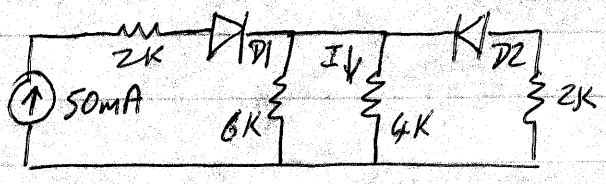
ECE 241 Assignment #3 Model Answers

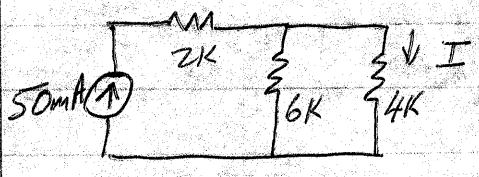
P3.25, 3.30, 3.32, 3.41, 3.48 AP3.6, 11.27, AP11.6

P3.25



Assume D1 on, D2 off.
For ideal Diodes:

redraw circuit!

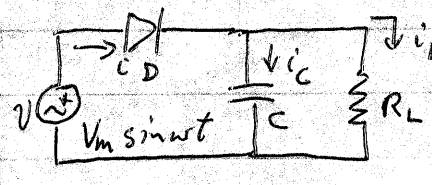


By current division,

$$I = \frac{6K}{6K+4K}\,50mA = 30mA$$

Check: $4K \times 30mA = +120V$, reverse biasing D2.

P3.30



$C = 100\mu F$ $R_L = 10k\Omega$ $V_m = 20V$ at 60Hz

(a) DC load current i'_L

Time constant $R_L C = 10^{-4} \times 10^{4} = 1s \gg \frac{1}{60}\,s$ (sinusoid period)

$\therefore$ ripple $V_r \ll V_m$ and $i'_L \approx \frac{V_m}{R_L} = \frac{20V}{10^4\Omega} = 2mA$

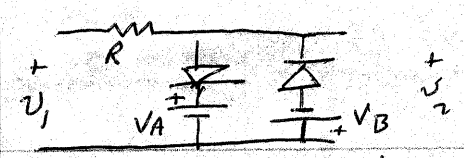
(b) $V_r = V_{DC}\frac{T}{R_L C} \approx \frac{V_m}{R_L}\frac{T}{C} = 2\times10^{-3}\,\frac{1/60}{10^{-4}} = \frac{1}{3}\,V$

$$\% \text{ ripple} = \frac{1/3}{20}\,100\% = \frac{100}{60}\% = 1.67\%$$

(c) Without C, circuit becomes simple 1/2 wave rectifier

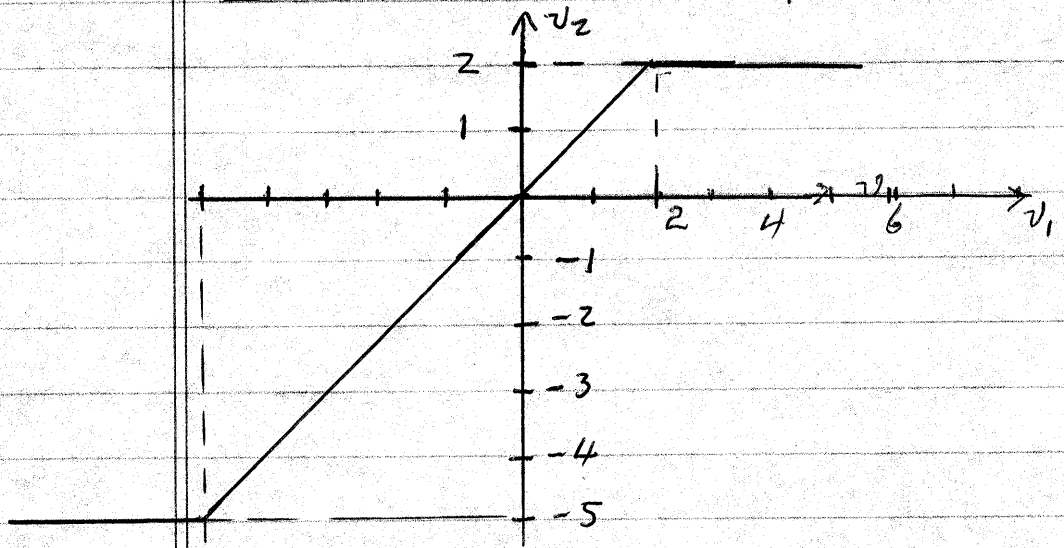
$$I_{DC} = \frac{I_m}{\pi} = \frac{V_m}{\pi R_L} = \frac{20}{\pi(10^4)} = 0.64\,mA$$

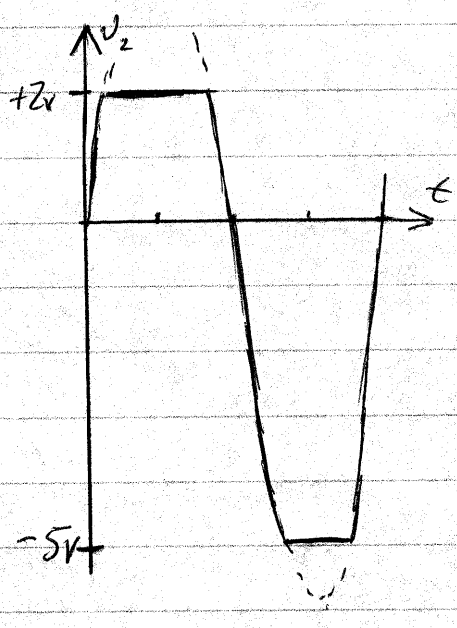
P3.32

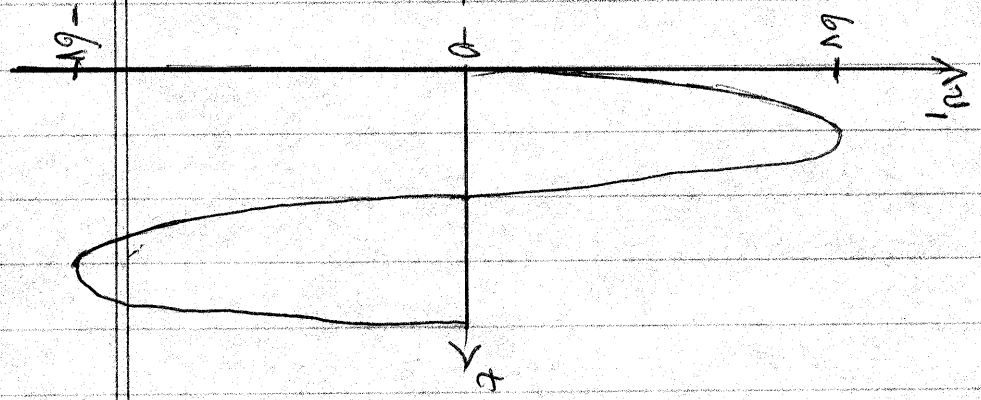


$R = 1K\Omega$ $V_A = 2V$ $V_B = 5V$

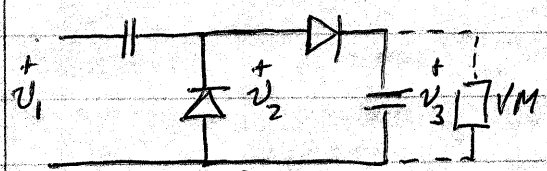
$v_1 = 6 \sin \omega t$ V





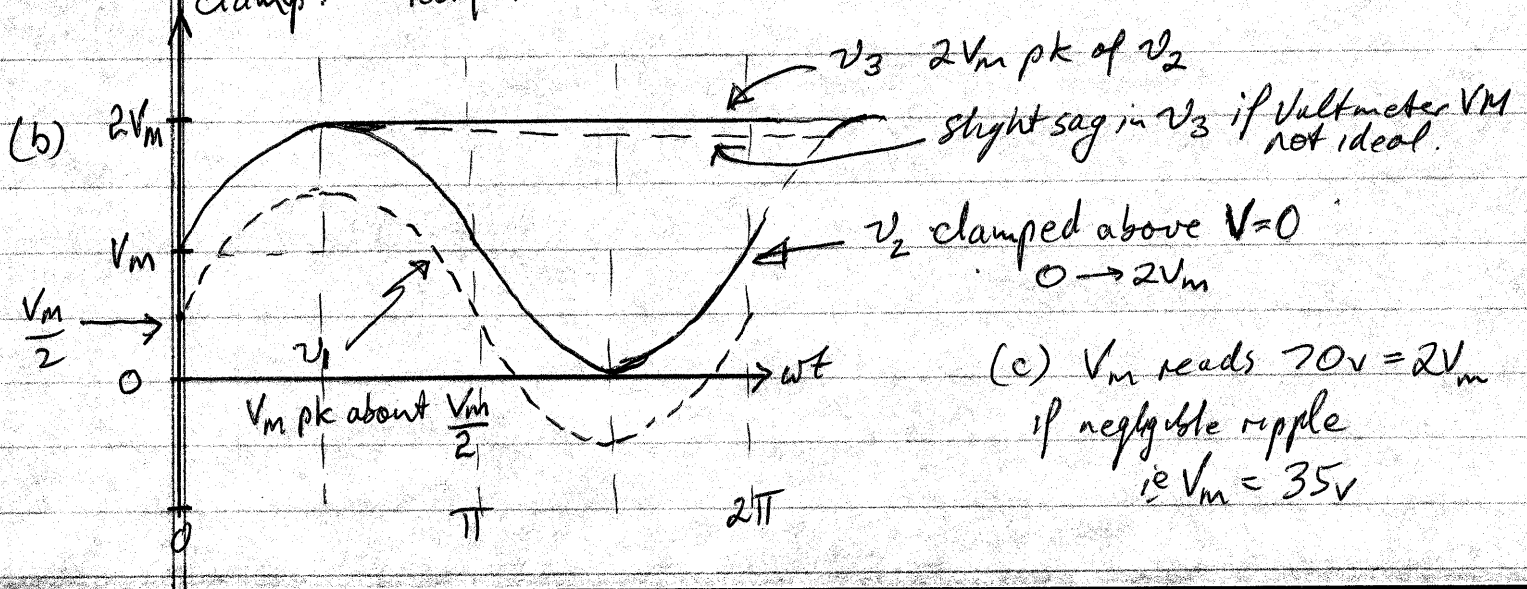


3.41



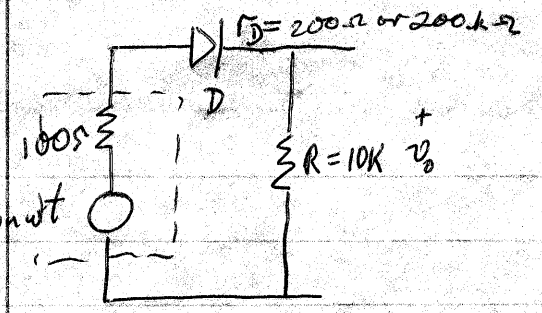
$v_1 = V_m(.5 + \sin \omega t)$

(a) Voltage clamp. Peak rectifier

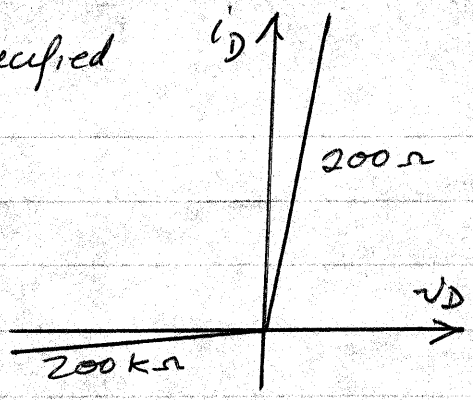


(c) V_m reads $70v = 2V_m$
if negligible ripple
i.e $V_m = 35v$

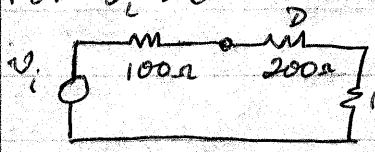
P3.48



Diode model specified



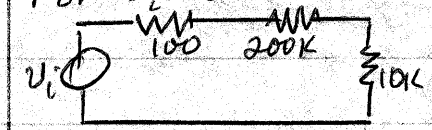
For $v_i > 0$



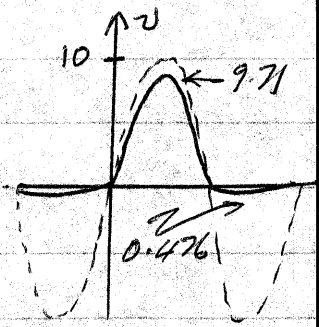
$$v_o = \frac{10K}{10.3K} v_i$$

$$= 9.71 \sin \omega t$$

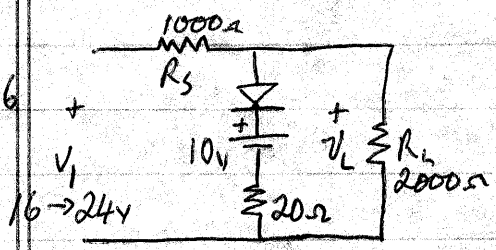
For $v_i < 0$



$$v_o = \frac{10K}{210.1K} = 0.476 \sin \omega t$$



AP3.6



$$V_I = V_L + \left(\frac{V_L - 10}{20} + \frac{V_L}{R_L}\right) R_S = V_L + \left[\left(\frac{V_L}{20} - \frac{10}{20}\right) + \frac{V_L}{2000}\right] 1000$$

$$= V_L + \frac{V_L}{2} + 50V_L - 500$$

$$\therefore V_L = \frac{V_I + 500}{51.5}$$

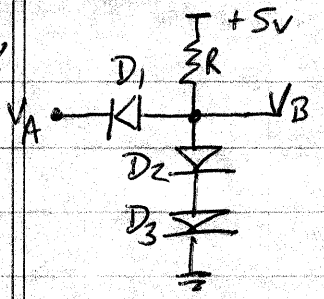
$V_I = 16v$ $\quad V_L = \frac{516}{51.5} = 10.02v$

$V_I = 24v$ $\quad V_L = \frac{524}{51.5} = 10.17v$

$$\therefore \% \text{ change} = \frac{10.17 - 10.02}{10.02} 100\% = \frac{.15}{10.02} 100\% \approx 1.5\%$$

ie. regulator working OK.

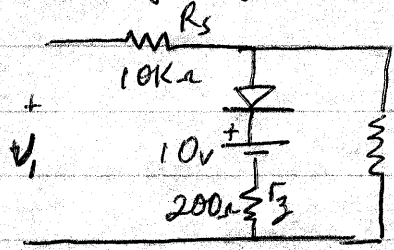
P11.28



Assume 0.7 diode "on" voltage

V_A	V_B	
+2v	+1.4v	D_2, D_3 on $\therefore V_B = 1.4v$ & D_1 off
+1v	+1.4v	" " " " & D_1 off still ($\frac{0.4v}{\text{fwd bias}}$)
0	+0.7v	D_1 on, 0.7v not enough to turn $D_2 + D_3$ on
−1v	−0.3v	" , D_2, D_3 off.

AP11.6 Replacing the zener by its equivalent circuit



$V_1 = 16 \to 24v$

This is (inadvertently) almost a duplicate of AP3.6

$$V_1 = R_S\left(\frac{V_L - 10}{r_Z} + \frac{V_L}{R_L}\right) + V_L$$

$$\to V_L = \frac{V_1 + 10\frac{R_S}{r_Z}}{1 + \frac{R_S}{r_Z} + \frac{R_S}{R_L}} = \frac{V_1 + 10\,\frac{104}{200}}{1 + \frac{104}{200} + \frac{104}{2\times 104}} = \frac{V_1 + 500}{1 + 50 + 0.5}$$

$$= (V_1 + 500)/51.5$$

$V_1 = 16v \quad V_L = 516/51.5 \simeq 10.02v$

$V_1 = 24v \quad V_L = 524/51.5 = 10.17v$

$\left.\begin{array}{l}\end{array}\right\}$ % change $= \frac{0.15v}{10.02}\,100\% \approx 1.5\%$

$\therefore$ Regulator functioning.