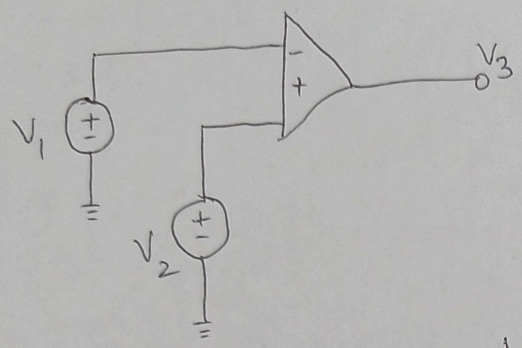
CSET102

Quiz 6 Solutions

(1)



$A = 10^2 = 100$

$V_2 = 0V$

$V_3 = 12.56V$

$$V_3 = A(V_2 - V_1)$$

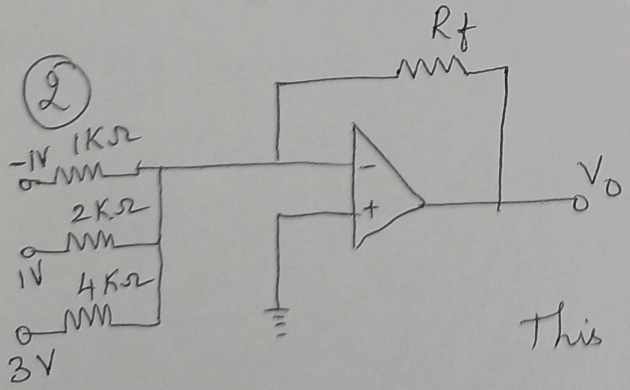
$$12.56 = 100(0 - V_1)$$

$$V_1 = -0.1256V.$$

Common mode input signal $(V_{icm}) = \frac{V_1 + V_2}{2}$

$$V_{icm} = \frac{-0.1256 + 0}{2} = -0.0628V.$$

(2)



$R_f = 53.71K\Omega$

This is a summing amplifier

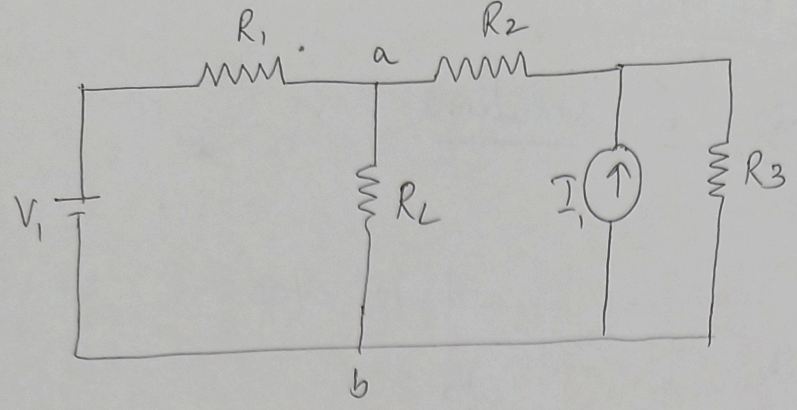
$$V_0 = -R_f\left[\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}\right]$$

$$= -53.71K\Omega\left[\frac{-1}{1K} + \frac{1}{2K} + \frac{3}{4K}\right]$$

$$= -53.71K\Omega\left[-1mA + 0.5mA + 0.75mA\right]$$

$$V_0 = -13.4275V.$$

(3)



$R_2 = 10K\Omega$

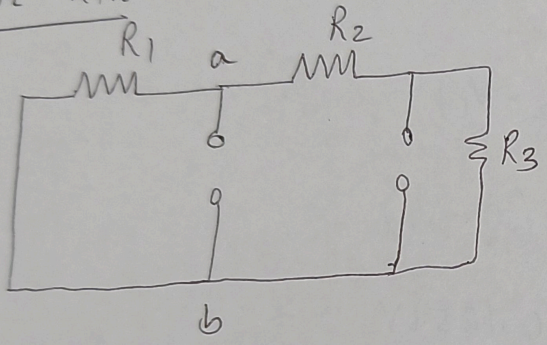
$R_3 = 6K\Omega$

$R_L = 1K\Omega$

$V_1 = 7V$

$I_1 = 11mA$

For R_{th}:



$(R_2 + R_3) \,||\, R_1 = R_{th}$

$16K\Omega \,||\, R_1 = 1K\Omega$

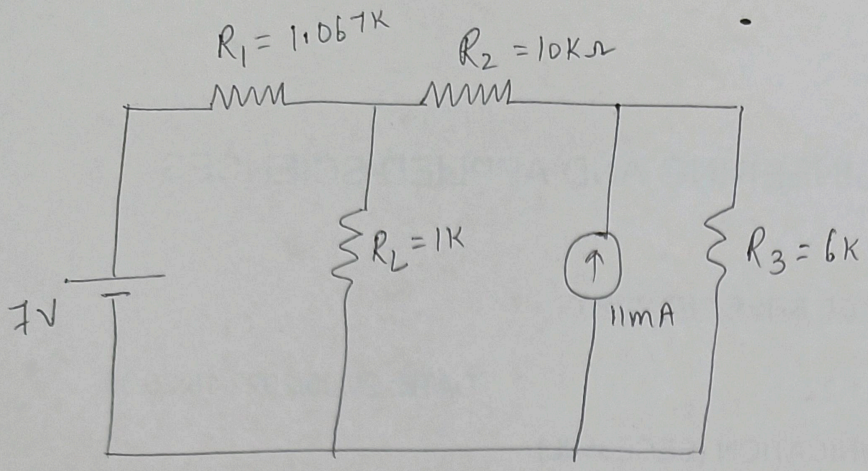
$$\frac{16 R_1}{16 + R_1} = 1K\Omega$$

$16 R_1 = 16 + R_1$

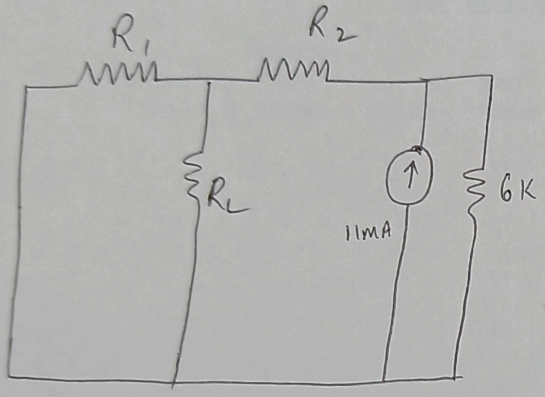
$15 R_1 = 16$

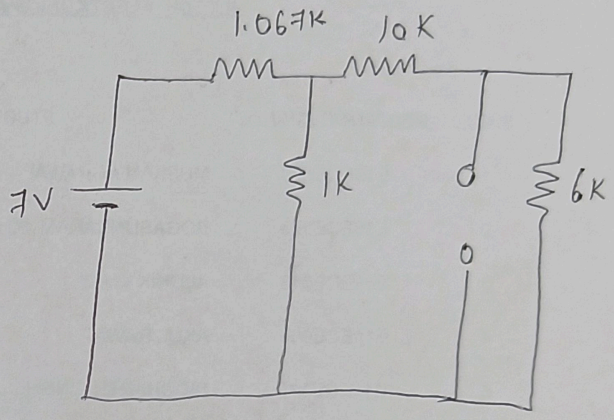
$R_1 = \frac{16}{15} = 1.067K\Omega$

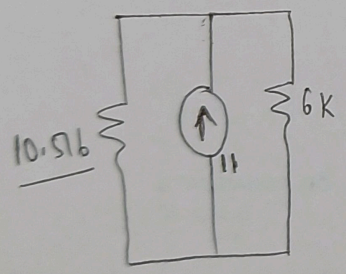
For max. Power $\rightarrow R_L = R_{th} = 1K\Omega$



Using Superposition theorem







$(1.067k \,||\, 1K) + 10K$

$0.516 + 10K$

10.516

$$I_{10.516} = 11 \times \frac{6}{10.516+6}$$

$\simeq 4$ mA

$$I_{R_L} = 4 \times \frac{1.067}{1.067+1}$$

$\simeq 2.0648$ mA — (1)

$$I_{tot} = \frac{7}{2} = 3.5\text{mA}.$$

$$R_{eq} = (16 \,||\, 1K) + 1.067$$

$\simeq 2K\Omega$

$$I_{R_L} = 3.5 \times \frac{16}{16+1} \simeq 3.3\text{mA}.$$ — (2)

$$I_{R_L} = (1) + (2)$$

$$I_{R_L} = 2.0648 + 3.3$$

$= 5.3648$ mA

$$P_{R_L} = I^2 R_L$$

$= (5.3648)^2 (1K)$

$P_{R_L} = 28.78$ mW.