Q1) a) We have $V_{ref} = 2.56V$

Total number of comparator for $n=8$, $2^n - 1 = 2^8 - 1 = 255$

$$\Delta = \frac{2.56}{2^n} = 10mV$$

Thus voltage comparison levels would be $\frac{\Delta}{2}, \frac{\Delta}{2}+\Delta, \frac{\Delta}{2}+2\Delta, \cdots$

i.e $5mV, 15mV, 25mV, \cdots, 2.545V$

b) if $V_{in} = 0.5V$

$b_0 \cdots b_8 = 110010$, Quantization error $= 50 \times \Delta - 0.5 = 0V$

if $V_{in} = 1.054V$

$\therefore b_0 \cdots b_8 = 101001$, Quantization error $= 105 \times \Delta - 1.054 = -4mV$

if $V_{in} = 2.543V$

$b_0, \cdots b_8 = 11111110$, Quantization error $= 254 \times \Delta - 2.543 = -3mV$

Q2) a) For monostable multivibrator using IC 555

$T_{ON} = 1.1RC$

we have $C = 0.5nF$

for $T_{ON} = 10\mu s$

$$R = \frac{10\mu s}{1.1 \times C} = 18.18k\Omega$$

b) if V_{th} is varie

then $V_c(t) = V_{cc}\left(1 - e^{-t/RC}\right)$

if $t = 20\mu s$ then

$V_c(t=20\mu) = 12V\left(1 - e^{-20\mu/(18.18k \times 0.5n)}\right)$

$V_{th} = 10.67V$

Q3) For an Astable circuit, $C = 680pF$

$$\text{Duty cycle} = \frac{(R_A + R_B)}{(R_A + 2R_B)} \quad \& \quad T_{ON} = \ln(2)(R_A + R_B) \cdot C$$

$$T_{OFF} = \ln(2)(R_B) \cdot C$$

$f = 20k\Omega \therefore \frac{1}{20k\Omega} = T_{ON} + T_{OFF} = \ln(2)(R_A + 2R_B) \cdot C$

$\& \quad R_A + 2R_B = 106.08k\Omega \quad \& \quad 0.8 = \frac{R_A + R_B}{R_A + 2R_B} \Rightarrow R_A = 3R_B$

Thus $R_A = 63.64k\Omega$ $R_B = 21.22k\Omega$