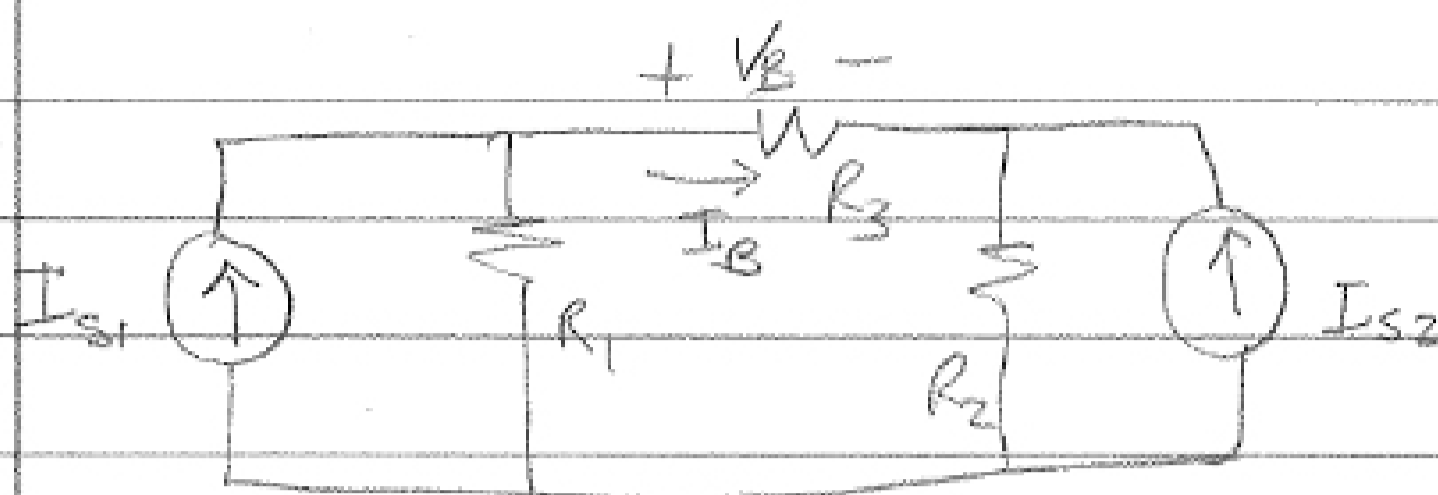


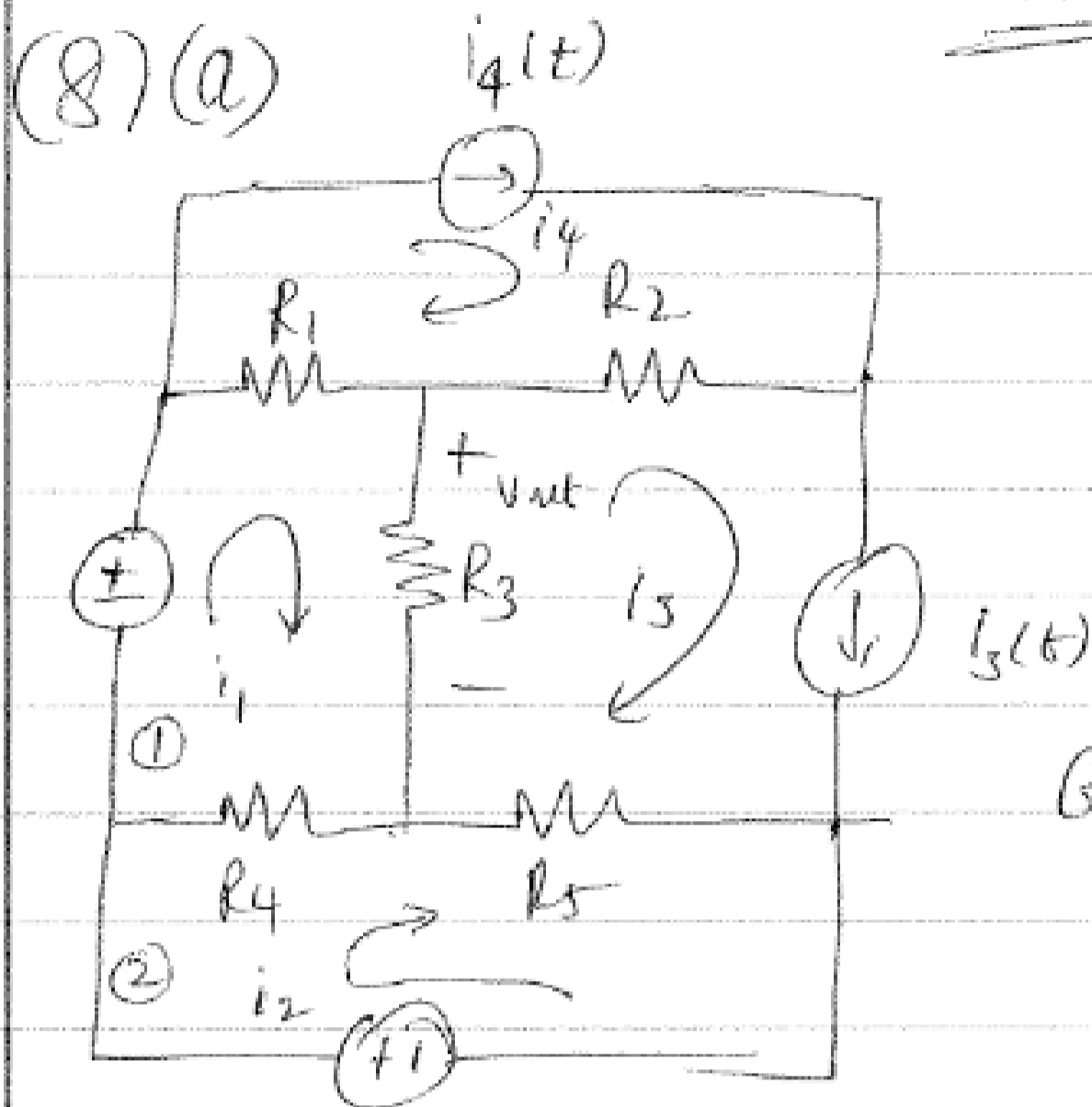
5-3



$$(a) \quad I_B = I_{s1} \frac{R_1}{R_1 + (R_2 + R_3)} - I_{s2} \frac{R_2}{R_2 + (R_1 + R_3)}$$

$$(b) \quad V_B = I_{s1} \frac{R_1}{R_1 + R_2 + R_3} R_3 - I_{s2} \frac{R_2}{R_2 + R_1 + R_3} R_3$$

HW-10



Assume i_1, i_2 be the currents in loops with sources $V_1(t), V_2(t)$ respectively

Given

$$R_1 = 18\Omega \quad R_2 = 9\Omega \quad R_3 = 18\Omega$$

$$R_4 = 36\Omega \quad R_5 = 18\Omega$$

Writing KVL for loop ①

$$V_1 = R_1(i_1 - i_4) + R_3(i_1 - i_3) + R_4(i_1 - i_2)$$

$$\Rightarrow V_1 = i_1(R_1 + R_3 + R_4) - R_4 i_2 - R_3 i_3 - R_1 i_4$$

$$\Rightarrow V_1 = 72i_1 - 36i_2 - 18i_3 - 18i_4 \quad \text{--- ①}$$

Writing KVL for ②

$$V_2 = R_4(i_2 - i_1) + R_5(i_2 - i_3)$$

$$= i_2(R_4 + R_5) - R_4 i_1 - R_5 i_3$$

$$\Rightarrow V_2 = -36i_1 + 54i_2 - 18i_3 \quad \text{--- ②}$$

$$\text{②} \Rightarrow i_2 = \frac{V_2 + 36i_1 - 18i_3}{54} \quad \text{--- ③}$$

Sub i_2 from ③ in ①

$$V_1 = 72i_1 - 18i_3 - \frac{2}{3}[V_2 + 36i_1 - 18i_3] - 18i_4$$

Rearranging

$$i_1 = \frac{V_1 + \frac{2}{3}V_2 + 30i_3 + 18i_4}{48} \quad \text{--- ④}$$

We know

$$V_{out} = (i_1 - i_3) R_3 \quad \text{--- (5)}$$

Sub i_1 from (4) in (5)

$$V_{out} = \left[\frac{V_1 + \frac{2}{3} V_2 + 30i_3 + 18i_4}{48} - i_3 \right] 18$$

$$\Rightarrow V_{out} = \frac{V_1 + \frac{2}{3} V_2 - 18i_3 + 18i_4}{\cancel{48} 8} \quad \cancel{18} 3$$

$$\Rightarrow V_{out} = \frac{3}{8} V_1 + \frac{1}{4} V_2 - \frac{27}{4} i_3 + \frac{27}{4} i_4$$

Note: The problem can also be solved using superposition theorem.

The solution is given below