Q Schmitt

a) $4-3 = \frac{2R_2}{R_1+R_2} V_{sat} \rightarrow \frac{R_1+R_2}{R_2} = 16$

$\frac{R_1}{R_2} + 1 = 16 = 15$

$4+3 = \frac{2R_1}{R_1+R_2} V_{ref} \rightarrow \frac{7}{2}\left(\frac{R_1+R_2}{R_1}\right) = V_{ref}$

$\hookrightarrow V_{ref} = \frac{7}{2} \times \frac{16}{15} = 3.7\,V$

b) $V_{UT} = -V_{LT} \rightarrow \frac{2R_1}{R_1+R_2} V_{ref} = 0$

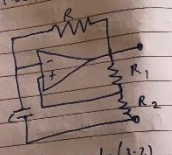
$\hookrightarrow V_{ref} = 0\,V$

Q $\beta = \frac{30}{35+30} = \frac{6}{7+6} = \frac{6}{13} = 0.46$

$T = 2RC\ln\left(\frac{1+\beta}{1-\beta}\right) = 2 \times 50k \times 0.01\mu \times \ln(2.717)$

$= 0.001\,s$

$f = \frac{1}{T} = 10^3\,Hz$



at $\beta_1 \rightarrow \beta_1 = \frac{100+10}{100+100+10} = 0.52$

$T_1 = 2RC\ln\left(\frac{1+\beta_1}{1-\beta_1}\right) = 2 \times 43k \times 0.1\mu \times \ln(3.2)$

$= 0.01\,s$

$f = \frac{1}{T} = 100\,Hz$

at $\beta_2 \rightarrow \beta_2 = \frac{10}{100+100+10} = 0.0476$

$T_2 = 2RC\ln\left(\frac{1+\beta_2}{1-\beta_2}\right) = 2 \times 43k \times 0.1\mu \times \ln(1.1)$

$= 0.82\,s$

$f = \frac{1}{T} = 1220\,Hz$

Q $\beta = \frac{R_1}{R_1+R_2} = \frac{30}{30+30} = 0.5$

$T = RC\ln\left(1+\frac{R_1}{R_2}\right) = 150k \times 1\mu \times 0.693$

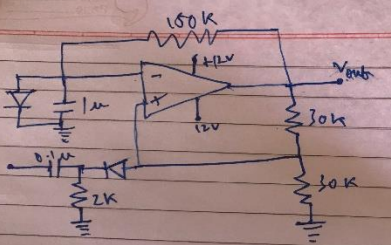
$= 0.104\,ms$

$T_c = RC\ln\left(\frac{1+\beta}{1-\frac{V_D}{V_{cc}}}\right) = 150k \times 1\mu \times \ln\left(\frac{1.5 \times 12}{12-0.7}\right)$

$= 150 \times 10^{-3} \times \ln 0.465 = 70\,ms$

$T_t = 104 + 70$

$= 174\,ms$



For $C = 0.1\mu F$

$R = \frac{1\,ms}{5 \times 0.1\mu}$

$= 2\,K\Omega$