

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 50 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.

There are 140 (+10 bonus points) total possible points on the exam.

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 6 long-answer questions (worth 80 points).

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

Part 2 is worth 40 points (+10 bonus points), and consists of two 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. Resistance and reluctance
 - b. Current, power and voltage
 - c. Voltage, current and resistance
 - d. Voltage and current

2. If a computer uses a 250 W power supply and it is activated for 30 minutes, how much energy has been consumed?
 - a. 450 kJ
 - b. 4.5 MJ
 - c. 4.5 kJ
 - d. None of the above

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. Light bulbs in series
 - b. Light bulbs in parallel
 - c. The same for light bulbs in series and 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 series
 - b. Light bulbs in parallel
 - c. The same for light bulbs in series and parallel
 - d. Not possible to determine from the given information

5. The circuit for which the battery will last the longest is
 - a. Light bulbs in series
 - b. Light bulbs in parallel
 - c. The same for light bulbs in series and parallel
 - d. Not possible to determine from the given information

6. What are the colors of a 620 k Ω resistor?
 - a. blue – blue – black
 - b. blue - red – green
 - c. blue – red - black
 - d. red – green – green

color	digit
black	0
brown	1
red	2
orange	3
yellow	4
green	5
blue	6
violet	7
gray	8
white	9

7. Which of the following statements describes a true outcome from executing the two Arduino statements?

```
pinMode(5,OUTPUT);  
analogWrite(5,100);
```

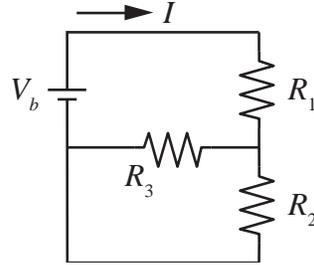
- a. An error because the pinMode statement should use ANALOG not OUTPUT
 - b. A square wave is generated on channel 5 that is used to approximate 1.96V
 - c. A square wave signal with a pulse height of 100mV is sent to channel 5
 - d. A pulse-width modulated signal is generated for 100 milliseconds
8. Which of the following variable types is **NOT** recognized by the Arduino
- a. float
 - b. int
 - c. long
 - d. fraction
9. What are the values of x, y and z at the end of the following code block?

```
int a,b,z;  
x = 3;  
y = 5;  
z = 15 - 10*(x/y);
```

- a. x = 3, y = 5, z = -45
 - b. x = 3, y = 5, z = 15
 - c. x = 3.0, y = 5.0, z = 15.0
 - d. x = 3, y = 5, z = -45.0
10. In Excel, what symbol is used to change a relative cell reference into an absolute cell reference?
- a. %
 - b. #
 - c. !
 - d. \$

LONG ANSWER SECTION (80 points)

1. (16 points) For the circuit shown, if $R_1 = 250k\Omega$, $R_2 = 300k\Omega$, $R_3 = 250k\Omega$ and $V_b = 10V$, fill in the missing values in the table below.



	R1	R2	R3	Req
V				
I				
R				
P				

2. (8 points) Fill in the blanks for the following statements:

```
int duty, reading;

reading = analogRead(1);
Serial.println(reading);
duty = reading*255.0/1023.0;
analogWrite(9, duty);
```

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

3. (16 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.

```
1  
3  
5  
7  
9  
  
9  
6  
3  
0
```

```
void setup() {
```

```
    for (          ) {
```

```
    }
```

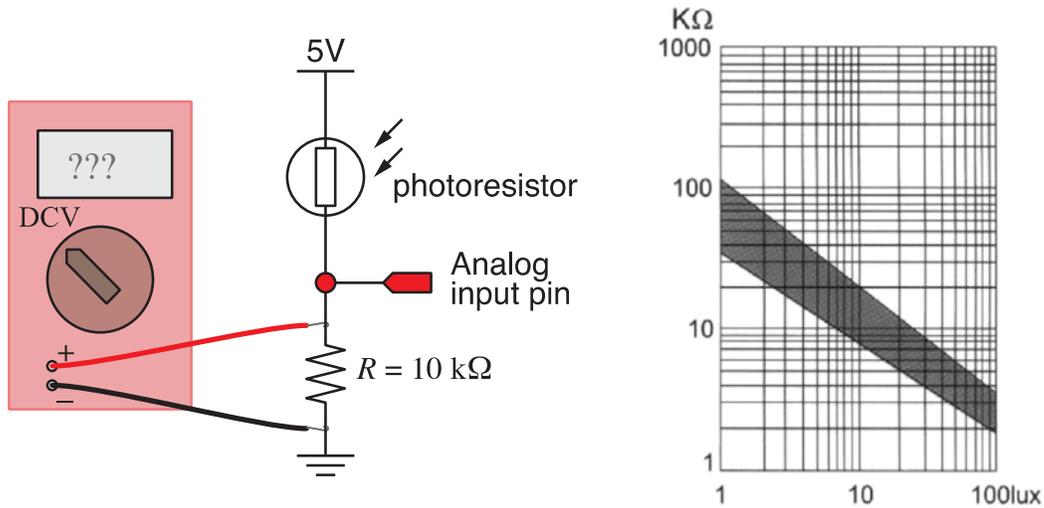
```
    for (          ) {
```

```
    }
```

```
}
```

```
void loop() {}
```

4. (15 points) A photoresistor and a conventional resistor are connected in series with a 5V power supply as shown in the circuit diagram below. If the photoresistor is illuminated with 12 lux of light:
- What voltage (or range of voltages) would be present on the analog input pin?
 - What function would you use to read the value on the analogue input pin
 - If this value (or range of values) were to be stored in a variable, the value(s) of this variable would be?
 - What happens if the photoresistor and conventional resistor are swapped around?
 - What would the new voltage present on the analog input pin be?



5. (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? Show your computations.

x:

y:

		C15	
		A	B
1	A	5.4	
2	B	2.2	
3	C	3	
4			
5	x	$= (B1-B2)^{B3}$	
6	y	$= B1*EXP(-B2*B3)$	
7			

(B) (5 points) Provide the analysis or explanation for your answer in part A above.

