Question 1

We know that $V_p = 0.55V_S$ and $V_n = 0.33V_s$

$$t_A = RC\ln\left(\frac{V_P(V_S - V_n)}{V_n(V_S - V_p)}\right)$$
$$= 100\text{k}\Omega \cdot 10\mu\text{F} \cdot \ln\left(\frac{0.55(1-0.33)}{0.33(1-0.55)}\right)$$
$$= 0.9089\text{s}$$

Question 2

From the screen-shot, we see that the Δx is 0.892s. This is close to the calculated t_A. Therefore:

$$f_{\text{osc}} = \frac{1}{\Delta x} = 1.12\text{Hz}$$

Question 3

We see that the period before

$$t_A = RC\ln\left(\frac{V_P(V_S - V_n)}{V_n(V_S - V_p)}\right)$$

and that the period now

$$t'_A = \frac{1}{2}RC\ln\left(\frac{V_P(V_S - V_n)}{V_n(V_S - V_p)}\right)$$

and therefore

$$t'_A = \frac{1}{2}t_A$$

the period is reduced by half (we should see the LED blinks faster)

Question 4

The LED will blink super faster to an extent that the eye could not even capture the changes. The oscilloscope actually captured this change (as the screen-shot indicates).

Question 5

The LED doesn't really affect the behavior of the circuit. The capacitor still discharge / charge in same amount of time no matter LED present or not. The LED, though, do play a role of visually indicating whether the circuit is in HIGH/LOW currently, and showing that the voltage is indeed, frequently changing between HIGH and LOW.

Question 6

Submitted in team document.