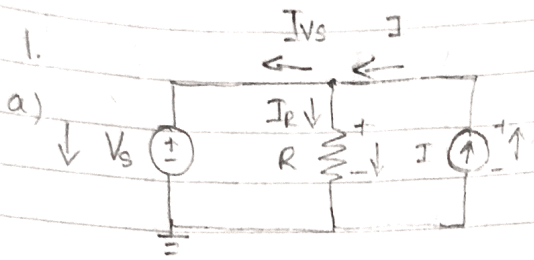
Homework 3.

1.

a)



$R = 5000$

$I = 5 \times 10^{-3}$

$V_S = 5$

$\therefore P_{VS} = -V_S I_{VS}$

$P_R = V_S I_R$

$P_I = -V_S I$

Using KCL:

$I_{VS} + I_R = I$

$I_{VS} = I - I_R$

$\rightarrow \therefore I_{VS} = I - \frac{V_S}{R}$

$\therefore P_{VS} = -V_S \cdot \left(I - \frac{V_S}{R} \right)$

$= (-5) \left(5 \times 10^{-3} - \frac{5}{(5 \times 10^3)} \right)$

$= (-5) \left(\frac{25 - 5}{5 \times 10^3} \right)$

$= \frac{-100}{5 \times 10^3} = \underline{-0.02\ W}$

b) $V_S = I_R R$

$\therefore I_R = \frac{V_S}{R}$

$\therefore P_R = V_S \cdot I_R$

$= \frac{(V_S)^2}{R}$

$= \frac{25}{(5 \times 10^3)} = \underline{0.05\ W}$

$\therefore P_I = -V_S I$

$= -5 \cdot (5 \times 10^{-3})$

$= \underline{-0.025\ W}$

c) $P_J = -40 \times 10^{-3}$.

$P_J = V_S \cdot I$

$-40 \times 10^{-3} = (5) I$

$I = -8 \times 10^{-3}$

$P_R = V_R I_R$

$= V_S \cdot \frac{V_S}{R} = \frac{5}{5 \times 10^3} =$

$P_{VS} = -V_S \cdot I_{VS} \rightarrow I_{VS} = I - I_R$

$= I - \frac{V_S}{R}$

$= -5 \left(I - \frac{V_S}{R} \right)$

$= (-5) \left((8 \times 10^{-3}) - \frac{5}{5 \times 10^3} \right)$

$= -0.035 W$

2.

a) $R_L = \infty \Rightarrow$ when $R = \infty$, the current through the resistor is 0, and so the potential difference is V_S

$I_L = 0$

$\therefore V_L = V_S$

$P_L = 0$

b) To maximize current, we need resistance $R_L = 0$

$\therefore$ There is no difference in potential and so $V_L = 0$.

$R_L = 0$

$I_L = V_S / R_S$

$V_L = 0$

$P_L = 0$

c) $P = VI = I^2R = \frac{V^2}{R}$

$\therefore I_L = \frac{V_S}{R_S + R_L}$

$\therefore P = \left(\frac{V_S}{R_S + R_L}\right)^2 \cdot R_L$

$= \frac{(V_S)^2 \cdot R_L}{(R_S + R_L)^2}$

$= \frac{(100 \times 10^{-8}) \cdot R_L}{(50 + R_L)^2}$.

$\therefore P_L = 5 \times 10^{-9}$ W.

$\therefore R_L = 50\ \Omega$

$\therefore I = 0.00001$ A.

$V_L = \frac{V_S R_L}{R_S + R_L}$.

$V = IR$

$I = \frac{V}{R}$

$\therefore I_L = \frac{V_L}{R_L} = \left(\frac{V_S R_L}{R_S + R_L}\right) \frac{1}{R_L}$

$= \frac{V_S}{R_S + R_L}$.

d) $50\ \Omega$.

8.

a) Capacity $= 2770 \times 10^{-3}$ Ah

Voltage $= 3.8$ V

Typical usage $= 0.8$ W.

$P = VI$

$\therefore I = \frac{0.3}{3.8}$

$\therefore$ time $= (2770 \times 10^{-3}) \cdot \frac{0.3}{3.8}$

$= \boxed{35.1}$ hours.

b) $Q = 2770 \times 10^{-3} \times 3600 = 9972$ As $= 9972$ C

$\therefore$ No of Electrons $= \frac{9972}{1.602 \times 10^{-19}} = \underline{6.225 \times 10^{22}}$

c) Energy $= WS \Rightarrow$ Power $\cdot$ time.

$\therefore$ Energy $= (2770 \times 10^{-3})(3.8) \times 3600$

$= \underline{37893.6}$ WS

d) $\therefore 31 \times 37893.6 \times \frac{1}{3600} \times \frac{1}{1000} \times 0.12 \cong \underline{4 \text{ cents}}$.

e) $V_2 = \frac{5 \times 10^{-3}}{(201 \times 10^{-3})} = 0.02488$.

$\therefore P = VI = \frac{V^2}{R} = \frac{(0.02488)^2}{1 \times 10^{-3}}$

$= \boxed{0.619}$ W

4.

a) $R_1 = 100\Omega \quad R_2 = 200\Omega$.

V_{out}

$$V_{out} = \frac{R_2 V_s}{R_1 + R_2} \quad -\textcircled{1}$$

$$= \frac{200 \cdot 5}{100+200} \quad -\textcircled{2}$$

$$= \underline{3.\overline{3}\ V}$$

V_{meas} $\quad \frac{1}{R} = \frac{1}{R_2} + \frac{1}{R_{VM}}$.

$$\therefore R_T = \frac{1}{\left(\frac{1}{R_2} + \frac{1}{R_{VM}}\right)}$$

$$= \frac{1}{\left(\frac{1}{200} + \frac{1}{1\times10^6}\right)} = \underline{199.96}$$

$$\therefore V_{meas} = \frac{R_T V_s}{R_1 + R_T} \quad -\textcircled{3}$$

$$= \frac{(199.96)(5)}{100+199.96} = \underline{3.33311}$$

b) $V_{out} = \frac{(10\times10^6)\cdot 5}{20\times10^6} = \underline{2.5\ V}$

$$R_T = \frac{1}{\left(\frac{1}{10\times10^6} + \frac{1}{1\times10^6}\right)} = 9090909091 \quad \therefore V_{meas} = \underline{0.41\overline{6}\ V}$$

∴ This voltmeter is not good.

7. I worked on Q1, Q2 during Homework Party on Thursday and Q3, Q4 during office hours on Friday. I worked with the people in office hours.