HW 2: Serial Communication, Optimization, and Feedback Control

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Question 1: SCI

Part A

The advantages of serial over parallel communications are as follows:

- Uses less wires
- It less expensive to implement
- It is easier to increase the the signal frequency.

Part B

```
1   void initSCI1()
2   {
3       // Clock at 14400
4       SC1BD = 104;
5
6       // Enable Odd Parity and Parity Checking
7       SCI1CR1 = 0x03;
8
9       // Enable TX, RX, RXFI, TXEI
10      SCI1CR2 = 0x6c;
11  }
```

Question 2: SPI

```
1   void initSPI()
2   {
3       SPI0BR = 0x52;
4       SPI0CR1 = 0xFD;
5   }
```

Question 3: I2C

Part A

The address is 0b0011010 or 0x1A

Part B

Data is being written to slave device. Data is 0b00010110 or 0x12.

Question 4: PID Control

```
// Time constants. Will be initialized in main().
double Kp; // proportional gain
double Ki; // integral gain
double Kd; // derivative gain

double cumulative_error = 0; // stores the sum of all prior errors
double previous_output = 0; // stores the value of prior output

// make_decision(): generates a drive signal
// - setpoint: desired condition
// - current_output: current condition measured by sensors
double make_decision(double setpoint, double current_output) {

    // PID terms
    double P, I, D;

    // Question (a)
    P = Kp * (setpoint - current_output);

    // Question (b)
    cumulative_error += (setpoint - current_output);
    I = Ki * cumulative_error;

    // Question (c)
    D = Kd * (current_output - previous_output);
    previous_output = current_output;

    return u = P + I - D;
}
```