HW #2

1-21.

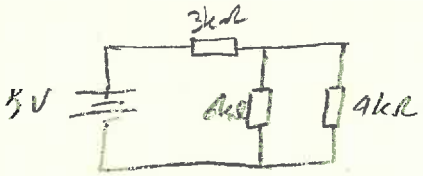
$$R_{eq} = 2k\Omega + \left[\left((3k\Omega \parallel 4k\Omega) + 5k\Omega\right) \parallel 7k\Omega \parallel 6k\Omega\right]$$

$$R_{eq} = 4.18\ k\Omega$$

$$V_{6k} = \frac{2k\Omega}{4.18k\Omega} \times 10\ V = 4.78\ V$$

1-22.

Step 1:

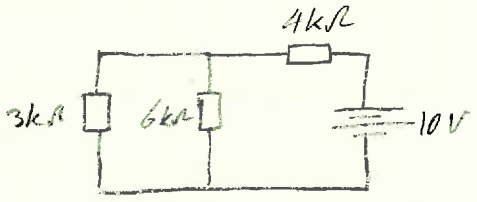


$$R_{eq} = 3k\Omega + (6k\Omega \parallel 4k\Omega) = 5.4\ k\Omega$$

$$I' = \frac{5}{5.4} = 0.925\ mA$$

$$I'_{6k} = \frac{4k\Omega}{6k\Omega + 4k\Omega} \times 0.925 = 0.37\ mA$$

Step 2:



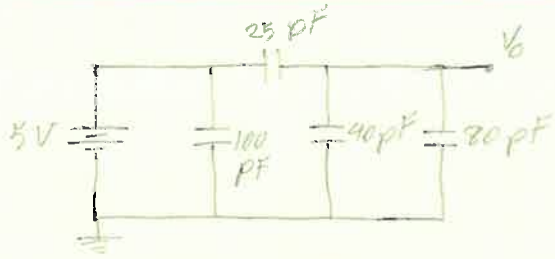
$$R_{eq} = 4k\Omega + (6k\Omega \parallel 3k\Omega) = 6k\Omega$$

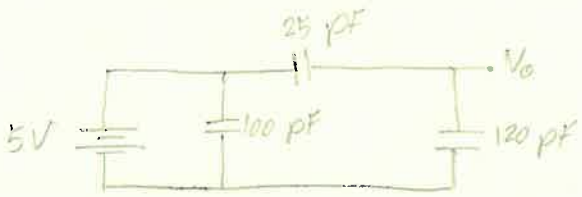
$$I'' = \frac{10}{6k\Omega} = 1.67\ mA$$

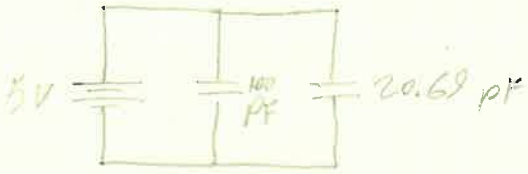
$$I''_{6k} = \frac{3k\Omega}{6k\Omega + 3k\Omega} \times 1.67 = 0.556mA$$

$$I_{6k} = I'_{6k} + I''_{6k} = 0.37 + 0.55 = 0.926mA$$

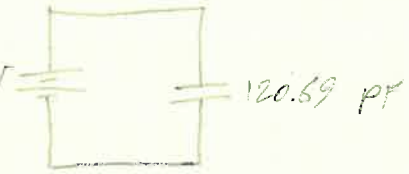
1-25.







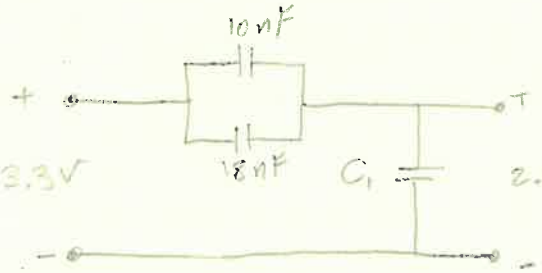
$\Rightarrow$



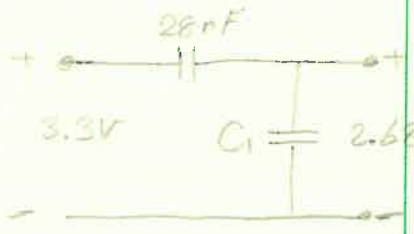
a) $W = \frac{1}{2} C V^2 = \frac{1}{2} \times 120.69 \times 10^{-12} \times 5^2 = 1.51 \text{ nJ}$

b) $V_o = \frac{25 \text{ pF}}{(120 \text{ pF} + 25 \text{ pF})} \times 5 \text{ V} = 0.862 \text{ V}$

1-26.



$\rightarrow$



$$2.68 = \frac{28 \text{ nF}}{28 \text{ nF} + C_1} \times 3.3 \text{ V}$$

$$\frac{28 + C_1}{28} = \frac{3.3}{2.68} \Rightarrow 28 + C_1 = 28 \times 1.23$$

$$\Rightarrow C_1 = 6.48 \text{ nF}$$

$$W = \frac{1}{2} \times 6.48 \times 10^{-9} \times (2.68)^2 = 23.27 \text{ nJ}$$

1-27.

$$Q_{T\,\text{before switching}} = Q_{T\,\text{after switching}}$$

$$C_1 V_1 + C_2 V_2 = (C_1 + C_2) V$$

$$(2+2) \times 10^{-9} \times 3 + 5 \times 10^{-9} \times 1.2 = (2+2+5) \times 10^{-9} \times V$$

$$12 + 6 = 9 \times V \quad \Rightarrow \quad V = \frac{18}{9} = 2\,V$$

1-28.

$$I_1 + I_3 = I_2$$

$$\frac{10 - V_o}{1\,k\Omega} + \frac{0 - (V_o + 0.7)}{1.8\,k\Omega} = \frac{V_o + 30}{1.5\,k\Omega}$$

$$\frac{10 - V_o}{1\,k\Omega} = \frac{V_o + 30}{1.5\,k\Omega} + \frac{V_o + 0.7}{1.8\,k\Omega}$$

$$10 - V_o = \frac{1.8V_o + 54 + 1.5V_o + 1.05}{2.7}$$

$$27 - 2.7V_o = 3.3V_o + 55.05$$

$$-28.05 = 6V_o \quad \Rightarrow \quad V_o = -\frac{28.05}{6} = -4.675\,V$$

$$I_1 = \frac{10 + 4.675}{1\,k\Omega} = 14.675\,mA$$

$$I_2 = \frac{-4.675 + 30}{1.5\,k\Omega} = 16.88\,mA, \quad I_3 = \frac{4.675 - 0.7}{1.8\,k\Omega} = 2.21\,mA$$

1.29 $I_S = 10\ nA$

a) $V_{BB} = 1V$

KVL:

$$-1 + 50k\Omega \times I_D + V_D + 80k\Omega \times I_D = 0$$

$$V_D = 1 - 130 \times I_D$$

$$I_D = I_S\left(e^{V_D/V_{th}} - 1\right)$$

$$= f(I_D)$$

I_D	$f(I_D)$
5 μA	7.01
6 μA	47.25
6.4 μA	6.4 μA

$$I_D = 6.4\ \mu A$$

$$V_D = 1 - 130 \times 10^{3} \times 6.4 \times 10^{-6} = 0.168\ V$$

b) $V_{BB} = 10\ V$

KVL:

$$V_D = 10 - 130 \times I_D$$

$$I_D = 10 \times 10^{-9} \times \left(e^{\frac{10 - 130k\Omega \times I_D}{0.026}} - 1\right)$$

$$= f(I_D)$$

$$I_D = 75.138\ \mu A$$

$$V_D = 0.232\ V$$