3.3 Questions

Assume a system clock frequency of 16 MHz, a prescaler value of 25, and the maximum ARR.

1. What is the time resolution (i.e. minimum time unit) of the input capture function?

$counter\ clock\ freq. = \frac{system\ clock\ freq.}{PSC+1} = \frac{16MHz}{25+1}$

$counter\ clock\ period = \frac{26}{16MHz} = 1.625us \rightarrow$ counter increments every 1.625us

The input capture function copies the counter values into CCR register. The resolution of one count increment is **1.625us**.

2. The pulse width of the ultrasonic sensor's output is in the range 150 µs to 38 ms. What are the differences in CCR values between two consecutive interrupts that correspond to the minimum and maximum pulse widths? Assume that the rising edge is triggered at CCR = 0.

Minimum pulse width → 150us. $\frac{1\ count}{1.625us} * 150us = 92.3\ counts \rightarrow$ **93 counts**

Since there cannot be fractional counts then we must go to the next highest integer which is 93 (if we went down to 92 then only 149.5us would have passed). This means a CCR difference of 93 correlates to the minimum pulse width but we will have a ~1us delay/error because we need to wait until 93 counts for the pulse width to be larger than 150us.

Maximum pulse width → 38000us. $\frac{1\ count}{1.625us} * 38000us = 23384.6\ counts \rightarrow$ **23385 counts**

Since there cannot be fractional counts then we must go to the next highest integer which is 23385 (if we went down to 23384 then only 37.999ms would have passed). This means a CCR difference of 23385 correlates to the maximum pulse width but we will have a ~1us delay/error because we need to wait until 23385 counts for the pulse width to be larger than 38ms.

3. What is the time (in seconds) between two consecutive timer resets?

Maximum ARR = (2^16)-1. The period between resets is ARR+1 so the time between consecutive interrupts is **2^16**.