EAS 199A Midterm Exam
Part 1   Fall 2011

Name: _____

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

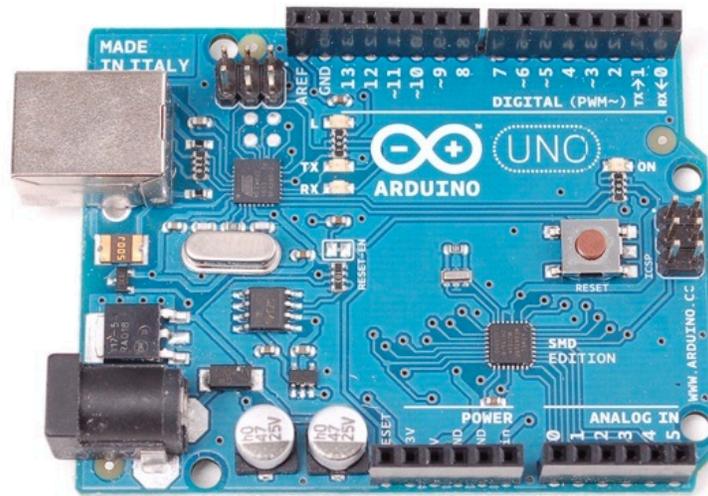**Potentially Useful Information**

1 coulomb = 6.24 x 10^{18} electrons   Avogadro's Number = 6.022 x 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

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1. (2 points) On the picture below, label the sockets that can be used for making a voltage measurement.

2. (2 points) A material that conducts electricity well is called a _____.

3. (2 points) Modern materials designed to conduct electricity only under certain conditions are called

   _____.

4. (2 points) If three resistors of resistance R are connected in parallel, the equivalent resistance is _____ .

5. (2 points) The definition of an amp, based on fundamental units or quantities, is _____ .

6. (2 points) _____ Current Law says that the sum of currents entering a node in a circuit is zero (no electrons are created).

7. (3 points) A resistor with a yellow-violet-orange stripe pattern would have a resistance of approximately

   _____.

8. (3 points) When the maximum allowable voltage is applied to an analog input pin, the numerical value of the reading (from `analogRead(...)`) is _____.

9. (5 points) The sketch to the right depicts a series connection of two 10kΩ resistors and one 20kΩ resistor with a 9V battery. The probes of a multimeter are connected to opposite ends of the middle resistor. When the multimeter is set to measure DC voltage, what is the reading?
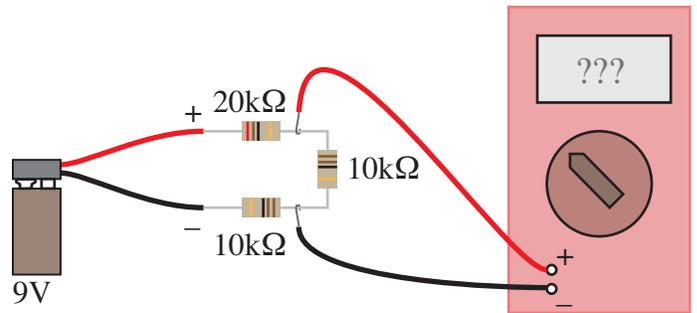
10. (5 points) An Arduino programmer wants to compute the average of 5 analog input readings. She produces the code to the right. Assume that this code snippet is part of the `loop` function, and that all other necessary parts of an Arduino sketch are included in the code that is not shown. Which of the following choices best describes the code?

```
int i;
float ave, sum;

sum = 0.0;
for ( i=1; i<=5; i++) {
   sum = sum + analogRead(5);
}
ave = float(sum)/5.0;
```

   a. This code snippet contains an error, and will not compile.

   b. The code snippet compiles, but the loop counter `i` does not function correctly.

   c. The code snippet compiles and the sketch runs, but gives an incorrect result because the voltage range of the input is not included in the computation of `ave`.

   d. The sketch runs, but produces incorrect results because `sum` cannot be added to itself.

   e. The code correctly computes the average.

11. (5 points) If 1.57 x 10^{19} electrons leave a DC power source over a 2-minute period, then the average current is closest to . . .

   (a) 0.021A   (d) 0.054
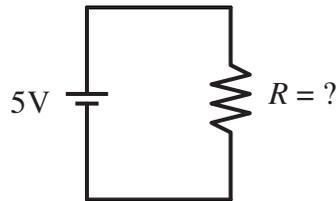
   (b) 0.032A   (e) 0.066A

   (c) 0.043A

12. (5 points) As shown in the sketch to the right, two AA batteries are connected to a 150Ω resistor. The power dissipated by the resistor is

   a. Not computable
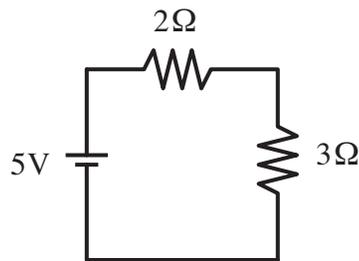
   b. 0

   c. 0.015 W

   d. 0.0225 W

   e. 0.030 W

$V_s = 1.5V$ $\quad R$
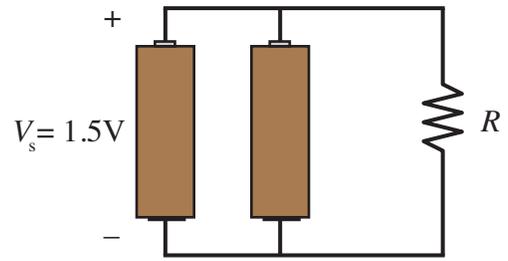
13. (5 points) If a current of 40mA (1000mA = 1A) leaves the power source, then the resistance R is closest to …

   (a) 0.1Ω

   (b) 0.25Ω

   (c) 125Ω

   (d) 250Ω

   (e) 1250Ω

5V $\quad R = ?$

14. (5 points) The power consumed by the 3Ω 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

2Ω

5V $\quad$ 3Ω

15. (5 points) In the circuit to the right, $R_1 = 50Ω$, $R_2 = 100Ω$, $R_3 = 100Ω$, $R_4 = 150Ω$ and $V_s = 5V$. What is the total current leaving the voltage supply? Show the formulas and intermediate calculations necessary to obtain your solution.

R_1

R_4 $\quad V_s$ $\quad R_2$ $\quad R_3$
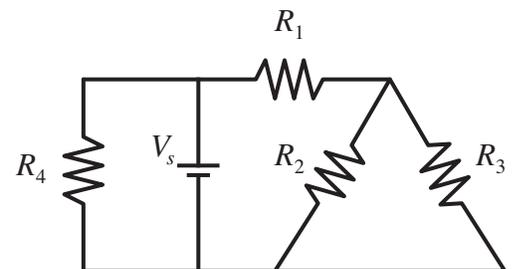
16. (5 points) The DC power plug allows power to be supplied to an Arduino Uno when it is not connected to a computer. The power plug can accept

    a. only 5VDC

    b. any DC voltage in the range 7 to 12 VDC

    c. any DC voltage in the range 5 to 9 VDC

    d. only 9 VDC

17. (5 points) Based on your answer to the preceding question, add wires to the following schematic so that the positive and negative terminals have sufficient input voltage for an Arduino Uno. The batteries are AA size, i.e. they have a 1.5V output.

Power leads to Arduino

$+$ $-$
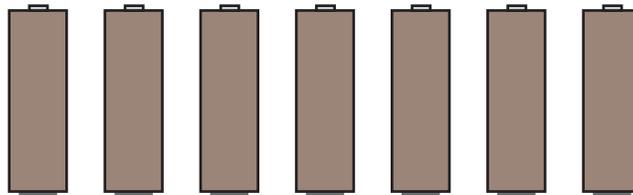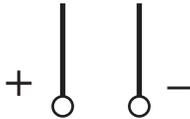
18. (5 points) The Arduino program to the right is supposed to cause an LED to blink. The electrical circuit (not shown) is correct and the power for the circuit is connected to digital pin 9. When the program to right is running the LED is on continuously. Suggest a change to the program that will cause the LED to blink. Hint: The best solution, one that gets the full points available, involves just one line of code. More complex solutions that also work may earn less than the full points available.

```
void setup() {
  pinMode(9, OUTPUT);
}

void loop() {
  digitalWrite(9, HIGH);
  delay(1000);
  digitalWrite(9, LOW);
}
```

19. (5 points) Material X has an atomic weight of 58 g/mole, and a density of 7.8 g/cm^3, and has 2 valence electrons. Compute the number of valence electrons in 0.01 cm^3 of material X

20. (10 points) The photoresistor in the circuit to the right has a resistance of 2.2kΩ when it is exposed to light from a window. What is the voltage value on the analog input pin at that level of brightness? Show the calculations necessary to obtain your answer.

5V

$R = 10 \text{ k}\Omega$

Analog
input pin

photoresistor