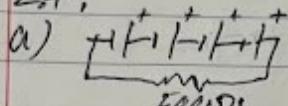


3.21

24:

a) 

$$V = 4V_B = 4 \left(65 - \frac{\int I dt}{2.7} + .75 \right)$$

$$= 6 - \frac{\int I dt}{2.7} \cdot 3$$

$$V = \cancel{I} 500 = 6 - \frac{\int I dt}{2.7} \cdot 3$$

$$\rightarrow 500I + \frac{3}{2.7} \int I dt = 6$$

$$\rightarrow 500I + \frac{3}{2.7} I = 0$$

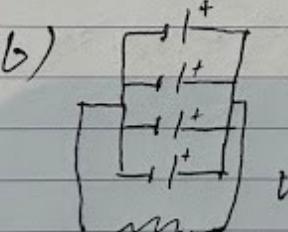
$$\rightarrow I + \frac{3}{1350} I = 0$$

$$\rightarrow I(t) = C e^{\frac{-3}{1350} t} \quad \& \quad I(0) = \frac{6}{500} \rightarrow C = \frac{6}{500}$$

$$\rightarrow I(t) = \frac{6}{500} e^{\frac{-3}{1350} t}$$

tend when $V=3 \Rightarrow I(t_{\text{end}}) = \frac{3}{500} = \frac{6}{500} e^{\frac{-3}{1350} t_{\text{end}}}$

$\rightarrow t_{\text{end}} = \approx 312 \text{ hours or } \approx 13 \text{ days}$

b) 

$$V = 1.5 - \frac{\int I dt}{4(2.7)} + .75$$

$$= 1.5 - \frac{.75}{10.8} \int I dt$$

$$V = 500I = 1.5 - \frac{.75}{10.8} \int I dt$$

$$500 \cancel{I} \rightarrow 500I + \frac{.75}{10.8} \int I dt = 1.5$$

$$\rightarrow 500I + \frac{.75}{10.8} I = 0$$

$$\rightarrow I + \frac{.75}{10.8} I = 0$$

$$\rightarrow I(t) = C e^{\frac{-0.75}{10.8} t} \quad \& \quad I(0) = \frac{1.5}{500} \rightarrow C = \frac{1.5}{500} = .003$$

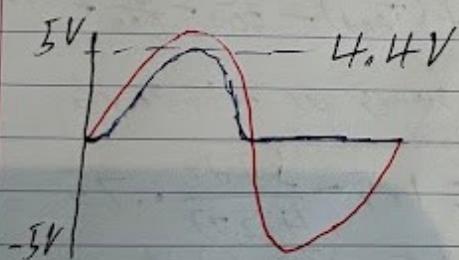
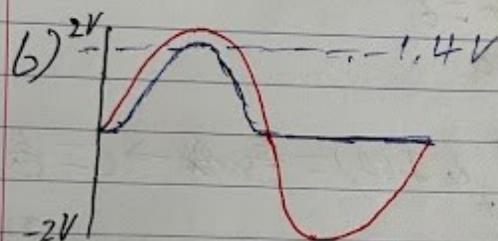
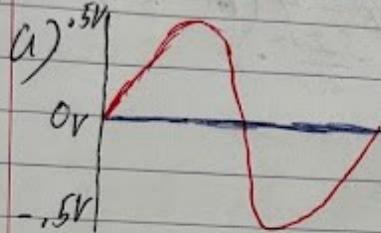
$$\rightarrow I(t) = .003 e^{\frac{-0.75}{10.8} t}$$

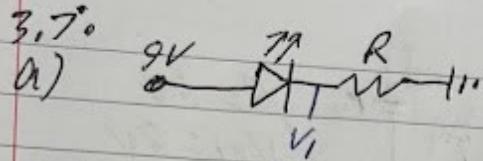
tend when $V=.75 \Rightarrow I(t_{\text{end}}) = \frac{.75}{500} = \frac{1.5}{500} e^{\frac{-0.75}{10.8} t_{\text{end}}}$

$\rightarrow t_{\text{end}} = 4987 \text{ hrs or } 208 \text{ days}$

3.4:

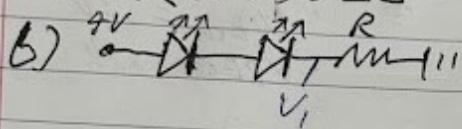
V_{in} V_{out}





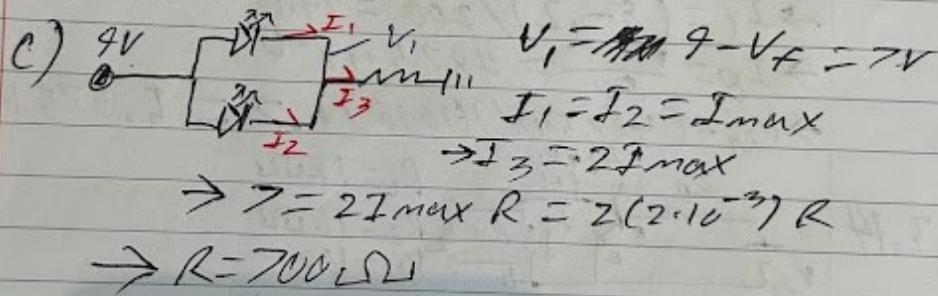
$$\Delta V = 9V \Rightarrow V_1 = 9 - V_f = 7 = I_{\max} R = (20 \cdot 10^{-3}) R$$

$$\rightarrow R = 350 \Omega$$



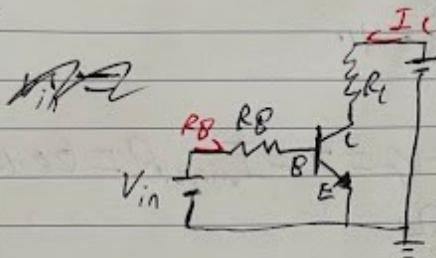
$$V_1 = 9 - 2V_f = 5 = I_{\max} R = (20 \cdot 10^{-3}) R$$

$$\rightarrow R = 250 \Omega$$



3.2

3.13:



$$\begin{aligned} \beta &= 80 \\ V_{CC} &= 8V \\ R_B &= 10k\Omega \\ R_L &= 200\Omega \\ V_{CEsat} &= .2V \\ V_{BEsat} &= .7V \end{aligned}$$

$$V_{in} = I_B R_B + V_{BE}$$

$$I_B = I_C / \beta$$

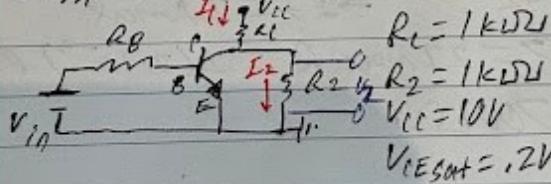
$$I_C = (V_{CC} - V_{CE}) / R_L$$

$$\rightarrow I_C = (8 - .2) / 200 = 3.9 \cdot 10^{-3}$$

$$\rightarrow I_B = \frac{3.9 \cdot 10^{-3}}{80} = 48.75 \cdot 10^{-6}$$

$$\rightarrow V_{in} = (48.75 \cdot 10^{-6})(10 \cdot 10^3) + .7 = 5.575V$$

3.14

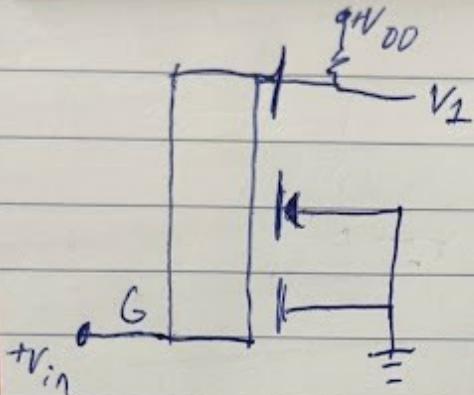


$$\text{a) } I_2 = I_C = \frac{V_{CC}}{R_1 + R_2} = \frac{10}{2 \cdot 10^3} = 5 \text{ mA}$$

$$\text{b) } V_2 = V_{CEsat} = .2V = I_2 R_2 = I_2 \cdot 1 \cdot 10^3$$

$$\rightarrow I_2 = .2 \text{ mA}$$

3.21



$$V_f = 1V$$

R_{DS(on)} ↓↓

a) if V_{in} = 0 V₁ = 5V

b) if V_{in} = 5V V₁ = 0V

