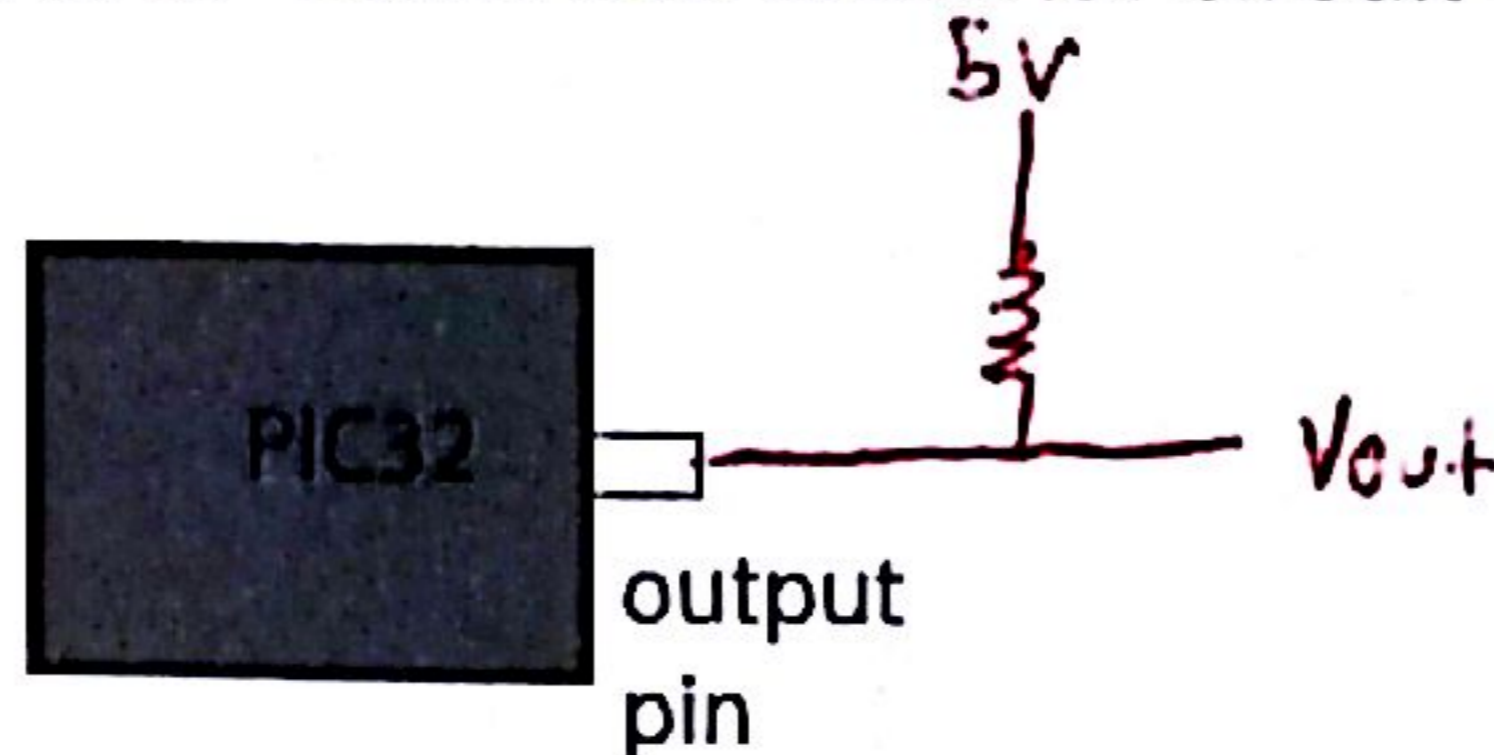
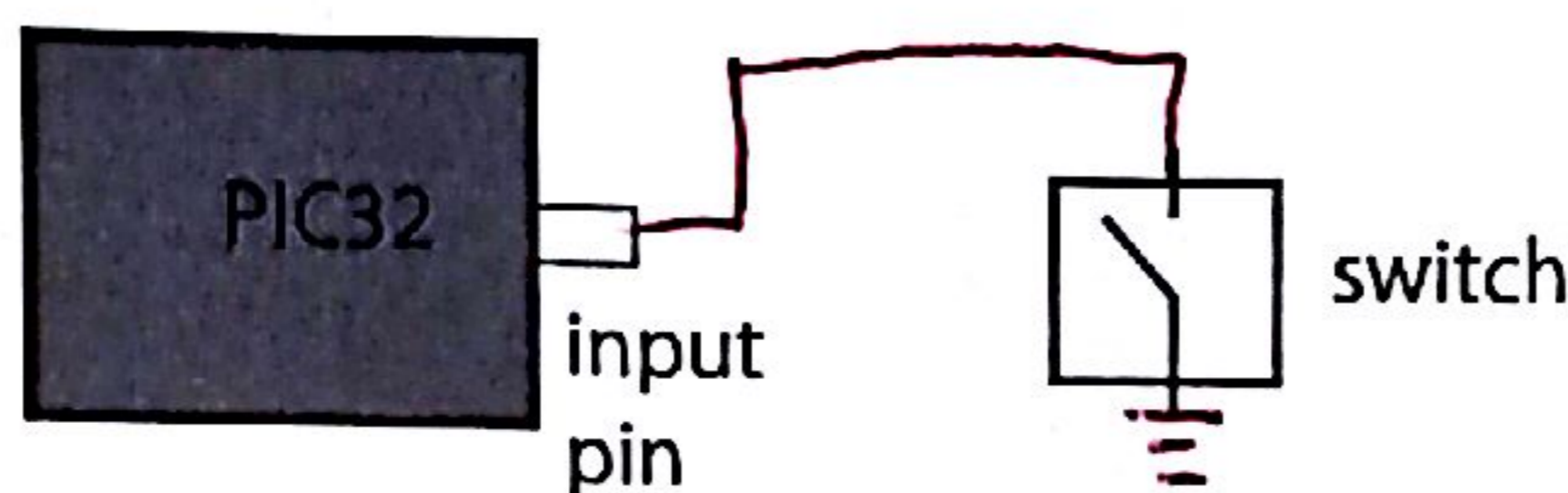


1. You have configured a digital output pin as open drain, and you want this digital output to read 5V when it is high and 0V when it is low. Draw the external circuit connected to this digital output to allow this to happen.



2. Some digital inputs are equipped with internal pull-up resistors. Say you want to use a switch (drawn below) as input on a digital input with an internal pull-up resistor. You want the input to read high when the switch is open and low when the switch is closed. Complete the circuit diagram below.



3. Explain what change notification is.

Triggers an interrupt when a pin value changes from high \rightarrow low or low \rightarrow high.

4. The PIC32 has five 16-bit counter/timers. Which timers can be combined to create a 32-bit timer?

Timer 2+3 and Timer 4+5

5. The 16-bit Timer1 can have prescalers $N = 1, 8, 64, \text{ or } 256$ ($2^0, 2^3, 2^6, \text{ or } 2^8$). What is the maximum number of input pulses (to the prescaler) Timer1 can count before it rolls over? What should the value of the prescaler N and period register PR1 be to achieve this maximum? Feel free to use exponents in your answers. a.) $N \cdot PR1 = 2^8 \cdot 2^{16} = 2^{24}$

$$b.) N = 2^8, PR1 = 65535 \text{ or } 2^{16} - 1$$

6. The output compare module OC5 is using Timer2 to help generate a 100 kHz 25% duty cycle PWM.

(a) Assuming Timer2 uses the 80 MHz PBCLK as input with a prescaler of $N = 1$, what is the value of PR2?

$$\frac{80,000,000}{100,000} = 800 \text{ counts} \quad PR2 = 799$$

(b) What is the value of OC5RS?

$$\frac{800 \text{ counts}}{4} = 200 \quad \text{duty cycle \%} \cdot PR = OC5RS$$

7. Reading an analog input has two steps: sampling to acquire the voltage, and conversion to turn it into a value 0 to 1023. The conversion takes 12 CPU cycles. Explain what is happening during 10 of those cycles.

A binary search that compares voltage estimate from digital analog converter (DAC) to Sample and Hold Amplifier (V_{SHA})