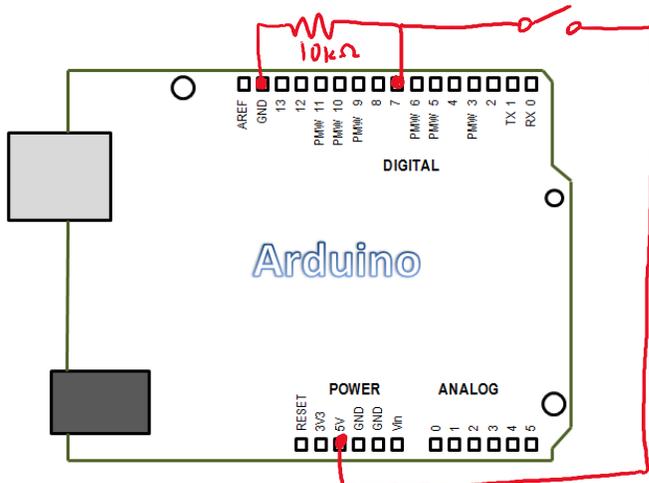
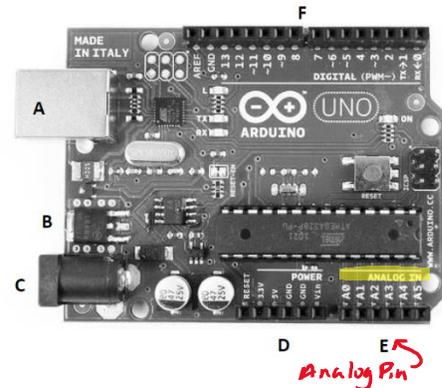


Exam Practice Problems (3 Point Questions)

Below are practice problems for the three point questions found on the exam. These questions come from past exams as well additional questions created by faculty. Some of the questions below appear as fill-on-the-blank. These were taken from previous iterations of the ENGR 121 Exam. Your test will consist of only multiple choice. Please note that these are just examples of questions and may not cover all concepts that could be asked in the 3-point section on your exam.

Electricity and Circuitry

1. If a voltage of 3.1 volts is sensed at a digital input on the Arduino, then the digitalRead() command will return a value of HIGH (high, low, ambiguous).
2. If a voltage of 1.8 volts is sensed at a digital input on the Arduino, then the digitalRead () command will return a value of LOW.
 - a. 1
 - b. 1023
 - c. Ambiguous
 - d. HIGH
 - e. 655
 - f. LOW
 - g. 368
3. When considering electricity, the difference between the strength of the electron supply and the severity of the electron shortage defines the voltage.
4. If you wanted to measure the light level striking a photoresistor as demonstrated in class, where would you need to plug in the wire to sense the state of the photoresistor circuit?
 - a. A
 - b. B
 - c. C
 - d. D
 - e. E
 - f. F
5. Draw the circuit diagram for a whisker circuit as it should be connected to the Arduino board below. Please show the switch and a 10kΩ resistor in the circuit.



6. A multimeter measures quantities by either hooking its leads so that they are either in parallel with something in the circuit, or in series with the rest of the circuit. If the leads are placed in series with the circuit, the multimeter must be measuring:
- Capacitance
 - Current
 - Power
 - Resistance
 - Voltage (AC)
 - Voltage (DC)
7. Which of the following materials would NOT be a good conductor?
- Air
 - Copper
 - Gold
 - Aluminum
 - Plastic
 - Silver
 - b, c, and d
 - a and e
 - a, d, and e
8. The unit of newton-meter is equivalent to the unit of:
- Joules
 - Joules per second
 - Mass
 - Meters² per second²
 - Watts
 - Weight
9. You are given a resistor that has the color code of red-white-blue. The resistor must have resistance of about:
- red white blue
2 9 6
29,000,000 Ω
- 110 ohms
 - 220 ohms
 - 296 ohms
 - 1000 ohms
 - 22,000 ohms
 - 29,000 ohms
 - 29,000,000 ohms
10. Power can be calculated from which of the following expressions?
- $P = I \cdot V = I^2 R = \frac{V^2}{R}$
- Voltage * current ✓
 - Current * voltage ✓
 - Current² * resistance ✓
 - Voltage² * resistance
 - Current² / resistance
 - Voltage² / resistance ✓
 - a, b, c, and f
 - b, c, and f
 - a, b, d, and e
 - b, d, and e

11. If a resistor has color stripes of brown, green and orange, then the resistance is closest to...

- a. 15 Ω
- b. 152 Ω
- c. 215 Ω
- d. 1500 Ω
- e. 5100 Ω
- f. 15000 Ω
- g. 21500 Ω

brown green orange
1 5 3

15000 Ω

12. Which of the units below is equivalent to a Joule of energy?

- a. $\frac{kg}{s}$
- b. $\frac{kg \cdot m}{s}$
- c. $\frac{kg \cdot m}{s^2}$
- d. $\frac{kg \cdot m^2}{s^2}$
- e. $\frac{kg \cdot m^3}{s}$
- f. $\frac{kg}{\frac{kg \cdot m^3}{s}}$

$$J = N \cdot m = \frac{kg \cdot m}{s^2} \cdot m = \frac{kg \cdot m^2}{s^2}$$

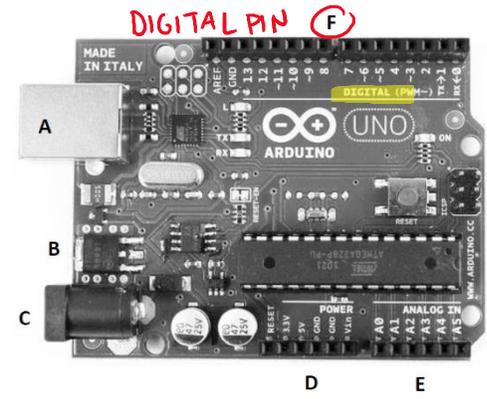
13. The unit of electric potential is the Volt. The basic units which define the Volt are...

- a. $\frac{\text{meter}^3}{\text{second}}$
- b. $\frac{\text{Joule}}{\text{Coulomb}}$
- c. $\frac{\text{Joule}}{\text{second}}$
- d. $\frac{\text{electrons}}{m^3}$
- e. $\frac{\text{electrons}}{\text{ohm}}$
- f. $\frac{\text{Coulomb}}{\text{second}}$
- g. $\frac{\text{electrons}}{\text{bushel}}$

$$\text{Volt} = \frac{\text{Joule}}{\text{Coulomb}}$$

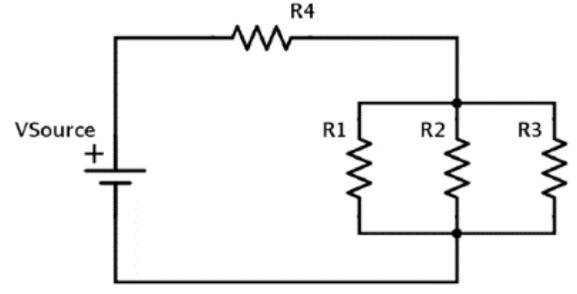
14. If you wanted to make an LED flash on and off repeatedly using the Arduino (the way we did early in ENGR 120, where we had an LED and a resistor in series on the breadboard), you would need one wire going from your breadboard back to GND. Where on the Arduino would you hook up the other wire?

- a. A
- b. B
- c. C
- d. D
- e. E
- f. F**



15. If you want to measure the current passing through R3, you should set your multimeter to _____ and connect the leads _____ . Assume that you can make changes to the wiring to help you make this measurement (if needed).

- a. DCV...in series with R3.
- b. DCV...in parallel with R3.
- c. DCA...in parallel with R2.
- d. DCA...in parallel with R3.
- e. DCA...in series with R3.**
- f. DCA...in series with R4.
- g. It is impossible to measure the current through R3.



16. A joule **(IS, IS NOT)** equivalent to a Newton-meter.

Linear Regression

17. When linear regression is applied, the term “r²” is used to determine the quality of the best fit curve. What is the name of the r² term? Coefficient of **DETERMINATION** .

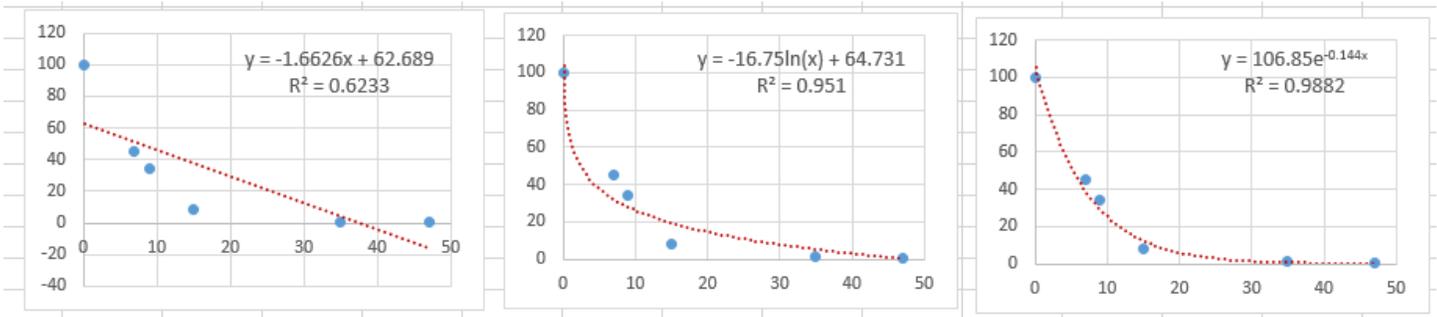
18. An r² value of 1.0 represents a perfect fit (**True** or False).

19. The official name for the r² which measures the “goodness of fit” is . . .
- a. the coefficient of amazingness
 - b. the coefficient of friction
 - c. the coefficient of uncertainty
 - d. the coefficient of determination**
 - e. the coefficient of robot squared
 - f. the mother of all coefficients
 - g. none of the above

20. The r^2 value provides a measure of how well the best-fit line fits the actual data. What is the r^2 value called?
- Least Squares slope
 - Greatest Squares coefficient
 - Y-intercept
 - Sum of squared error coefficient
 - Coefficient of roughness
 - Coefficient of grit
 - Coefficient of determination**
 - Modulus of Elasticity

21. Which type of model will best fit the data shown in the graphs?

- Linear
- Exponential**
- Power
- Polynomial
- Sinusoidal
- Fashion



22. The coefficient of determination (R^2) is an indication of HOW WELL THE BEST FIT LINE FITS THE ACTUAL DATA.

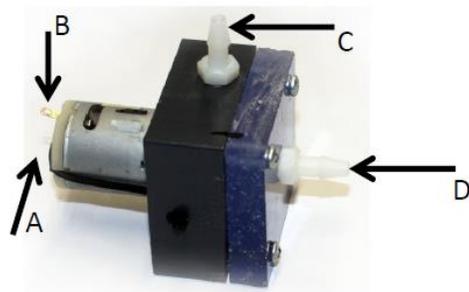
Fabrication

23. The type of drill bit used to drill the large, flat-bottomed holes in the pump body are called FORSTNER bits (starts with an F).
24. The name of the company where most of the materials used to fabricate the pump were ordered is McMaster-Carr.
25. The bushing in the pump (the small metal insert pressed into the hole to properly align the motor shaft and to provide for sealing) was made of what material? BRASS

26. The name of the company where the gray PVC rod used to make the pump body was purchased is:
- Digikey
 - McMaster
 - Walmart
 - KFC industrial
 - Tolliver
27. The body of the pump is made of what material?
- nitrogen120
 - PVC
 - HDPE
 - Bronze
 - Acrylic
 - Polyester
 - UHMWPE
 - Kryptonite
 - Teflon
28. The large drill bits (1 inch and 1.25 inch) used to make the impeller cavity in the pump body are commonly called...
- #44 bits
 - Q bits
 - N bits
 - bacon bits
 - end mills
 - Forstner bits
 - jobber bits
 - flat-bottomed, rotational cutting implements

Pump and Efficiency

29. The head is measured from:
- The bottom of the pump to the exit tube
 - The top of the pump to the exit tube
 - The center of the pump to the exit tube
 - The top of the water supply to the exit tube
 - The bottom of the water supply to the exit tube
 - The center of the water supply to the exit tube
 - The floor to the exit tube
30. Which port on the pump is the water inlet?
- A
 - B
 - C
 - D
 - A & B
 - C & D
 - All of the above
 - None of the above



31. A cylindrical container 1-inch in diameter and 2-inches tall is filled with water. The volume of the water in the container is closest to...

- a. 0.026 L
- b. 0.054 L
- c. 0.075 L
- d. 0.103 L
- e. 0.371 L
- f. 0.987 L
- g. 1.57 L
- h. 1.94 L
- i. 8.71 L

$$V = \frac{\pi}{4} (1\text{in})^2 (2\text{in}) = 1.57\text{in}^3 \cdot \left(\frac{0.0254\text{m}}{1\text{in}}\right)^3 \cdot \frac{1\text{L}}{0.001\text{m}^3} = 0.0257\text{L}$$

32. Which of the statements below is true?

- a. potential energy has units of Joules per second
- b. kinetic energy has units of Joules per hour
- c. potential energy and kinetic energy both have units of Joules
- d. electrical energy has units of Coulombs/second
- e. the force exerted by a gram of water is one Newton
- f. the fundamental unit of electrical charge is the "sparky"
- g. a force multiplied by a distance is a horsepower

33. If the mass of water in the Ruston water tower is 1Mg (mega-gram) and it is positioned at an average height of 50m, it must have a potential energy of 490500J.

$$1\text{Mg} = 1 \times 10^6\text{g} \cdot \frac{1\text{kg}}{1000\text{g}} = 1000\text{kg}$$

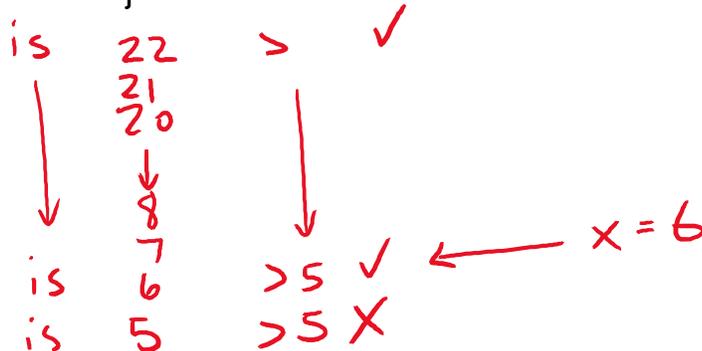
$$PE = mgh = 1000\text{kg} \left(9.81\frac{\text{m}}{\text{s}^2}\right) (50\text{m}) = 490500\text{J}$$

Arduino Programming

34. Consider the Arduino code below. When this for statement is executed, x will take on different values. The **smallest** value of x that will be printed to the serial monitor is...

- a. -65535
- b. -32767
- c. 0
- d. 5
- e. 6
- f. 21
- g. 22
- h. 225
- i. 32767
- j. 65535

```
for (int x=22; x>5; x--) {
  Serial.println(x);
}
```



35. Assuming the white wire of a servo is connected to pin 12, what will the following sketch cause the servo to do?

- a. Spin at a constant speed forever
- b. Spin at a constant speed for 2s then stop
- c. Start out stationary and increase gradually to full speed over 2s
- d. Start out at full speed and slow down gradually to stop over 2s
- e. Alternately spin clockwise then counterclockwise for 2s each
- f. Remain stationary forever

```
#include <Servo.h>

Servo myservo1;

void setup() {
  myservo1.attach(12);
  myservo1.writeMicroseconds(1480);
}

void loop() {
  delay(2000);
}
```

SolidWorks

36. If you wanted to model the part shown by a single sketch and a single feature in Solidworks, which type of feature could you use?

- a. Extruded Boss/Base ✓
- b. Revolved Boss/Base ✓
- c. Extruded Cut
- d. Fillet
- e. Linear Pattern
- f. Mirror
- g. a or b
- h. a and e

