Laboratory Worksheet #06
Analog-to-Digital Conversion

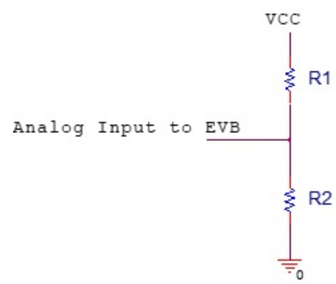

Figure 1: Voltage Divider

The above resistor network has two resistors, R1 and R2 (neither of these are potentiometers), connected in series between 5V and ground (0V). Recall, the total resistance for a series network is $R_{Tot} = R1 + R2$. The voltage across resistors in series is found by using voltage divider concepts. For the circuit shown, the voltage across each resistor is:

$$V_{R1} = \frac{R1}{R1 + R2}(Vcc) \qquad V_{R2} = \frac{R2}{R1 + R2}(Vcc)$$

In general, for N resistors in series, the voltage across the ith resistor is given by

$$V_{Ri} = \frac{Ri}{\sum_{n=1}^{N} R_n}(Vcc)$$

When answering the following questions, the current flowing through the two resistors is 2.5mA and the voltage input to the EVB is 1.25V when VCC = 5V.

Exercise 1:

1)	What is the total resistance of the two resistors?	2000Ω
2)	What is the voltage across R1?	3.75V
3)	What is the voltage across R2?	1.25V
4)	What is the resistance value of R1?	1500Ω
5)	What is the resistance value of R2?	500Ω

6) Using the closest resistor components you can find, build the small circuit and measure the voltage at the EVB input using the voltmeter. How close is it to the spec? (Put your resistors back when finished.)

3.72V. This value is very close to the spec.

Exercise 2: Software Initialization and A/D conversion

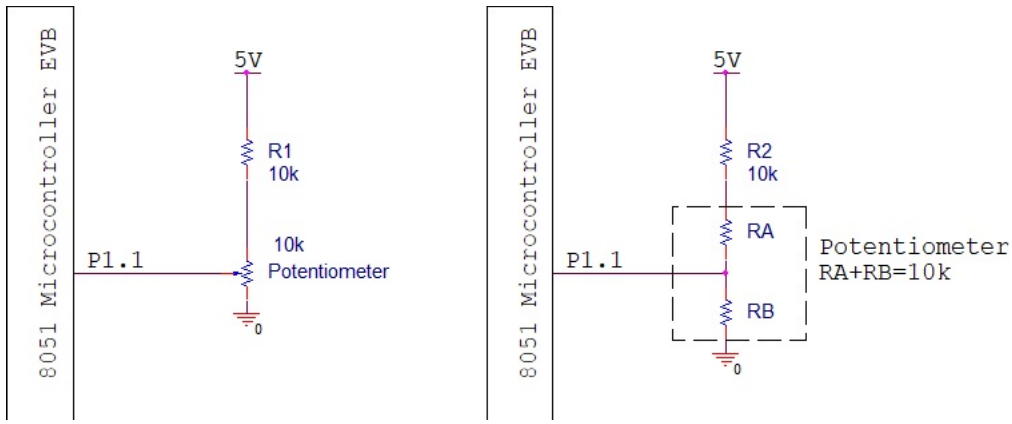

Figure 2: Potentiometer Circuit

In the above circuit, a resistor in series with a potentiometer is shown on the left. The equivalent circuit is shown on the right, with the two variable resistors inside the potentiometer. When determining voltage input to P1.1, you should treat the potentiometer as two resistors in series, making the effective circuit three resistors in series. The voltage at P1.1 is equal to the voltage across the 'bottom' resistor of the potentiometer, RB. The general voltage divider expression from Exercise 1 applies to the circuit. Answer the following questions based on the schematic shown above.

1) Write a function emphvoid Port_Init(void) to configure P1.1 as an analog input. Your function should leave the other bits (0, 2-7) unchanged.

P1MDIN &= ~0x02;	//Set P1.1 as an analog input
P1MDOUT &= ~0x02;	// Set P1.1 as a input port bit
P1 |= 0x02;	// Set P1.1 to a high impedance state

2) Write a function emphvoid ADC_Init(void) to set VREF to use the internal voltage reference of 2.4 V, set the ADC gain to 1, and enable ADC1.

REF0CN = 0x03;	// Configure ADC1 to use VREF
	//
ADC1CF |= 0x01;	// Set a gain of 1
ADC1CN = 0x80;	// Enable ADC1

3) Write a function *void ADC_Test(void)* that performs an ADC (analog to digital conversion) on P1.1 and stores the result in variable *P1_1_Result*.

AMX1SL = 1;	// Set the Port pin number
ADC1CN = ADC1CN & ~0x20;	// Clear the conversion complete flag
ADC1CN = ADC1CN | 0x10;	// Start and A/D conversion
while ((ADC1CN & 0x20) == 0x00);	// Wait for the conversion to be complete
P1_1_Result = ADC1;	// Assign the A/D conversion result

4) When the potentiometer is adjusted such that RA = 6k and RB = 4k, what is the voltage at P1.1? (Apply voltage divider concepts.)

1V

5) Considering parts 3 and 4, what value (unsigned char) will be stored in the variable P1_1_Result?

106

6) If the voltage at P1.1 is now changed to 3.53 V, what value will be stored in P1_1_Result?

255

When complete, include Worksheet 6 with your Laboratory 2 Pre-lab submission.