1. Thevenin Circuit

$$R_{new} = \frac{3 \cdot (4 \cdot 5 + 1 \cdot 5)}{3 + 4 \cdot 5 + 1 \cdot 5}$$

$$= \frac{18}{9} = 2$$

$$V_A = \frac{2}{2+3} \cdot V_S = \boxed{4V}$$

$$V_B = \frac{1 \cdot 5}{4 \cdot 5 + 1 \cdot 5} \cdot V_A = \frac{1 \cdot 5 \cdot 4}{6} = \boxed{1V}$$

$$\therefore V_A - V_B = 4 - 1$$

$$= \underline{3V}$$

Norton Circuit.

$$R_{new} = \frac{(1 \cdot 5)(3)}{1 \cdot 5 + 3} = \underline{1 \, \Omega}$$

$$V_C = \frac{1}{3+1} \cdot V_S = 2 \cdot 5$$

$$\therefore I_{R_4} = \frac{2 \cdot 5}{1 \cdot 5} = \underline{\frac{5}{3} A}$$

$$\therefore R_{Th} = \frac{3}{(5/3)} = \underline{\frac{9}{5} \, \Omega}$$
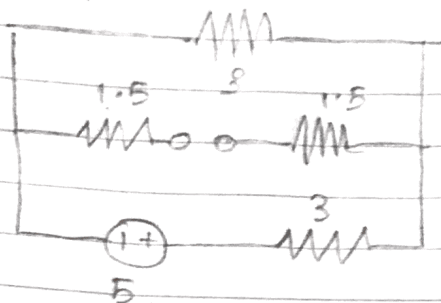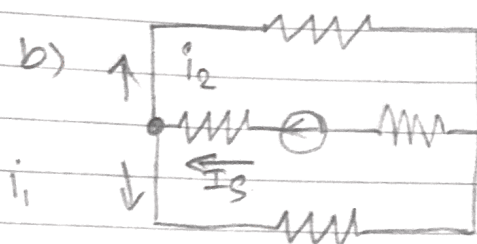
Thevenin Circuit : V_{Th}
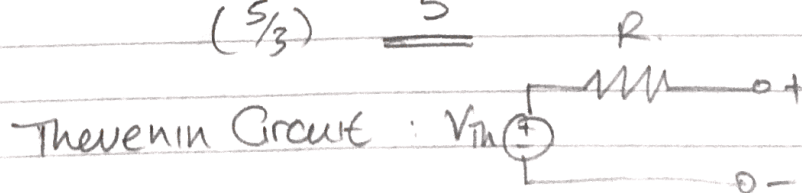
Norton Circuit

2.

a) Turn of current source :

$$V = IR$$
$$I = \frac{5}{3+3} = \frac{5}{6} \; A.$$
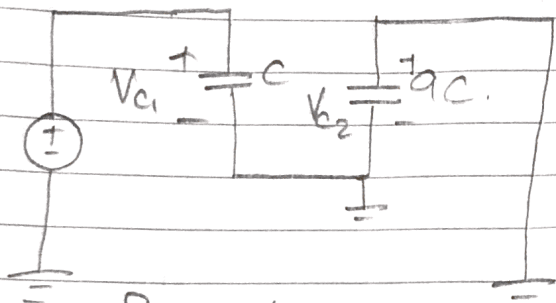
b)

KCL

$$I_s = i_1 + i_2$$

$$2i_2 = +1$$
$$i_2 = \frac{1}{2} \; A$$

By superposition, $\frac{-5}{6} + \frac{1}{2} = \frac{-1}{3} \; A$

3.

a)

Phase 1

$$V_{c_1,1} = V_{source} - 0 = \boxed{V_{source}}$$

$$V_{c_2,1} = 0 - 0 = \boxed{0}$$

$$Q_{c,1} = V_{c_1,1} \, C_1 = C V_{source}$$

$$Q_{c_2,1} = V_{c_2,1} \, C_2 = 0$$

4. $Q = VC$

$$I = \frac{dV}{dt} C$$

$$I = \frac{V_{init} - V_{min}}{t_{store}} C_{bit}$$

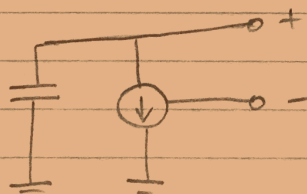$$= \frac{(1.2 - 0.9) \cdot 28f}{1 \times 10^{-3}}$$

$$= 8.4 pA$$

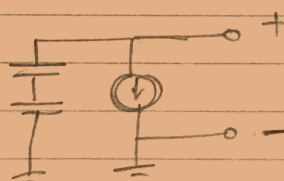5. $$I_S = C_2 \frac{dV_{out}(t)}{dt}$$

$$V_{out} = \int \frac{I_s}{C_2} dt$$

$$= \frac{I_s t}{C_2} + V_{out}(0)$$

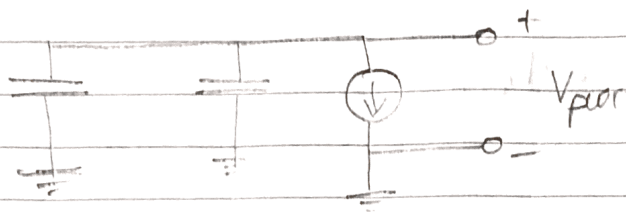$$= \frac{I_s t}{C_2}$$

6.
a) Config 1 :

b) Config 2

b) Case 1:

$$V_{pwr} = \frac{Q}{C_{sc}}$$

$$= \frac{Q_{init} - i_{load}t}{C_{sc}}$$

$$= \frac{V_{init}C_{sc} - i_{load}t}{C_{sc}}$$

$$= V_{init} - \frac{i_{load}t}{C_{sc}}$$

Case 2:

$$V_{pwr} = \frac{Q}{C_{eq}}$$

$$= \frac{Q_{init} - i_{load}t}{C_{eq}}$$

$$= \frac{V_{init}C_{sc} - i_{load}t}{C_{eq}}$$

$$= 2V_{init} - \frac{2i_{load}t}{C_{sc}}$$

Case 3:

$$V_{pwr} = \frac{Q}{C_{eq}}$$

$$= \frac{Q_{init} - i_{load}t}{C_{eq}}$$

$$= \frac{2V_{init}C_{sc} - i_{load}t}{C_{eq}}$$

$$= V_{init} - \frac{i_{load}t}{2C_{sc}}$$

7.

a) $\quad C_{full} = \dfrac{\varepsilon_{H_2O}\, h \cdot \omega}{\omega} = 81 \cdot \varepsilon \cdot h_{tot}$

$\quad C_{empty} = \dfrac{\varepsilon_{air}\, h \cdot \omega}{\omega} = \varepsilon h_{tot}$

b) $\quad C_{water} = \dfrac{\varepsilon_{H_2O}\, h_{H_2O}\, \omega}{\omega} = 81 \varepsilon h_{H_2O}$

$\quad C_{air} = \dfrac{\varepsilon_{air}\,(h_{tot} - h_{H_2O})\,\omega}{\omega} = \varepsilon\,(h_{tot} - h_{H_2O})$

$\quad C_{tank} = C_{water} + C_{air} = \varepsilon\,(h_{tot} + 80\, h_{H_2O})$

c) $\quad I_c = C_{tank}\,\dfrac{dV_c}{dt}$

$\quad I_c = I_s$

$\quad \dfrac{dV_c}{dt} = \dfrac{I_s}{C_{tank}}$

$\quad V_c = \dfrac{I_s}{C_{tank}}\, t$

d) $\quad C_{tank} = \dfrac{I_s}{V_c(t)} \cdot t$

$\quad h_{H_2O} = \dfrac{C_{tank} - h_{tot} \cdot \varepsilon}{80\,\varepsilon}$

e) $\quad V_c = \dfrac{I_s}{C_{tank}} \cdot t$

$\quad C_{tank} = \dfrac{I_s \cdot T_1}{V_{ref}}$

$\quad h_{H_2O} = \dfrac{C_{tank} - h_{tot}\,\varepsilon}{80\,\varepsilon}$

10. I worked alone for this resubmission using the
    solutions that were released over the weekend