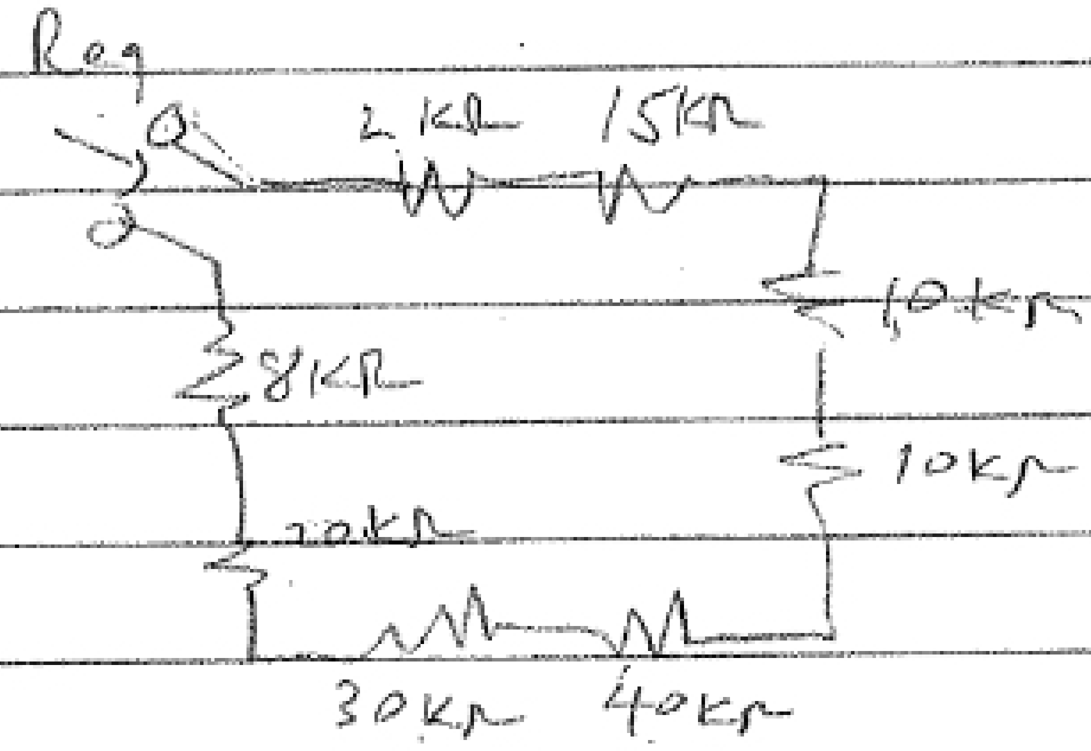
HW #6

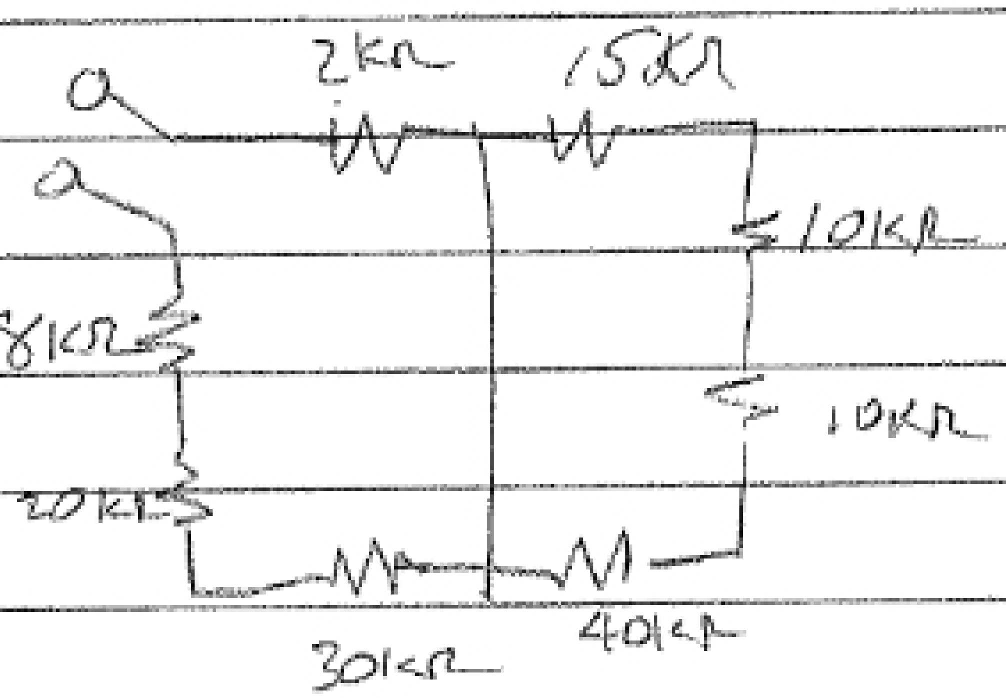
2-46



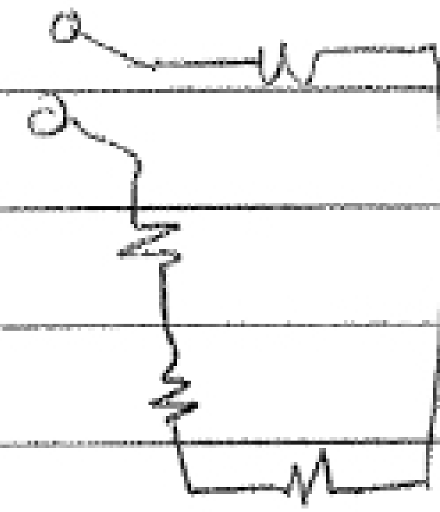
$R_{eq} = \Sigma R$ since all are in series

~~$= 135\ k\Omega$~~

(b)

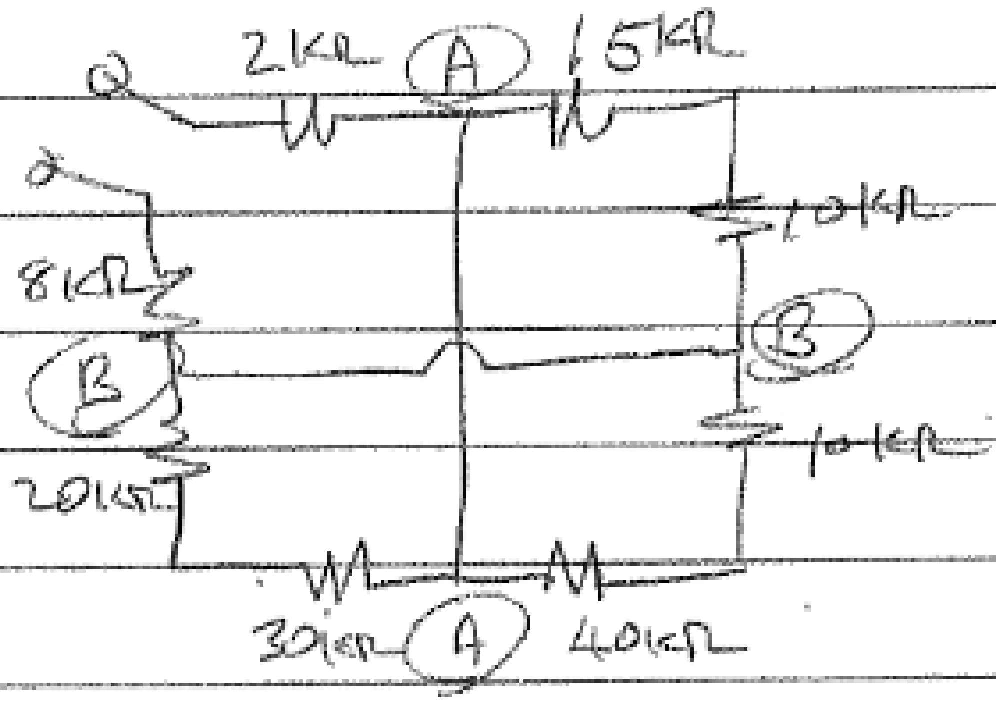


⇒



$R_{eq} = 60\ k\Omega$

(c)



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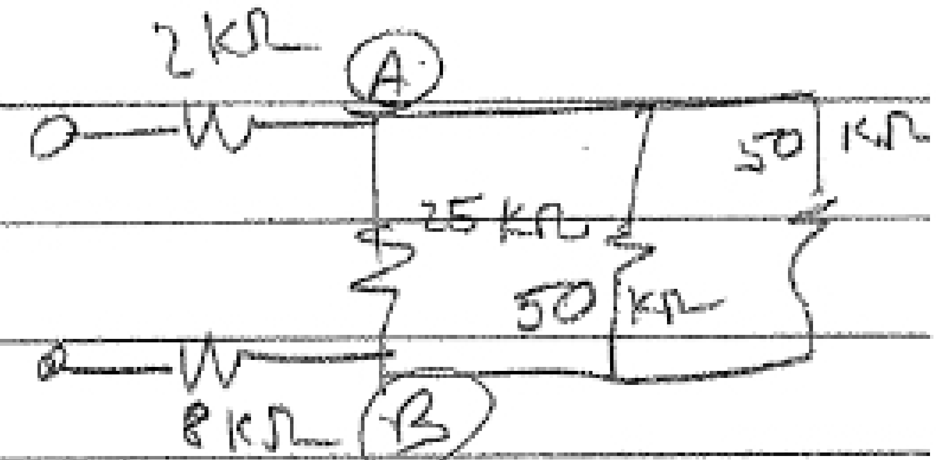
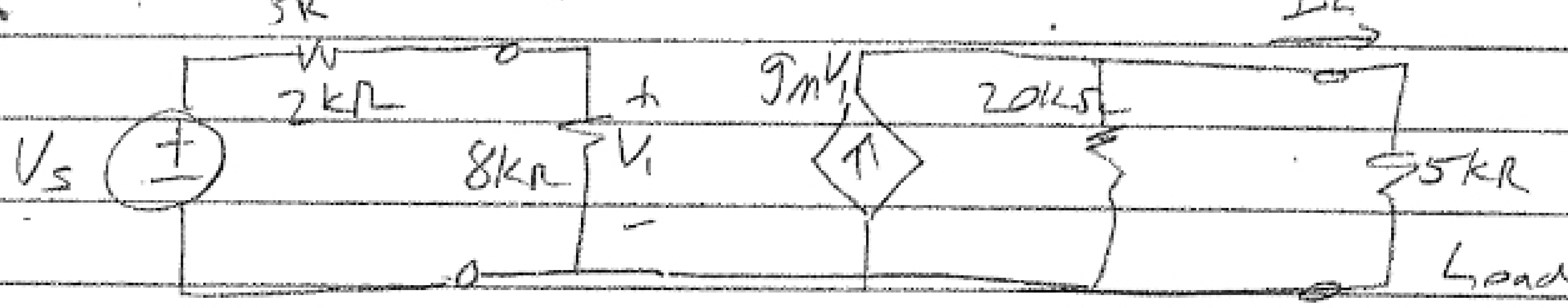


$R_{eq} = 10\ k\Omega + 25 \| 50 \| 50\ k\Omega$

$= 22.5\ k\Omega$

(with $P_{5K} = 10 P_{IN}$)

2-62



$$P_{5k\Omega} = I_L^2 R_L$$

where $R_L = 5k\Omega$

$$I_L = g_m V_1 \frac{0.2\,mS}{0.2\,mS + 0.05\,mS}$$

$$= 0.8\, g_m V_1$$

$$P_{5k\Omega} = (0.8\, g_m V_1)^2 R_L$$

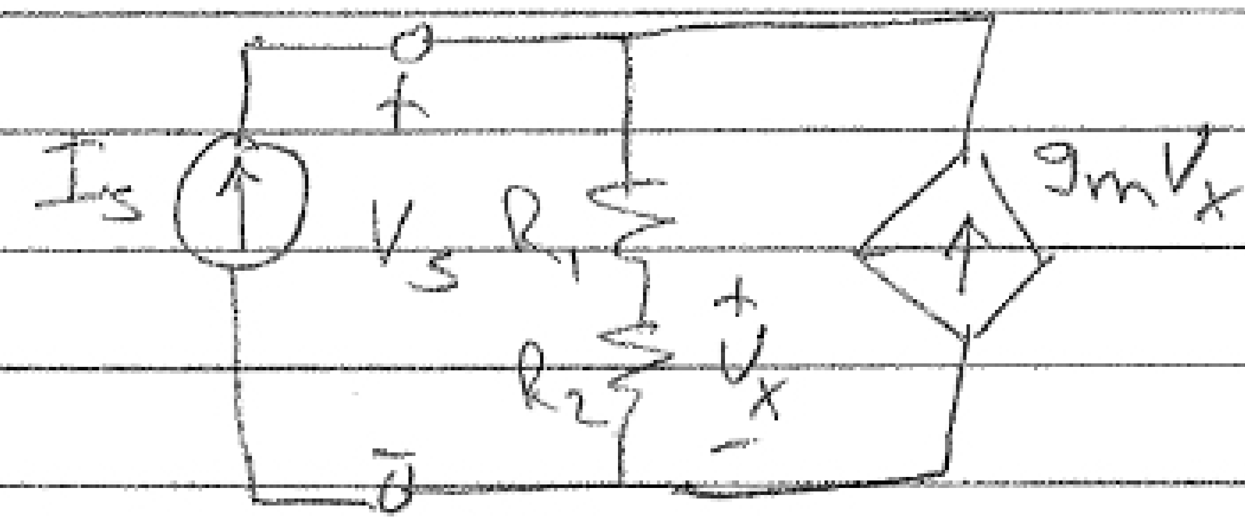
$$P_{in} = \frac{V_1^2}{8k\Omega}$$

$$\frac{P_{5k\Omega}}{P_{IN}} = \frac{(0.8\, g_m V_1)^2 R_L}{V_1^2 / 8k\Omega}$$

$$= 0.64\, g_m^2 (5k\Omega)\, 8k\Omega = 10$$

$$g_m = \sqrt{\frac{10}{(0.64)(5k\Omega)(8k\Omega)}} = 0.625\ mS$$

2-63



Use KCL at top node:

$$-I_s + \frac{V_s}{R_1+R_2} - g_m V_x = 0$$

$$V_x = V_s \frac{R_2}{R_1+R_2}$$ by Voltage Division

$$-I_s + \frac{V_s}{R_1+R_2} - g_m V_s \frac{R_2}{R_1+R_2} = 0$$

$$-I_s + V_s \left[\frac{1}{R_1+R_2} - \frac{g_m R_2}{R_1+R_2}\right] = 0$$

$$-I_s + V_s \left(\frac{1-g_m R_2}{R_1+R_2}\right) = 0$$

$$G_{eq} = \frac{I_s}{V_s} = \boxed{\frac{1-g_m R_2}{R_1+R_2} = G_{eq}}$$

$$R_{eq} = G_{eq}^{-1} = \boxed{\frac{R_1+R_2}{1-g_m R_2} = R_{eq}}$$

For $R_1 = 1\,k\Omega$, $R_2 = 3\,K\Omega$, $g_m = 0.2\,mS$

$$G_{eq} = \frac{1-(0.2\,mS)(3\,k\Omega)}{4\,K\Omega} = \boxed{0.1\ mS = G_{eq}}$$

$$R_{eq} = G_{eq}^{-1} = \boxed{10\,K\Omega = R_{eq}}$$