

Name: _____

Recitation Section: L _____

Student Number: _____

1. Check that your exam includes all 6 pages (cover, 6 problems). Additionally, there is a 2-sided formula sheet and a 2-sided set of interest rate tables for 1.5%, 6%, 8%, and 12%.
2. Read all instructions and problems carefully. Points will be deducted for failure to follow instructions.
3. Complete the information requested in the spaces above.
4. PRINT your name and student number in the spaces at the top of all remaining pages of this exam.
5. **Show ALL of your work on these pages.** The pages in this exam may be separated for grading; therefore, if you need extra space for a particular problem, write on the back of the page for that problem. The instructions for a specific question may limit the amount of space allowed for an answer. For all multiple choice questions, select the closest, or most appropriate, answer. Answers without supporting calculations may be discounted.
6. You are permitted one sheet (8 1/2 x 11, double-sided) of **handwritten** notes. Use of any other notes, books, or other resources is prohibited.
7. Calculators are permitted; however, you are not allowed to use the calculator memory to store notes, etc. No cellular telephones are permitted.
8. This exam lasts for 55 minutes. Point values are listed for each problem to assist you in best using your time.

_____	Problem 1.	(20 points possible)
_____	Problem 2.	(16 points possible)
_____	Problem 3.	(9 points possible)
_____	Problem 4.	(20 points possible)
_____	Problem 5.	(15 points possible)
_____	Problem 6.	(20 points possible)
_____	TOTAL.	(100 points possible)

Manufacturing-Related Formulas

$$C_p = (USL - LSL) / (6 \sigma) \quad C_{pk} = C_p (1 - k)$$

$$k = | \text{Actual Mean} - \text{Target Mean} | / ((USL - LSL) / 2)$$

$$\text{First-time yield, FTY} = e^{-dpu}$$

$$\text{Prob \{ k defects \}} = (dpu^k / k!) e^{-dpu}$$

Name: _____

Student #: _____

Problem 1. (20 points)

A company is considering two different types of 125 horsepower motors to operate a large assembly line. The motors are scheduled to be in service for 5 years, and both will deliver the same operational characteristics for the assembly line. At the end of the fifth year, the equipment will be returned to the manufacturer, with a predetermined salvage value. A nominal interest rate of 6% is to be used. Determine the equivalent present value of the lifetime operating cost of each motor, including maintenance, electricity and salvage value, and then determine the cheapest motor. The purchase prices of both motors are equal, so that does not need to be considered. Show all calculations and factors. Factor calculations may be shown in space to right, and the accompanying interest tables may also be used..

Motor #1

Maintenance \$5,000 first year, decreases \$300 per year.
Electricity: \$400 per month
Salvage value of \$800 at end of fifth year

Motor #2

Maintenance-Single payment contract, \$25,000, payable at end of third year.
Electricity: \$300 per month
Salvage value of \$600 at end of fifth year

Motor #1

(9) Lifetime Cost (Present Value)= _____

Motor #2

(9) Lifetime Cost (Present Value)= _____

(2) Cheapest Motor # _____

Problem 2. (16 points)

Answer the following multiple choice questions by circling the letter in front of the most appropriate response.

- A. The variance of the project duration for a PERT chart for project scheduling is assumed to be
- (a) The square root of the sum of the squares of the individual activity variances along the critical path
 - (b) The sum of the individual activity variances along the critical path
 - (c) The square of the sum of the individual activity standard deviations along the critical path
 - (d) The square root of the sum of the squares of the individual activity standard deviations along the critical path
- B. Which one of the following statements is most nearly correct?
- (a) A fundamental disadvantage associated with recycling is that the technology can change, rendering the process uneconomical.
 - (b) A fundamental disadvantage associated with recycling is that the mixed material components are difficult to separate.
 - (c) A fundamental advantage associated with recycling is that the material constituents are not a significant portion of the cost.
 - (d) A fundamental advantage associated with reuse is that it rarely becomes uneconomical due to technological change
- C. The rooftop portion of the Quality Function Deployment diagram indicates primarily:
- (a) which product characteristics are most important to the consumer
 - (b) which engineering attributes are the result of which stated consumer desires
 - (c) The tradeoffs and correlations among the engineering characteristics
 - (d) The engineering characteristics that cause the most difficulty in manufacture.
- D. A manufacturing process connects two resistors in series such that $R_{eq}=R_1+R_2$. The batch of resistors from which R_1 is selected has a mean of 4 kilohms with an absolute tolerance of 4%, and the batch from which R_2 is selected has a mean of 6 kilohms with an absolute tolerance of 2%. The absolute tolerance indicates maximum and minimum values. Determine the mean and absolute tolerance of the equivalent series resistance.
- (a) mean of 5 kilohms and tolerance of 160 ohms.
 - (b) mean of 5 kilohms and tolerance of 280 ohms.
 - (c) mean of 10 kilohms and tolerance of 120 ohms.
 - (d) mean of 10 kilohms and tolerance of 160 ohms.
 - (e) mean of 10 kilohms and tolerance of 280 ohms.

Name: _____

Student #: _____

Problem 3. (9 points)

For each of the sentence pairs below, select the sentence (#1 or #2) that is **incorrect**, by either word usage, spelling, or content (do not consider punctuation).

- A. #1 There are twenty-four bimonthly periods in one year.
#2 There are four biennial periods in two years.
- B. #1 The design team was unable to effect a solution to the interface issue.
#2 The company was unable to raise sufficient capitol to operate.
- C. #1 There are fewer divisions in the higher levels of a hierarchical design than there are divisions in the lower levels.
#2 A prototype always involves a simulation.

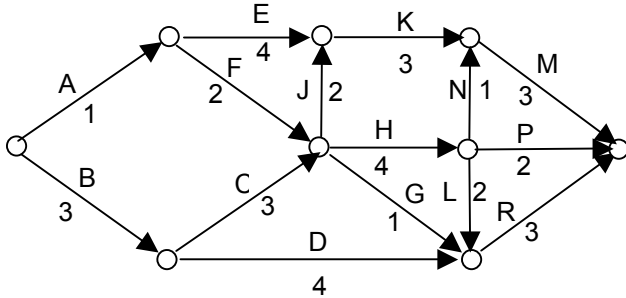
Problem 4. (20 points)

For each of the following statements, circle either TRUE or FALSE.

- A. For the straight-line method of depreciation, if the estimated salvage value doubles, the first year depreciation expense charged decreases. **TRUE FALSE**
- B. In the payback period method of project evaluation, the average rate of interest is used to determine the present worth of future payments . **TRUE FALSE**
- C. The book value of a piece of capital equipment is always greater than the market value. **TRUE FALSE**
- D. The effective rate of interest is usually greater than the nominal rate for a given calculation, assuming semiannual compounding. **TRUE FALSE**
- E. For a manufacturing process, if Cpk is non-zero, then the actual mean cannot be equal to the target mean. **TRUE FALSE**

Problem 5. (15 points)

A. (7 points) Determine the critical path, and its duration, for the following CPM chart. State the path in terms of activity letters in order from start to finish. Example: AEKM, duration=11



Path and Duration _____

B. (8 points) Determine the float for

(i) Activity K

Float K = _____

(ii) Activity H

Float H = _____

Problem 6. (20 points)

A data processing company is seeking to construct a 25 terabyte (TB) storage system for long-term database backup. A review of available products has identified three possible suppliers of data storage units that could be combined to create such a storage system. Two of the units have a fixed capacity, while the third can be purchased with a varying amount of storage.

The following table summarizes the available options and prices. The total price listed represents the present value of the total cost of each unit (including purchase price, maintenance, electricity, etc.) over the expected system lifetime of five years.

Option	Storage Capacity	Total price (present value)	
A	1 TB	\$3500	
B	8 TB	\$22,000	
C	2 TB additional 2 TB	\$8000 \$5000	up to three additional 2 TB storage elements may be added to the basic system, for a maximum capacity of 8 TB

- A) (12 points) For total storage capacities of 2 TB, 4 TB, 6 TB, and 8 TB, what option (or combination of options) has the **lowest total price**? Fill in the table below.

Total Storage	2 TB	4 TB	6 TB	8 TB
Option(s)				
Total Price				
Price / terabyte				

- B) (5 points) For the desired storage system with a total capacity of 25 TB, what combination of units has the **lowest total price**? Assume that multiple units of each option may be combined in any desired configuration.

Combination _____

Total Price _____

- C) (3 points) One of your co-workers suggests that the best solution would be to buy 4 of option C, including 9 added storage elements, for a total capacity of 26 TB. Do you agree with this recommendation? If this does not match your lowest total price solution from part B, what justification(s) might your co-worker have for recommending this system configuration?