

**NOTE:** This exam was given in October of 2010 and provides sample questions. The format of the exam is subject to change. The written portion of the new exam may include only multiple choice questions, although both qualitative and quantitative questions can be expected. Expect at least one challenge problem (alligator problem).

**ENGR 120                      Exam 1                      Name :** \_\_\_\_\_

**Written Portion:** Allowed materials include calculator (without wireless capability), pencil or pen

*Honor Statement:* On my honor, I promise that I have not received any outside assistance on this exam (I didn't look at another student's paper, I didn't view any unauthorized written materials, I didn't talk or listen to another student, . . .). \_\_\_\_\_ signature

**Information that you may need:**

1 coulomb =  $6.28(10)^{18}$  electrons  
Avogadro's Number =  $6.022(10)^{23}$  per mol

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

1. (2 points) A material that conducts electricity well is called a \_\_\_\_\_.
2. (2 points) Modern materials designed to conduct electricity only under certain conditions are called \_\_\_\_\_.
3. (2 points) \_\_\_\_\_ is a measure of the strength of an electron supply and the severity of the electron shortage.
4. (2 points) The definition of an amp, based on fundamental units or quantities, is \_\_\_\_\_.
5. (2 points) Water pressure is the mechanical analogous to what electrical quantity? \_\_\_\_\_
6. (2 points) \_\_\_\_\_ Current Law says that the sum of currents entering a node in a circuit is zero (no electrons are created).
7. (2 points) 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, low, ambiguous).
8. (2 points) The Arduino Duemilanove has \_\_\_\_\_ digital I/O pins and \_\_\_\_\_ analog input pins.
9. (2 points) The device that we stuck to the aluminum plate on our robots beside our Arduino boards is called a \_\_\_\_\_. This device allows you to quickly prototype circuits without soldering or special connectors.
10. (3 points) A resistor with a yellow-violet-orange stripe pattern would have a resistance of approximately \_\_\_\_\_.

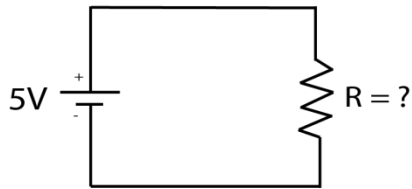


15. (5 points) If  $1.57(10)^{19}$  electrons leave a DC power source over a 2-minute period, then the average current is closest to . . .

- (a) 0.021A
- (b) 0.032A
- (c) 0.043A
- (d) 0.054A
- (e) 0.066A

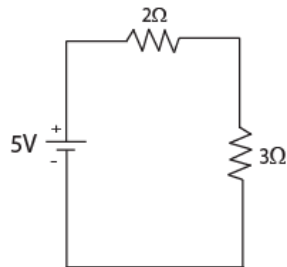
16. (5 points) If a current of 40mA ( $1000\text{mA} = 1\text{A}$ ) leaves the power source, then the resistance R is closest to . . .

- (a)  $0.1\Omega$
- (b)  $0.25\Omega$
- (c)  $125\Omega$
- (d)  $250\Omega$
- (e)  $1250\Omega$



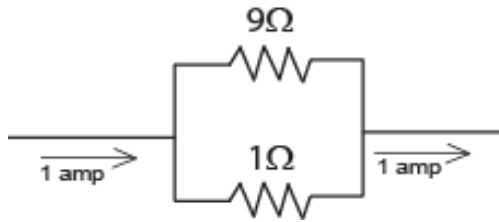
17. (5 points) The power consumed  $3\Omega$  resistor is closest to . . .

- (a) 0.11W
- (b) 0.33W
- (c) 0.50W
- (d) 1.0W
- (e) 2.0W
- (f) 3.0W
- (g) 5.0W



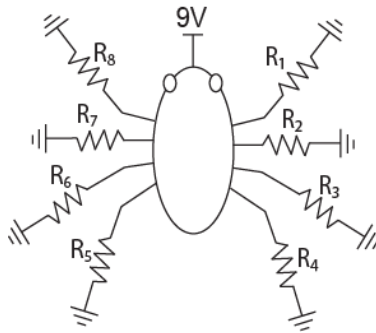
18. (5 points) A portion of a circuit is shown below. If a current of 1 amp enters and leaves as shown, then the total power consumed by the two resistors is closest to . . .

- (a) 0.5W
- (b) 0.9W
- (c) 1.1W
- (d) 9W
- (e) 10W



19. (5 points) If each of the 8 resistors has a resistance of 1Ω, then the voltage drop across R1 is closest to . . .

- (a) 1V
- (b) 2V
- (c) 3V
- (d) 4V
- (e) 5V
- (f) 6V
- (g) 9V



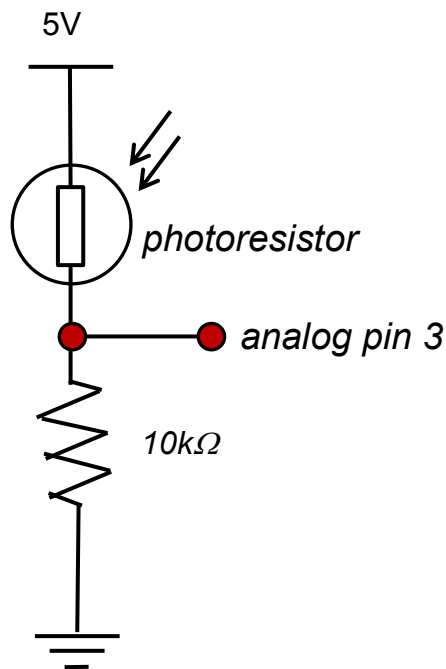
20. (5 points) The photoresistor circuit used in class is attached to analog input 3 to “measure” the light level. If the light level is such that the resistance of the photoresistor is 2,000Ω, then the Serial Monitor will show that “val” is closest to . . .

- (a) 20
- (b) 80
- (c) 120
- (d) 170
- (e) 200
- (f) 580
- (g) 850

```
int analogPin = 3;
int val = 0;

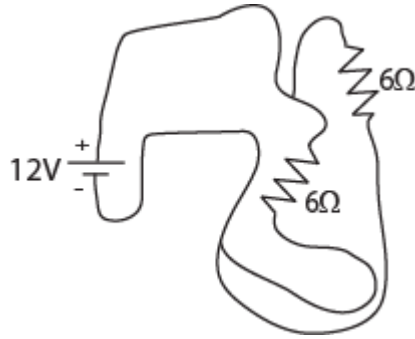
void setup() {
  Serial.begin(9600);
}

void loop() {
  val = analogRead(analogPin);
  Serial.println(val);
}
```



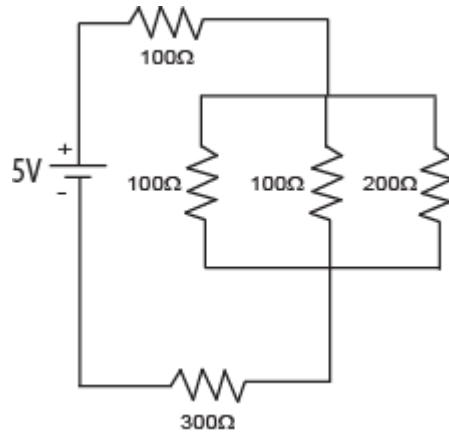
21. (5 points) The current leaving the power source is closest to . . .

- (a) 0.33A
- (b) 0.66A
- (c) 1.0A
- (d) 1.3A
- (e) 2A
- (f) 4A



22. (5 points) The current passing through the  $200\Omega$  resistor is closest to . . .

- (a) 2.3mA
- (b) 4.6mA
- (c) 5.8mA
- (d) 7.9mA
- (e) 13.2mA
- (f) 20mA



**ENGR 120****Exam 1****Name:** \_\_\_\_\_

**Computer Portion:** Allowed materials include calculator and computer, Boe-Bot, multimeter, pen or pencil. You must start your Mathcad and Excel work from scratch, but you may start the Boe-Bot problem with existing programs.

*Honor Statement:* On my honor, I promise that I have not received any outside assistance on this exam (I didn't look at another student's paper, I didn't view any unauthorized written materials, I didn't talk or listen to another student, my network connectivity was not turned on, . . .). \_\_\_\_\_ signature

*Please raise your hand after finishing each problem.*

1. **(10 points)** Complete the following activities using Mathcad. **Note:** If you can't do the units, just omit them for partial credit.

<p>(a) Define the following constant: <math>R_1 = 220 \cdot \Omega</math> (be sure to include the unit of ohms)</p> <p>(b) Enter the function <math>P(V_1) = \frac{V_1^2}{R_1}</math>.</p> <p>(c) Create a range variable allowing <math>V_1</math> to vary from 5 to 20 V in increments of 0.1 V.</p> <p>(d) Plot P versus <math>V_1</math> (<b>utilize proper engineering format</b>).</p>	<p><b>INSTRUCTOR CHECK OF WORK:</b></p> <p><input type="checkbox"/> constant defined with units</p> <p><input type="checkbox"/> function correctly entered with units</p> <p><input type="checkbox"/> range variable correctly entered</p> <p><input type="checkbox"/> an appropriate plot of P versus <math>V_1</math> is presented, with axis labels, a title, and units</p>
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2. **(10 points)** Write a program to make the Arduino do the following:

- The robot should start in wait state with the LED blinking: 1 second on, 1 second off, 1 second on, 1 second off, . . . (waiting for one of the whiskers to be pressed or for the photoresistor to be covered).
- While a whisker is pressed, the LED should blink ½ second on, ½ second off, ½ second on, ½ second off, . . .
- While a photoresistor is covered with your hand, the LED should blink 0.1 seconds on, 0.1 seconds off, 0.1 seconds on, 0.1 seconds off, . . .
- When the whisker is released and the photoresistor is uncovered, the LED should go back to its original blinking pattern (1 second on, 1 second off, . . .). The entire process should then start over, waiting for a whisker to be pressed or for the photoresistor to be covered. This entire process should be able to continue indefinitely.