

Practice Problems for Final Exam

ENGR 120

Note: 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. The coefficient of determination (R^2) is an indication of how well a linear regression curve fits the data you are analyzing.
2. A joule IS (IS, IS NOT) equivalent to a Newton-meter.
3. 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 490,500 N-m. (PE = $m \cdot g \cdot h = 1 \text{ Mg} \cdot 9.81 \text{ m/s}^2 \cdot 50 \text{ m} \cdot 1000 \text{ kg/1 Mg}$)
4. A set of data points that line up in a straight line when plotted on semi-log paper would most likely follow which form of equation? Exponential

Multiple Choice:

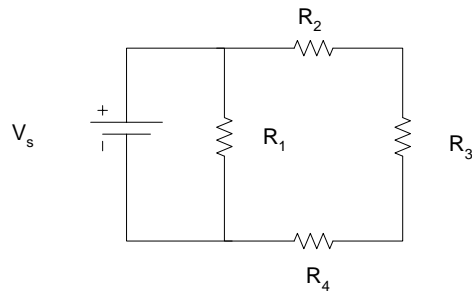


Figure 1. Circuit diagram for Multiple Choice Questions 1-2. For this diagram, $V_s = 20\text{V}$, $R_1 = 50\Omega$, $R_2 = 20\Omega$, $R_3 = 30\Omega$, and $R_4 = 40\Omega$:

1. The overall equivalent resistance (R_{eq}) for the circuit in Figure 1 is most nearly:
 - a. 140Ω
 - b. 32.1Ω : $R_{234} = (20+30+40)\Omega = 90\Omega$. $R_{eq} = 1 / (1/50 + 1/90)\Omega$**
 - c. 35.8Ω
 - d. None of the above

2. If R_{eq} for the circuit in Figure 1 is 100Ω (It is *not*, but assume for this problem that it *is*), then the power generated by the voltage source is most nearly:
 - a. 0.5W
 - b. 1.0W
 - c. 4.0W . $P = V_s^2 / R = 400\text{V}^2 / 100\Omega$**
 - d. 5.0W

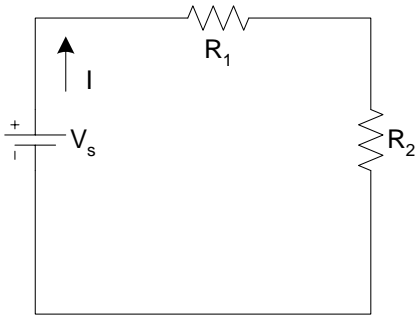


Figure 2. Circuit Diagram for Multiple Choice Questions 3-4. For this diagram, $V_s = 20\text{V}$, $R_1 = 50\Omega$, and $I = 0.2\text{A}$

3. The power generated by the voltage source is most nearly:
 - a. 2W
 - b. 4W. $P = V \cdot I = 20\text{V} \cdot 0.2\text{A}$**
 - c. 8W
 - d. Cannot be determined from the information given.

4. The value of R_2 is most nearly:
 - a. 50Ω . $V_{R1} = 50\text{V} \cdot 0.2\text{A} = 10\text{V}$. $V_{R2} = V_s - V_{R1} = 20\text{V} - 10\text{V} = 10\text{V}$. $R_2 = V_{R2} / I = 10\text{V} / 0.2\text{A}$**
 - b. 100Ω
 - c. 150Ω
 - d. Cannot be determined from the information given.

5. The efficiency of an electric drill that produces 1 HP (745.7 Joules/second) when supplied with 10A of current at 115V is most nearly:
- 1%
 - 10%
 - 65%. $\eta = \text{energy output} / \text{energy input} = 745.7 \text{ J/s} / 1150 \text{ W (or J/s)}$**
 - 90%
6. A pump requires 1.5kW to raise 5000L of gasoline 10 meters in a half-hour . If the velocity of the gasoline is 5 m/s, and the density of gasoline is 670 kg/m³, then the efficiency of the pump is most nearly:
- 1%
 - 14%. $m = 5000 \text{ L} * 670 \text{ kg/m}^3 = 3.35 * 10^3 \text{ kg}$;
 $\eta = ((0.5 * m * v^2) + (m * g * h)) / (\text{power} * \text{time})$. Note that the actual answer is about 0.137 or 13.7%**
 - 20.45%
 - 35%

A geneticist is looking at the growth rate of an HIV virus. She has gathered the following data about how fast the virus is growing

Hour	No. of Viruses
1	10
5	20
10	30
15	37

Based on a visual inspection of the numbers, she is guessing that the rate of growth fits an exponential curve.

7. Assuming that the best fit for the data is in fact an exponential curve, then the best regression equation for the data is (assuming $y =$ No. of viruses and $x =$ Hour):
 - a. $y = 1.9255x + 9.3273$
 - b. $y = 9.7767 x^{0.4819}$
 - c. **$10.743 e^{0.0908x}$. Has to be this choice because it's the only one in the form of an exponential.**
 - d. None of the above

8. Given the regression curve you developed for Problem 7, do you agree that an exponential curve is a good fit for the data?
 - a. **Yes, because the R^2 value is high. Running the table of numbers through the regression formulas for an exponential curve show that $R^2 = 0.915$; anything above around 0.9 is pretty good. You may have noticed that a linear fit is an even better fit for the data points ($R^2 = 0.985$); however, as the question is worded, you aren't asked if the exponential form is the BEST form; only if it is a GOOD one. FYI, the more data points you are given, the easier it will be to figure out which form of regression analysis is the best one to use.**
 - b. No, because the R^2 value is low.
 - c. Either (a) or (b) is a valid response.

NASA has been tracking the average global temperature from 1980 through to today. Given the data provided for 1985-1989, you believe that a straight line will be the best fit.

Year	Avg .Global Temp
1985	15.17
1986	15.23
1987	15.38
1988	15.41
1989	15.29

9. Assuming that the best fit for the data is in fact a straight line, then the best regression equation for the data is (assuming $y = \text{Avg. Global Temp}$ and $x = \text{Year}$):
- $y = 0.042x - 68.158$. Running the data through the linear form of the regression equation, we find that $m = 0.042$ and $b = -68.158$. Because one of the choices is “none of the above,” you can’t assume that a choice with the correct slope has to be the right answer.**
 - $y = 0.015x - 70.124$
 - $y = 0.02x - 80.3$
 - None of the above
10. Given the regression curve you developed for Problem 7, do you agree that a linear curve (straight line) is a good fit for the data?
- Yes, because the R^2 value is high.
 - No, because the R^2 value is low. The R^2 value is 0.437, meaning that less than half of the variability in global temperature can be explained by the changes in the year.**
 - Either (a) or (b) is a valid response.

Part II. Computer Exam

1. (Excel) Beginning with Aug. 31, 2006, one of your professors has tracked the number of entries contained in the online encyclopedia Wikipedia, and has produced the following table, where Day 0 represents 8/31/06 and Day 434 represents 11/8/07:

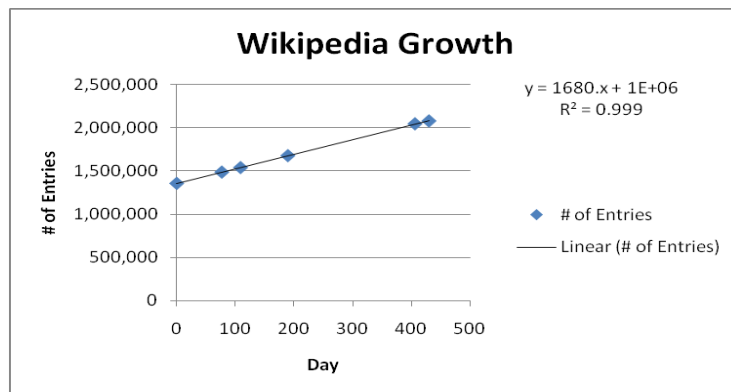
Day	# of Entries
0	1,356,724
77	1,486,871
109	1,539,070
190	1,676,896
407	2,044,879
431	2,077,344

Use linear regression in Microsoft EXCEL (a trendline analysis) to determine whether the best fit for the increasing number of entries is a linear, exponential, or power curve.

Write your choice here: linear.

The best curve for the data presented in the table is: Entries = 1680*Day + 1,000,000

The R² value for the curve is: 0.999



2. (robot) Write a program to move your robot approximately 2 feet forward at the rate of about 1 in/s. As the Boe-Bot moves forward, an LED should blink rapidly (0.25 s on; 0.25 s off) when the photo-resistor senses darkness; the LED should blink slowly (0.75 s on; 0.25 s off) when the photo-resistor senses light. Download your program to the robot and demonstrate its operation to the instructor on the test track he provides.

3. (*Mathcad*) A steam power plant that uses coal for fuel runs at 33% efficiency. If it produces 3500hp, then:

- How much power from coal will it need, in hp?
- If coal supplies 12000 BTU of energy per lbm, then how much coal will the plan need to run for an hour?

(a)

$$\eta := 0.33$$

$$P_{\text{output}} := 3500\text{hp}$$

$$P_{\text{coal}} := \frac{P_{\text{output}}}{\eta}$$

$$P_{\text{coal}} = 7.909 \times 10^6 \text{ W}$$

$$P_{\text{coal}} = 1.061 \times 10^4 \text{ hp}$$

(b)

$$\text{Time} := 1\text{hr}$$

$$\text{Mass}_{\text{coal}} := P_{\text{coal}} \cdot \text{Time} \frac{1\text{lb}}{1200\text{BTU}}$$

$$\text{Mass}_{\text{coal}} = \blacksquare$$

Note to students: if you don't know what a BTU is, you can just ask MathCAD, as below

$$1\text{BTU} = \blacksquare$$

Note to students: Now we know that the SI unit that's dimensionally equivalent to BTU is Joules, which are units energy. We also now know the conversion factor for BTUs to Joules, though we usually will let MathCAD handle this for us. Remember that you can always go to the Insert menu and through the choices under Units to help you figure out how to enter an unfamiliar unit, or even to see how to classify that unfamiliar unit.

4. (*SolidWorks*) Create a part file that represents the part with the dimensions as shown . . .
(parts and assemblies such as the pump)