

Print your name: _____ Sign your name: _____



Portland State
UNIVERSITY

ME 120: Introduction to Engineering

FINAL EXAMINATION

Winter 2016

TIME ALLOWED: One (1) hour and fifty (50) minutes

TOTAL: 140 points

INSTRUCTIONS: **DO NOT OPEN THE EXAM BOOKLET UNTIL YOU ARE TOLD TO DO SO.**

Answer **all** questions.

Section A is multiple-choice and is out of 20 points.

Section B consists of 4 long answer questions (each worth 20 points) and is out of 80 points.

Section C consists of practical exercises using MS Excel and SolidWorks and is out of 40 points.

Correcting fluid or tape is not permitted.

Hand held devices other than non-programmable calculators are not allowed.

NOTES: Candidates should show **all working** in calculations.

Answer question 1 (multi-choice) using the answer sheet at the rear of this paper.

Section A - Multi-choice (20 points)

Answer this section on the answer sheet provided at the rear of this paper.

You will score two (+2) points for every CORRECT answer; minus one (-1) point for every INCORRECT answer and zero (0) points for NO ANSWER. You cannot score less than zero.

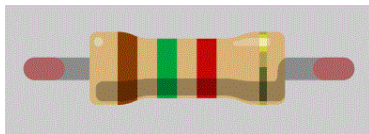
1. A potentiometer has three pins

- A. True
- B. False

2. The function Serial.println (val) will print the value stored in the variable val. Because it is Serial.println and not Serial.print, the next variable printed will be on a new line.

- A. True
- B. False

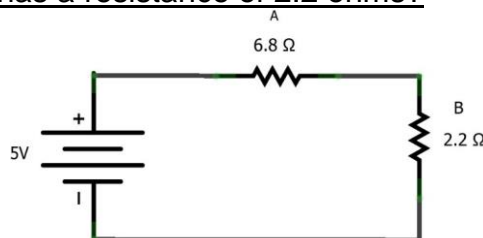
3. Determine the resistance of the shown resistor.



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

- A. 5.1 k Ω
- B. 2.1 M Ω
- C. 250 Ω
- D. 1.5 k Ω

4. What is the total resistance of the circuit shown if resistor A has a resistance of 6.8 ohms and resistor B has a resistance of 2.2 ohms?



- A. 6.8 ohms
- B. 9 ohms
- C. 1.66 ohms
- D. 4.6 ohms

5. When uploaded, how will the following code appear in the serial monitor?

```
void setup() {  
  Serial.begin(9600);  
}  
  
void loop() {  
  int i;  
  for ( i=0; i<10; i++) {  
    i = 5;  
    Serial.println(i);  
  }  
  Serial.println("for loop over\n");  
}
```

- A. The serial monitor will constantly scroll with the value 5.
- B. The serial monitor will constantly scroll between the values 0 and 5 increasing by increments of 1.
- C. The serial monitor will constantly scroll between the values 0 and 9 increasing by increments of 1 and ending each loop with the statement "for loop over"
- D. The serial monitor will constantly scroll between the values 0 and 10 increasing by increments of 1.

6. In the list below, which of these options is not a selection of layer in SolidWorks when using the fan project template?

- A. CUT
- B. ENGRAVE
- C. RASTER
- D. IMPRINT

7. In Excel, what symbol is used to change a relative cell reference into an absolute cell reference?

- A. %
- B. \$
- C. #
- D. !

8. When uploaded, how will the following code appear in the serial monitor?

```
void setup() {  
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void loop() {  
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    i = 5;  
    Serial.println(i);  
  }  
  Serial.println("for loop over\n");  
}
```

- A. The serial monitor will constantly scroll with the value 5.
- B. The serial monitor will constantly scroll between the values 0 and 5 increasing by increments of 1.
- C. The serial monitor will constantly scroll between the values 0 and 9 increasing by increments of 1 and ending each loop with the statement "for loop over"
- D. The serial monitor will constantly scroll between the values 0 and 10 increasing by increments of 1.

9. To measure voltage the multimeter should be placed in:

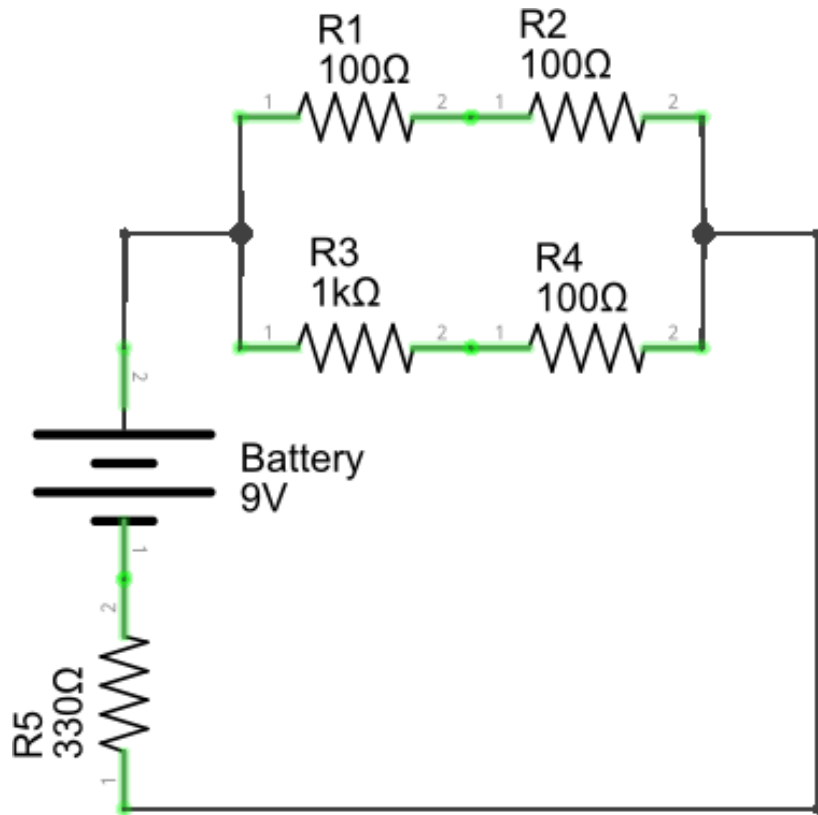
- A. Parallel
- B. Series
- C. It does not matter
- D. A multimeter cannot measure voltage

10. In a simple photoresistor circuit, a resistance is added in series to the photoresistor. Why?

- A. To reduce the voltage across the photoresistor
- B. To reduce the current going through the photoresistor
- C. To avoid short circuits if the photoresistor has a high resistance value
- D. To avoid short circuits if the photoresistor has a low resistance value

Section B – Long answer questions

Question 1: For the circuit shown, fill in the missing values in the table below.



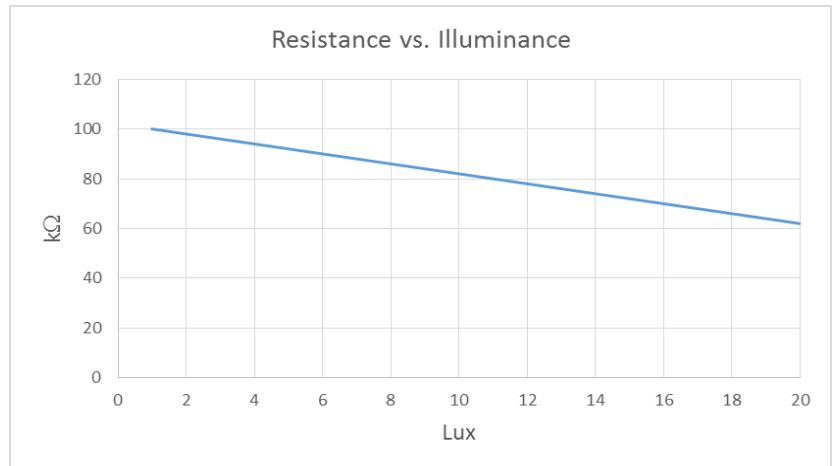
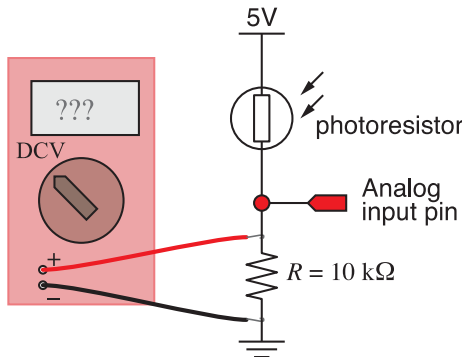
	R1	R2	R3	R4	R5	Req
V						
I						
R						
P						

Question 1 working

Question 2

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:

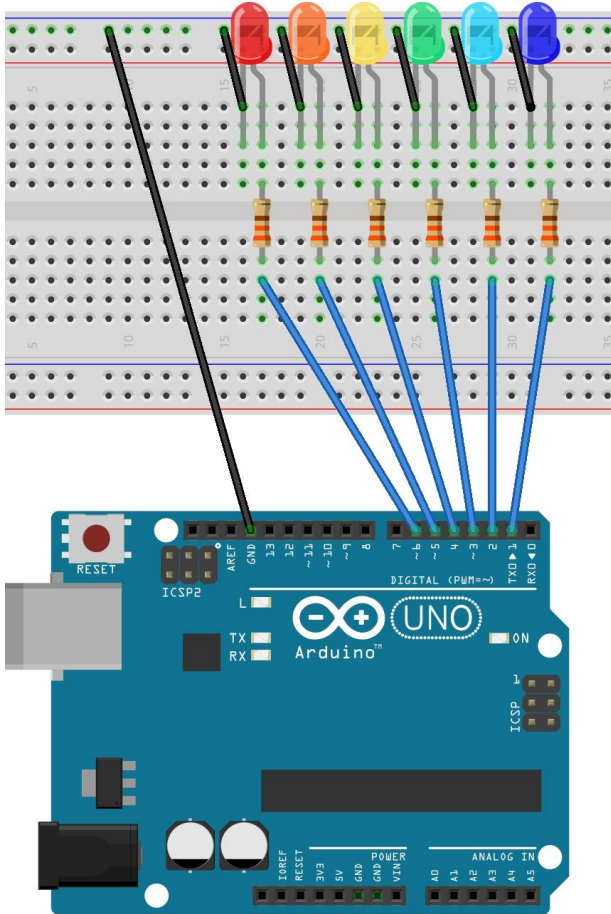
- What voltage would be present on the analog input pin?
- What function would you use to read the value on the analogue input pin?
- If this value were to be stored in a variable, the value of this variable would be?
- What happens if the photoresistor and conventional resistor are swapped around?
- What would the new voltage present on the analog input pin be?



Question 2 working

Question 3

- a) What does the circuit below do? The arduino board is connected to a computer, running the code written to the right.
Be as explicit as possible.



```
int timer = 100;

void setup() {
  for (int thisPin = 2; thisPin <= 6; thisPin++) {
    pinMode(thisPin, OUTPUT);
  }
}

void loop() {
  for (int thisPin = 2; thisPin < 6; thisPin++) {
    digitalWrite(thisPin, HIGH);
    delay(timer);
    digitalWrite(thisPin, LOW);
  }

  for (int thisPin = 6; thisPin >= 2; thisPin--) {
    digitalWrite(thisPin, HIGH);
    delay(timer);
    digitalWrite(thisPin, LOW);
  }
}
```

b) Re-write the code shown in a) using a user-defined function. The code modification should not change the behavior of the circuit. The user-defined function will be called in the void loop() function and will have three arguments: the lowest and highest digital pin numbers used to turn the LEDs on, and the time LEDs will be on. It should be the only line of code in the void loop() function.

c) Show how you would change the code shown in a), to have only every other LED turn on?
(you can write on the printed code)

Question 4

- a) Describe the six (6) different holes (holes for zip ties count as one type) drilled in the pump body: list the hole types in chronological order, with briefly describing their purpose.
- b) Distinguish which hole needed relatively high precision, medium precision, low precision. Explain why.
- c) Describe all the components added to the pump body to fabricate the pump, with clearly describing their purpose. The only parts missing to run the pump should be hoses and power supply.

ROUGH WORKING – will NOT be graded

Section C – Practical Exercises

**DO NOT START THIS SECTION WHILE YOU STILL
HAVE SECTIONS A & B IN YOUR POSSESSION!!**

1. Excel Problem (20 points)

A research group has been working on new sound level sensor interfaced with an Arduino through one of the analog input channels. They record the following readings on the serial monitor:

Sound level (dB)	Arduino input (raw)
1	10
5	420
10	510
15	550

Complete the following tasks using MS Excel or another spreadsheet

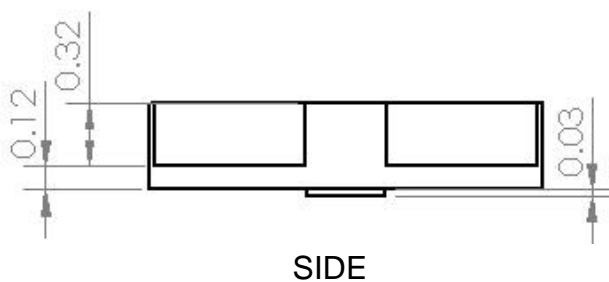
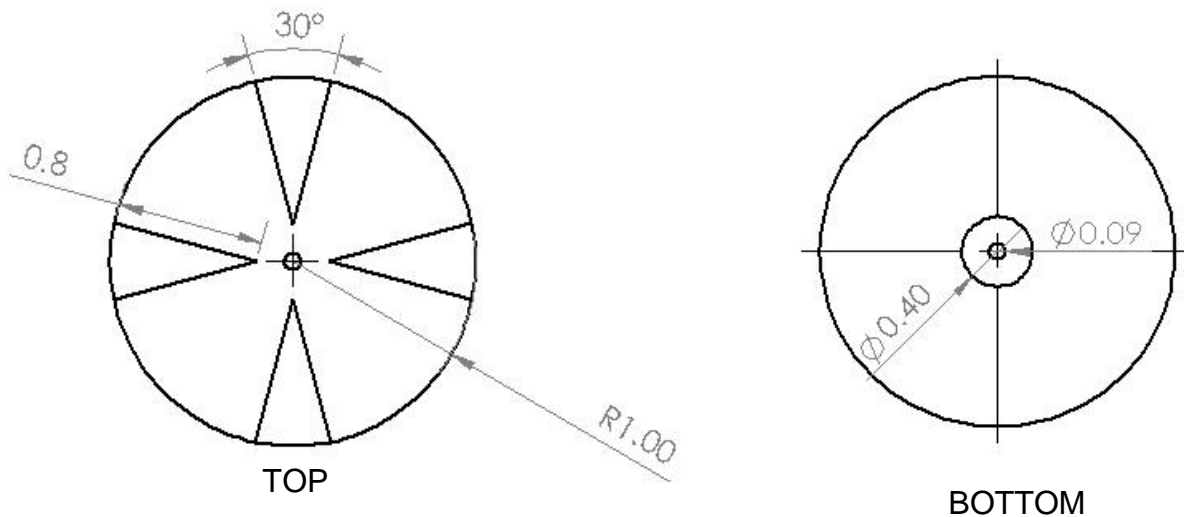
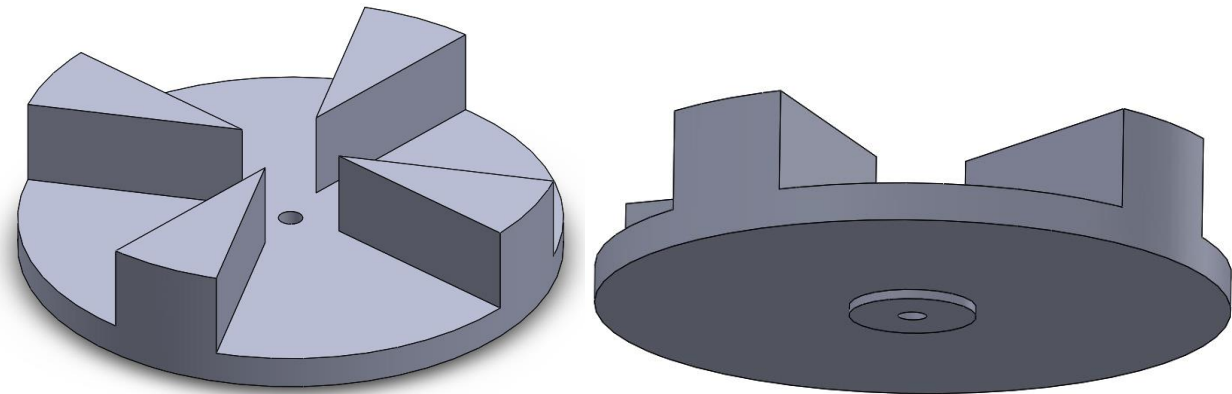
- Generate a table of the values given with clearly labels columns.
- Using this table, generate a plot of Arduino input vs Sound level. The data points should be identified by symbols and *not* connected by lines or smooth curves.
- Add a title and axis labels to the plot.
- Generate a best-fit line for the data and indicate the equation and R^2 value of this line.
- Under your table generated in part (a), briefly discuss your choice of best-fit line.

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 SOLIDWORKS DROPBOX.

2. SolidWorks Problem (20 points)

To celebrate Pi day (ie. today!), a student generates the following “pie-inspired” pump impeller. Using Solidworks, recreate the part shown below (ALL UNITS ARE IN INCHES).



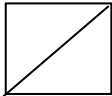
Once you have completed this question, be sure to upload your file into the Solidworks problem DropBox on D2L. You will only be able to upload one time and it is advised that you save your work regularly prior to uploading. Make sure you include your first and last names in the filename!

DO NOT UPLOAD IT INTO THE EXCEL DROPBOX.

Print your name: _____ Sign your name: _____

ME 120: Introduction to Engineering Winter 2016

SECTION A – MULTI CHOICE ANSWER SHEET

Indicate your answers like this: 

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