

Print your name: \_\_\_\_\_

Sign your name: \_\_\_\_\_

*Do not open the exam booklet until you are told to do so.*

**This exam has two parts:**

You will have 1 hour and 40 minutes to complete *both parts* of the exam. You will need to monitor and allocate the time you spend on each part. The instructor will not force you to switch between the two parts. Once you submit Part 1, you cannot return back to it.

There are 130 total possible points on the exam (including 15 bonus points).

**Part 1:** Closed book and closed notes. You are allowed to use a calculator.

Part 1 consists of 10 multiple choice questions (worth 20 points) and five (5) long-answer questions (worth 60 points). **ANSWER THE MULTIPLE CHOICE USING THE ANSWER SHEET AT THE BACK OF THIS QUESTION SHEET.**

**Part 2:** Hands-on, with your laptop, Arduino Inventor's Kit, and multimeter.

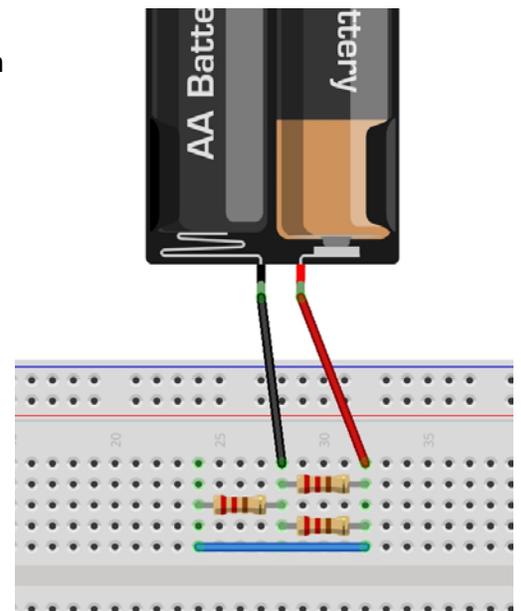
Part 2 is worth 35 points (+15 bonus points), and consists of two (2) questions.

**This exam booklet constitutes Part 1 of the exam. It contains:**

- This cover sheet
- Questions to be answered with closed books, closed notes, and a calculator

### MULTIPLE CHOICE SECTION (20 points)

1. Ohm's Law is an equation that relates the following electrical concepts:
  - a. Voltage, current and resistance
  - b. Resistance and reluctance
  - c. Current, power and voltage
  - d. Voltage and current
2. If a computer uses a 200 W power supply and it is activated for 45 minutes, how much energy has been consumed?
  - a. 540 MJ
  - b. 5.4 kJ
  - c. None of these answers
  - d. 540 kJ
3. You would like to set up a circuit with 2 identical light bulbs and a battery. You hesitate between putting them in series or in parallel. The circuit that dissipates the most power is:
  - a. The same for light bulbs in series and parallel
  - b. Light bulbs in series
  - c. Light bulbs in parallel
  - d. Not possible to determine from the given information.
4. For the circuit discussed in Question 3, the circuit for which the lights are the brightest is:
  - a. Light bulbs in parallel
  - b. The same for light bulbs in series and parallel
  - c. Light bulbs in series
  - d. Not possible to determine from the given information
5. The circuit for which the battery will last the longest is
  - a. The same for light bulbs in series and parallel
  - b. Light bulbs in series
  - c. Light bulbs in parallel
  - d. Not possible to determine from the given information
6. The resistors to the right are:
  - a. In series
  - b. In parallel
  - c. A network of resistors in series and in parallel
  - d. Not enough information to answer



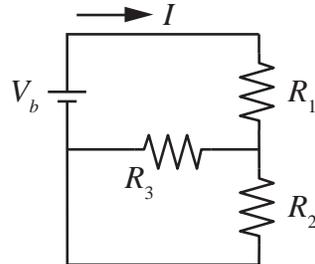
7. Which of the following variable types is **NOT** recognized by the Arduino
- float
  - int
  - long
  - All of these variable types are recognized by the Arduino
8. In the Arduino, what is the symbol used to calculate modulo:
- %
  - #
  - !
  - \$
9. Which of the following statements describes a true outcome from executing the two Arduino statements?

```
pinMode(5,OUTPUT);  
analogWrite(5,128);
```

- A pulse-width modulated signal is generated for 128 milliseconds
  - A square wave is generated on channel 5 that is used to approximate 2.51V
  - A square wave signal with a pulse height of 128mV is sent to channel 5
  - An error because the pinMode statement should use ANALOG not OUTPUT
10. In Excel, what symbol is used to change a relative cell reference into an absolute cell reference?
- %
  - #
  - !
  - \$

**LONG ANSWER SECTION (60 points)**

1. (26 points) For the circuit shown, if  $R_1 = 330\Omega$ ,  $R_2 = 1k\Omega$ ,  $R_3 = 470\Omega$  and  $V_b = 100V$ , fill in the missing values in the table below.



	<b>R1</b>	<b>R2</b>	<b>R3</b>	<b>Req</b>
<b>V</b>				
<b>I</b>				
<b>R</b>				
<b>P</b>				

2. (10 points) Fill in the blanks for the following statements:

```
int duty, reading;

reading = analogRead(1);
Serial.println(reading);
duty = reading*255.0/1023.0;
duty = constrain(duty,100,200);

analogWrite(11, duty);
```

reads a value from pin number \_\_\_\_\_. The number assigned to **duty** is initially in the range \_\_\_\_\_ to \_\_\_\_\_, which corresponds to a voltage between \_\_\_\_\_ and \_\_\_\_\_. Subsequently, the number stored in **duty** is modified to be between \_\_\_\_\_ and \_\_\_\_\_. The **analogWrite** command sends a \_\_\_\_\_ (type of signal) to pin \_\_\_\_\_. Additionally, the Arduino displays the value of \_\_\_\_\_ on the serial monitor.

b) (4 points) If the value of **reading** is found to be 859, what is the input voltage of the signal entering the Arduino? Show your working!

3. (20 points) The box below contains an incomplete Arduino program. Fill in the missing pieces so that the code produces the output in the Serial Monitor below. Your code *must use the two loops* shown in the box below. Include all missing code, including the code to print values to the Serial Monitor. Your code should only be added to the setup() function. The loop() function must remain empty.

```
BEGIN:  
0  
2  
4  
6  
8  
  
8  
4  
0  
  
END
```

```
void setup() {  
  
    for (          ) {  
  
    }  
  
    for (          ) {  
  
    }  
  
}  
void loop() {}
```

4. (A) (5 points) The image to the right is a screen shot of an Excel worksheet. What numerical values are stored in the cells adjacent to x and y in the fifth and sixth rows (ie. B5 and B6)? Show your computations.

x:

	A	B
1	<b>A</b>	<b>3.2</b>
2	<b>B</b>	<b>2.2</b>
3	<b>C</b>	<b>5</b>
4		
5	<b>x</b>	<b>=(B1-B2)^2</b>
6	<b>y</b>	<b>=B1*EXP(-B2*B3)</b>
7		
8		
9		
10		

y:

(B) (5 points) Imagine that you were explaining this worksheet to a person who was completely unfamiliar with Excel. Explain the formatting, syntax and symbology used in this worksheet to that person.



1. (20 points) Complete the following tasks using Excel or another spreadsheet on your laptop
  - a.  $x$  is a variable that can take any integer value between -5 and 5. Enter all the values of  $x$  in a column labeled “ $x$ ”.
  - b. In an adjacent column, labeled “ $y$ ”, compute  $y$ . This variable is a function of  $x$  and behaves as:  
$$y(x) = x^3 \qquad -5 \leq x \leq 0$$
$$y(x) = x \cdot \log(x) \qquad 0 < x \leq 5$$

Do not compute the values with a calculator to then enter them into cells in Excel.
  - c. Make a plot of  $y$  versus  $x$ . The data points should be identified by symbols and *not* connected by lines or smooth curves.
  - d. Add labels to the axes of the plot. “ $x$ ” and “ $y$ ” are acceptable labels.

Once you have completed this question, be sure to upload your file into the Excel problem DropBox on D2L. You will only be able to upload one time and it is advised that you save your work regularly prior to uploading. Make sure you include your first and last names in the filename!

DO NOT UPLOAD IT INTO THE ARDUINO DROPBOX.

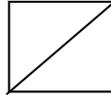


# ME 120: Introduction to Engineering

## Winter 2016

### SECTION A – MULTI CHOICE ANSWER SHEET

Indicate your answers like this:



	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>
<b>1</b>				
<b>2</b>				
<b>3</b>				
<b>4</b>				
<b>5</b>				
<b>6</b>				
<b>7</b>				
<b>8</b>				
<b>9</b>				
<b>10</b>				

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