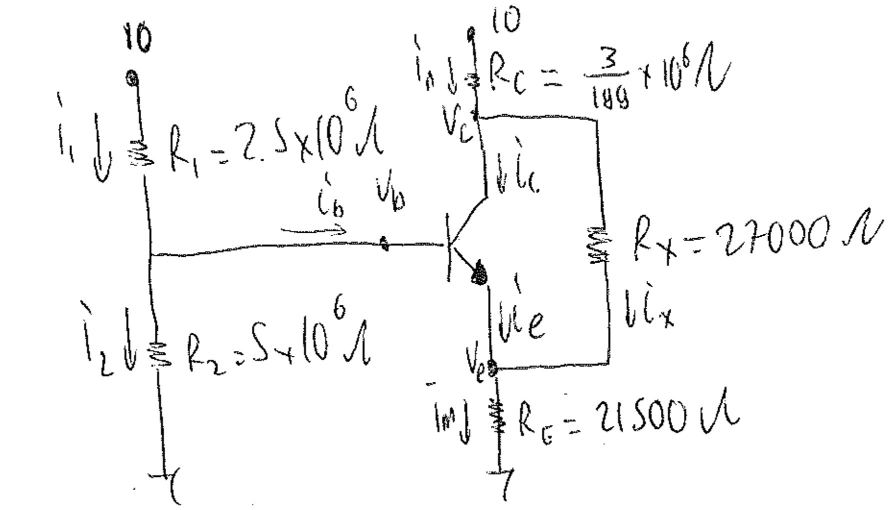
(Q1)

MECE 246
Makeup@ - Resit
2017-2018
spring
solutions



Page 1

(a)

$\beta = 99 \quad \beta+1 = 100$

$$\frac{10-V_b}{R_1} = \frac{V_b}{R_2} + i_b \qquad (8)$$

$i_e = (\beta+1)\, i_b \qquad i_e + i_x = i_m$

$V_b - V_e = 0.7$ Volt

$$(\beta+1)\, i_b + \frac{V_c - V_e}{R_x} = \frac{V_e}{R_e} \qquad (8)$$

$i_n = i_c + i_x$

$$\frac{10-V_c}{R_c} = \beta i_b + \frac{V_c - V_e}{R_x} \qquad (9)$$

$$100\times10^{-6} + \frac{7-4.3}{27000} = \frac{4.3}{21500}$$

$$100\times10^{-6} + \frac{2.7}{27000} = \frac{4.3}{2.15\times10^4} \rightarrow 100\times10^{-6} + 10^{-4} = 10^{-4}\times 2$$

(b)

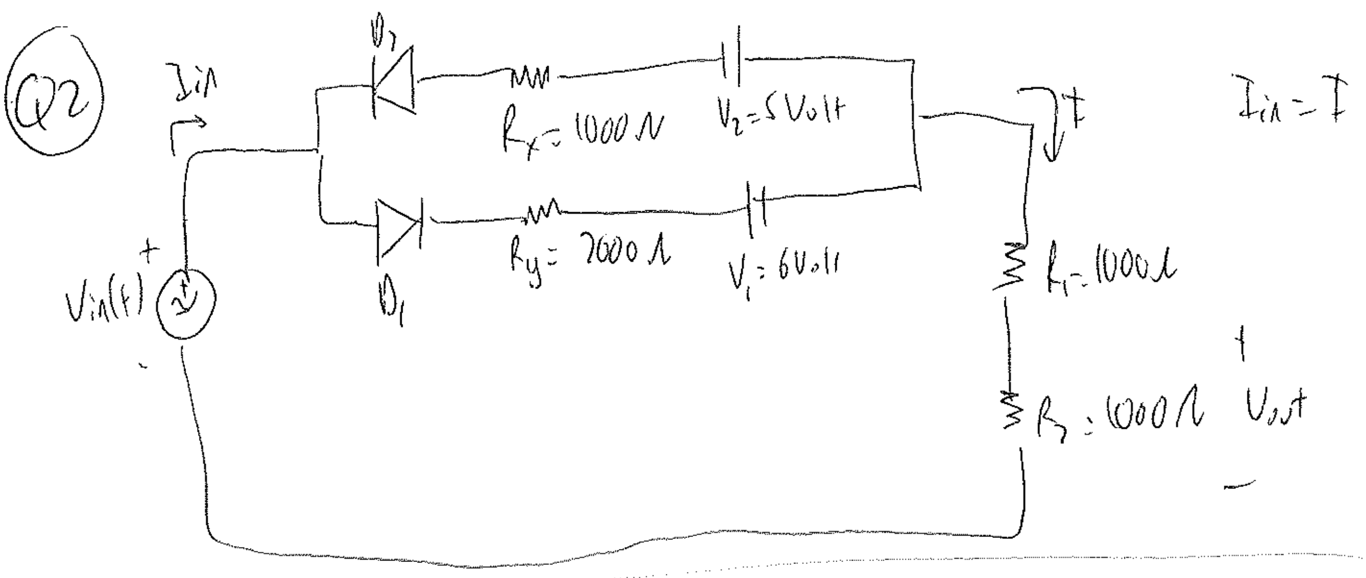
$V_b = 5$ V $\quad V_e = 4.3$ V $\quad V_c = 7$ V $\quad i_b = 10^{-6}$ Amper

$$\frac{10-5}{2.5\times10^6} = \frac{5}{5\times10^6} + 10^{-6} \rightarrow \frac{5}{2.5\times10^6} = \frac{5}{5\times10^6} + 10^{-6} \rightarrow 2\times10^{-6} = 10^{-6} + 10^{-6}$$

$$\frac{10-7}{\frac{3}{199}\times10^6} = 99\times10^{-6} + \frac{7-4.3}{27000} \rightarrow 199\times10^{-6} = 99\times10^{-6} + \frac{2.7}{27000}$$

$$199\times10^{-6} = 99\times10^{-6} + 10^{-4} \rightarrow 199\times10^{-6} = 99\times10^{-6} + 100\times10^{-6}$$

Q2



if $V_{in} > V_1 = 6$ Volt D_1 on D_2 off $I = \frac{V_{in} - 6}{R_1 + R_2 + R_y} = \frac{V_{in} - 6}{4000}$ (positive current)

if $-V_2 < V_{in} < V_1$ D_1 off D_2 off $I = 0$

$-5 < V_{in} < 6$

if $V_{in} < -V_2$ D_2 on D_1 off $I = \frac{V_{in} + 5}{R_x + R_1 + R_2} = \frac{V_{in} + 5}{3000}$

$V_{in} < -5$

(negative current)

$V_{in} > V_1 = 6$ Volt $V_{out} = I * R_2 =$

$= \frac{V_{in} - 6}{4000} \times 1000 = \frac{V_{in} - 6}{4}$ ampere

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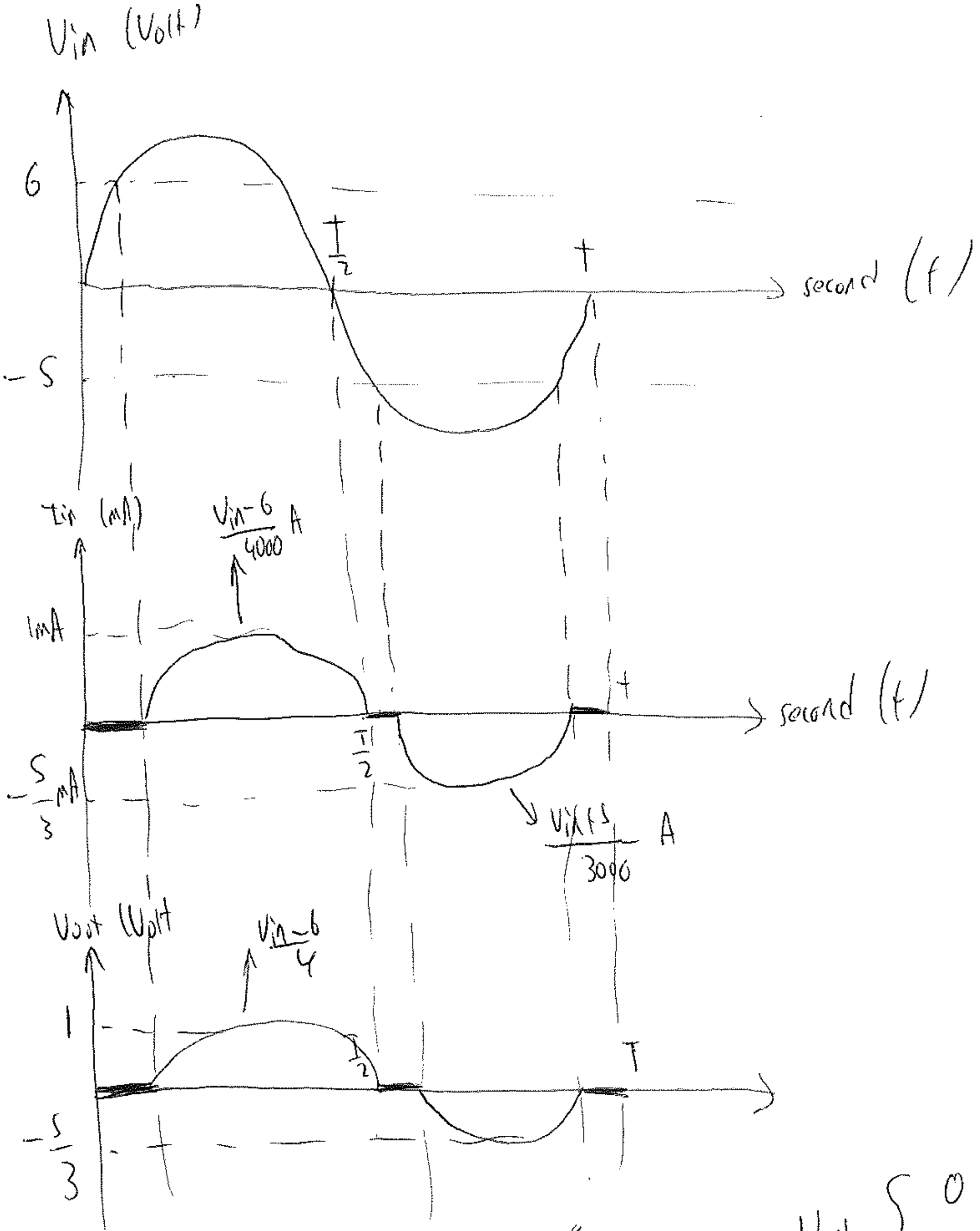
$-V_2 < V_{in} < V_1$ $V_{out} = 0$

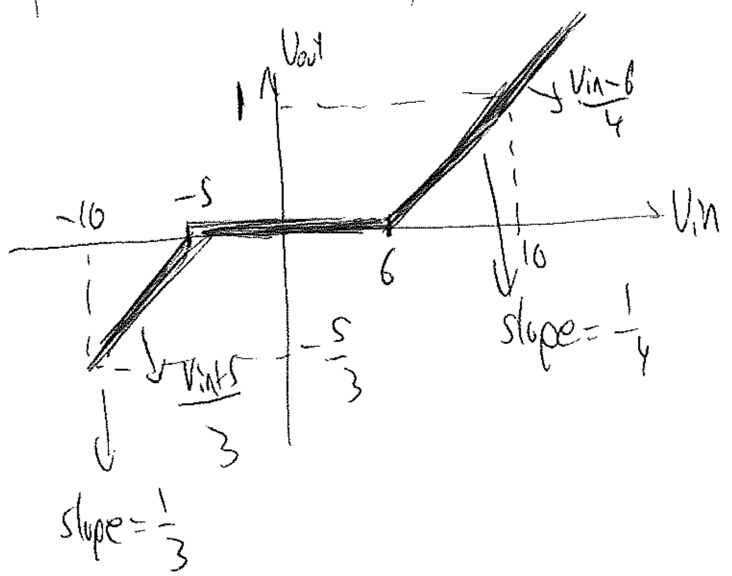
$-5 < V_{in} < 6$

$V_{in} < -V_2$ $V_{out} = I * R_2 = \frac{V_{in} + 5}{3000} \times 1000$

$V_{in} < -5$ $= \frac{V_{in} + 5}{3}$



(b)



$$V_{out} = \begin{cases} 0, & -5 < V_{in} < 6 \\ \frac{V_{in}-6}{4}, & 6 < V_{in} \\ \frac{V_{in}+5}{3}, & V_{in} < -5 \end{cases}$$