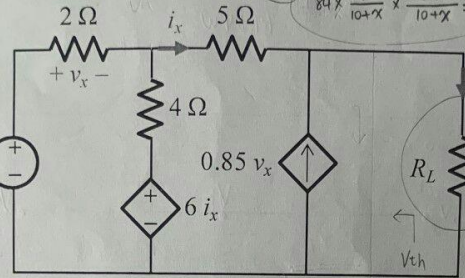
3. 考慮如下圖所示之電路。

- (a) (10%) 當 $R_L = 32 \Omega$ 時，求輸出電流 i_{out} 的數值。
 (b) (10%) 若想要使輸出電壓 $v_{out} = 20V$ ，求此時負載電阻 R_L 的數值。
 (c) (10%) 若想要使輸出電流 $i_{out} = 5A$ ，求此時負載電阻 R_L 的數值。
 (d) (10%) 若想要使負載電阻 R_L 的輸出功率 $= 176.4W$ ，求此時負載電阻 R_L 的數值。



$$\frac{V_A - V_B}{5} + \frac{V_A - 6ix}{4} + \frac{V_A - V_B}{5} = 0$$

$$\frac{V_A - V_B}{5} - 0.85V_x = 0$$



$$13V_A + 4V_B = 408$$

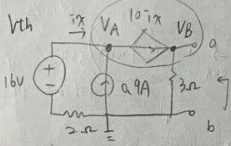
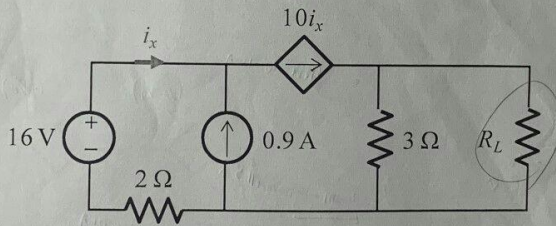
$$13V_A + 2V_B = 240$$

$$3.25V_A - V_B = 102$$

$$V_B - V_A = 102 + 0.25V_A = 0$$

$$2V_B = 168 \quad V_B = 84$$

4. (10%) 考慮如下圖所示之電路。若此負載電阻 R_L 試圖從此電路汲取最大的輸出功率，那麼 $6.5V_A = -10$ R_L 的電阻值應等於多少歐姆？

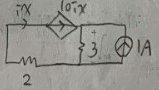
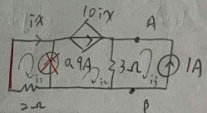


$$-ix - 0.9 + 10ix = 0$$

$$9ix = 0.9$$

$$ix = 0.1A$$

$$V_i = 3V$$



$$10ix = ix \Rightarrow ix = 0 \rightarrow \text{短路}$$

$$3\Omega$$

(因沒有迴路)

$V=0 \rightarrow \text{短路}$