Practice Exam
ENGR 120 – Fall 2007

Note: This practice exam is similar in format to what you may expect for your first exam in this class. Do not assume that this practice exam represents every type of problem that you may see on your exam, or that the percentage values for each set of problems on this exam will be the same as those on your exam.

Part I. Written Exam

This part of the exam is closed book, closed notes. You may use a calculator. You may write ONLY on this exam.

Fill in the Blank (30 points; 6 points each). Write the most correct answer in the blank. You should not show your work.

1. A resistor with color markings of "blue-green-red" has an approximate resistance of ***6500*** ohms. *(Note to students: If a resistor color code chart is needed, it will be provided. You do NOT need to memorize the resistor color codes. "Blue" = **6**; "green" = **5**; and "red" = **2**. The resistor therefore = **65** x 10^{2} ohms, or 6500 ohms.)*

2. A conductor easily lets go of its ***valence*** electrons.

3. To stop a servo motor from turning, you should program your robot to send a pulse width of ***1.5*** ms. *(Note to students: a pulse of 1.5 ms is equivalent to sending a duration of 1500 µs.)*

4. When you want a formula in EXCEL to refer to a specific cell, you must either give the cell (a name) *(text inadvertently left off the exam)* or use *absolute* addressing.

5. The number 10101110_2 is equivalent to what base-10, or decimal number? ***174***. *The binary number is = $1x2^7 + 0x2^6 + 1x2^5 + 0x2^4 + 1x2^3 + 1x2^2 + 1x2^1 + 0x2^1 = 128 + 32 + 8 + 4 + 2 = 174$.*

Multiple Choice (30 points; 5 points each). Circle the best answer for each question. Referring to Figure 1, answer questions 1-4:

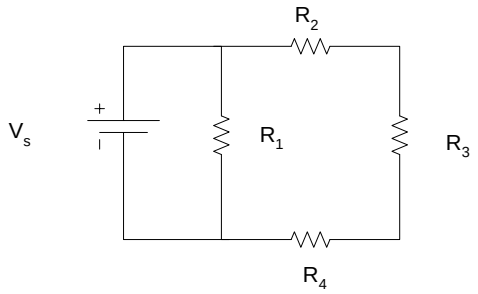


Figure 1. Circuit diagram for Multiple Choice Questions 1-4.

1. The resistors that are in parallel with each other are:
   (a) R_2 and R_4 *(No; R_2 is not connected directly with R_4 at each end of the resistor, even though the figure is drawn to make them look like they are in parallel.)*
   (b) R_1 and R_3 *(No; R_1 is not connected directly with R_3 at each end of the resistor, even though the figure is drawn to make them look like they are in parallel.)*
   (c) Both R_2 and R_4 along with R_1 and R_3 *(No, for the same reasons that (a) and (b) are wrong.)*
   (d) R_1 and (R_2 + R_3 + R_4) *(Yes, because R_2 , R_3 , and R_4 are in series and can be combined into a single equivalent resistor that then would be connected to R_1 at both ends of the resistors.)*
   (e) None of the above *(No, because (d) is correct.)*

2. The voltage drop across R_1 =
   (a) V_s *(Yes, by Kirchoff's Voltage Law)*
   (b) R_1 times the current through R_1 *(Yes, by Ohm's Law) (Note: the original test incorrectly had this answer as R_2 times the current through R_2)*
   (c) The sum of the voltage drops across R_2, R_3, and R_4 *(Yes, by Kirchoff's Voltage Law.)*
   (d) None of the above *(No, because at least one answer was correct.)*
   (e) Answers (a), (b), and (c) (Yes)

3. If R_{eq} = 100Ω and V_s = 10V, the current leaving the voltage source must be
   (a) 1000A *(No. Be careful not to get confused; Ohm's Law states that V = I*R, so I = V/R)*
   (b) 1000W *(No; wrong units)*
   (c) 0.1A (Yes, because by Ohm's Law I = V/R = 10V / 100 Ω)
   (d) 0.1W *(No, because W is the unit for power)*
   (e) None of the above *(No, because (c) is true.)*

4. If V_s = 5V, the current through R_1 = 1A and the current through R_3 = 2A, then
   (a) The current leaving the voltage source = 3A *(Yes, by Kirchoff's Current Law)*
   (b) The current through R_2 = 2A *(Yes, because R_2 and R_3 are in series.)*
   (c) The power generated by the voltage source = 5W *(No, because from (a) we know that the current leaving the voltage source = 3A, and P = V*I = 5V * 3A = 15W)*
   (d) The power generated by the voltage source = 15W *(Yes; see explanation for (c))*
   (e) None of the above *(obviously incorrect)*
   (f) Answers (a), (b), and (d) (Yes, from explanation above)
   (g) Answers (b) and (c) *(No; only 1 of the 2 answers is correct.)*

Referring to Figure 2, answer questions 5 – 6:

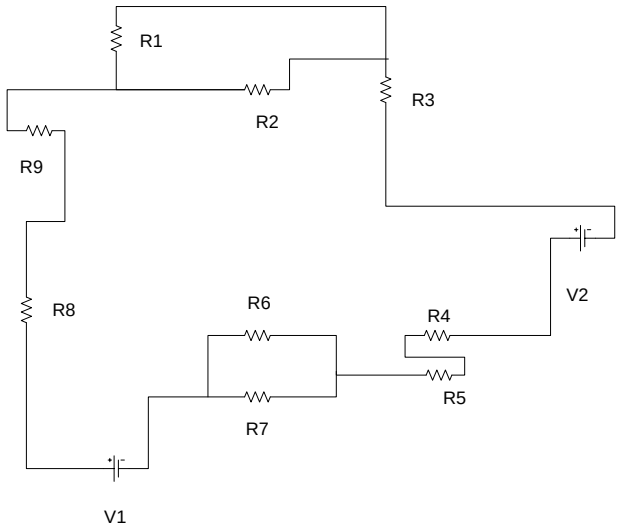


Figure 2. Circuit Diagram for Multiple Choice Questions 5-6

5. R_1 and R_2 are:
   (a) in series
   (b) **in parallel** *(Yes, because the resistors are connected directly together at both ends.)*
   (c) neither (a) nor (b)
   (d) both (a) and (b)

6. R_8 and R_9 are:
   (a) **in series** *(Yes, because as current travels through R_8 it has no choice but to travel through R_9)*
   (b) in parallel
   (c) neither (a) nor (b)
   (d) both (a) and (b)

Work-Out Problem (10 points). For the following problem, SHOW ALL WORK. Present your solution using the engineering format. You may want to write a draft solution on the back of the exam, and then write your solution neatly in the space provided.

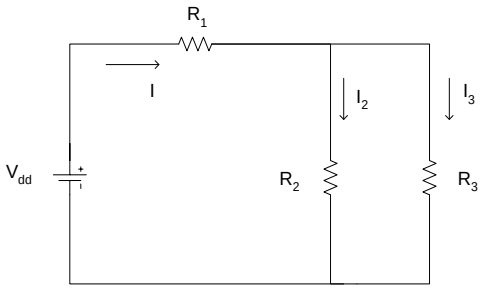


Figure for Work-Out Problem

Given that V_{dd} = 5V, R_1 = 100Ω, R_2 = 50Ω, and R_3 = 150Ω, find
(a) I; and
(b) The total power generated by V_{dd}

Given: The circuit as shown on the exam and the following values:

$V_{dd} = 5V$ $R_2 = 50\Omega$

$R_1 = 100\Omega$ $R_3 = 150\Omega$

Required: Find
(a) I (the overall current)
(b) the total power generated by V_{dd}

Solution:

(a)

To find the overall current, first calculate R_{eq}.

Let R_{23} = the equivalent resistance for R_2 and R_3

$$R_{23} = \frac{1}{\frac{1}{R_2} + \frac{1}{R_3}}$$

$$R_{23} = \frac{1}{\frac{1}{50\Omega} + \frac{1}{150\Omega}}$$

$R_{23} = 37.5\,\Omega$

$$R_{eq} = R_1 + R_{23}$$

$$R_{eq} = 100\Omega + 37.5\Omega$$

$$R_{eq} = 137.5\,\Omega$$

Applying Ohm's Law

$$I = \frac{V}{R}$$

$$I = \frac{V_{dd}}{R_{eq}}$$

$$I = \frac{5V}{137.5\Omega}$$

$$I = 0.036\,A$$

(b)

$$P = I \cdot V$$

$$P = I \cdot V_{dd}$$

$$P = 0.036A \cdot 5V$$

$$P = 0.18\,W$$

Part II. Computer Exam (30 points; 10 points each).

For this part of the exam, you must use your computer. You may not refer to old MathCAD or EXCEL worksheets; however, for the programming question you may refer to programs you have written. After you complete each problem, show your work to the instructor so that he or she can write notes on how well you completed each part.

1. Develop a MathCAD worksheet that will convert a set of values from °F to °C. The range of values for °F should be 0 to 100 in increments of 10°. Plot the values in a graph with proper engineering format.

   Instructor code: _____

Mathcad Professional - [engr 120 - computer mathcad problem]

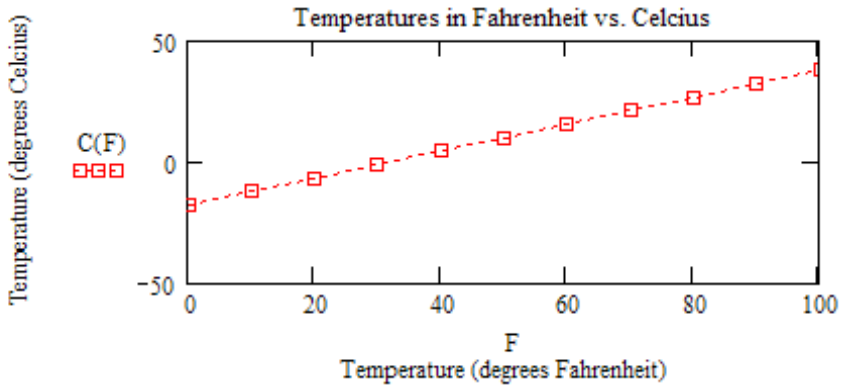
File Edit View Insert Format Math Symbolics Window Help

Normal Arial 10

$F := 0, 10 .. 100$

$C(F) := \frac{5}{9} \cdot (F - 32)$

F =	C(F) =
0	-17.778
10	-12.222
20	-6.667
30	-1.111
40	4.444
50	10
60	15.556
70	21.111
80	26.667
90	32.222
100	37.778



Press F1 for help.

Note to students: The solution was developed in MathCAD 2001i, which has fewer options for formatting graphs.

NOTE: *We are using Arduinos instead of Boe-Bots. However, this problem still provides an example of the type of problem that could be included in the exam.*

2. Write a Boe-Bot program that will produce a set of tones each time the instructor presses a whisker. The tones should follow the same pattern each time: On for a quarter-second, off for a half-second, and on for a half-second. Each time the whisker is pressed, the frequency of the first tone should be 2000Hz and the frequency for the second tone should be 2500Hz.

   Instructor code: _____

```
' {$STAMP BS2}
' {$PBASIC 2.5}


' Note: This program assumes that the speaker is connected to Pin 3
'       and the whiskers are connected to Pins 5 and 7.

DO
  IF (IN5 = 0) OR (IN7 = 0) THEN
    FREQOUT 3, 250, 2000
    PAUSE 500
    FREQOUT 3, 500, 2500
  ENDIF
LOOP

END
```

3. Develop a spreadsheet that creates a table of values of the sine and the cosine of an angle. The angles should range from 0° to 360° in increments of 10°. Format the table by showing units in the headings for each column, bolding the headers, and formatting the numbers in the sine and cosine columns to show 3 decimal places to the right of the decimal point. Plot both the sine and cosine against the angle. Be sure to format the graph with proper engineering format.

   Instructor code: _____

Here is a partial list of the table of values from the EXCEL spreadsheet:

Angle (°)	Sine	Cosine
0	0.000	1.000
10	0.174	0.985
20	0.342	0.940
30	0.500	0.866
40	0.643	0.766
50	0.766	0.643
60	0.866	0.500
70	0.940	0.342
80	0.985	0.174
90	1.000	0.000