A Sample Exam in LaTeX

The exam consists of 6 pages, not including this cover page. Please go through your copy to make sure that all pages have been printed.

The first part of the exam consists of short questions. No partial credit will be given. The second part of the exam consists of longer questions. Partial credit will be given for correct reasoning. Show all work for the longer questions. There are 95 points, total, on this exam.

Good luck!

Name: _____

ID Number: _____

Page	Points	Score
1	35	
2	15	
3	10	
4	10	
5	10	
6	15	
Total:	95	

Mindanao State University - General Santos City
College of Engineering
Summer 2025
2nd Chapter Examination
ENS 162 - Dynamics of Rigid Bodies

INSTRUCTIONS: For the following problems, use four (4) significant digits for intermediate numerical results and three (3) significant digits for the final answer. Final answers must be boxed.

1. (15 points) A skateboarder of mass M, traverses a half-pipe in the shape of the curve $y = \frac{1}{4}x^2$. Assuming no friction,
   (a) (5 points) Draw a free body diagram of the skateboarder at point A, with coordinates (0,0).
   (b) (5 points) Determine an expression for the magnitude and direction of a_n, the acceleration of the mass normal to the curve at point A.
   (c) (5 points) Calculate the normal force acting at point A when $M = 50\,kg$ and $v_A = 10\,m/s$.

2. (5 points) A monopolist has discovered that the inverse demand function of a person with income M for the monopolist's product is $p = 0.002M - q$. The monopolist is able to observe the incomes of its consumers and to practice price discrimination according to income. The monopolist has a total cost function, $c(q) = 100q$. The price it will charge a consumer depends on the consumer's income, M, according to the formula
   A. $p = 0.002M - 100$
   B. $p = M^2$
   C. $p = 0.01M^2 + 100$
   D. $p = 0.001M + 50$
   E. None of the above.

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3. (5 points) An industry consists of two duopolist firms choosing their output simultaneously. They decide to enter into a secret agreement to maximize their joint profits. The *total* output of the industry then goes $[X]$ and the price goes $[Y]$.

   A. $X =$ up, $Y =$ down

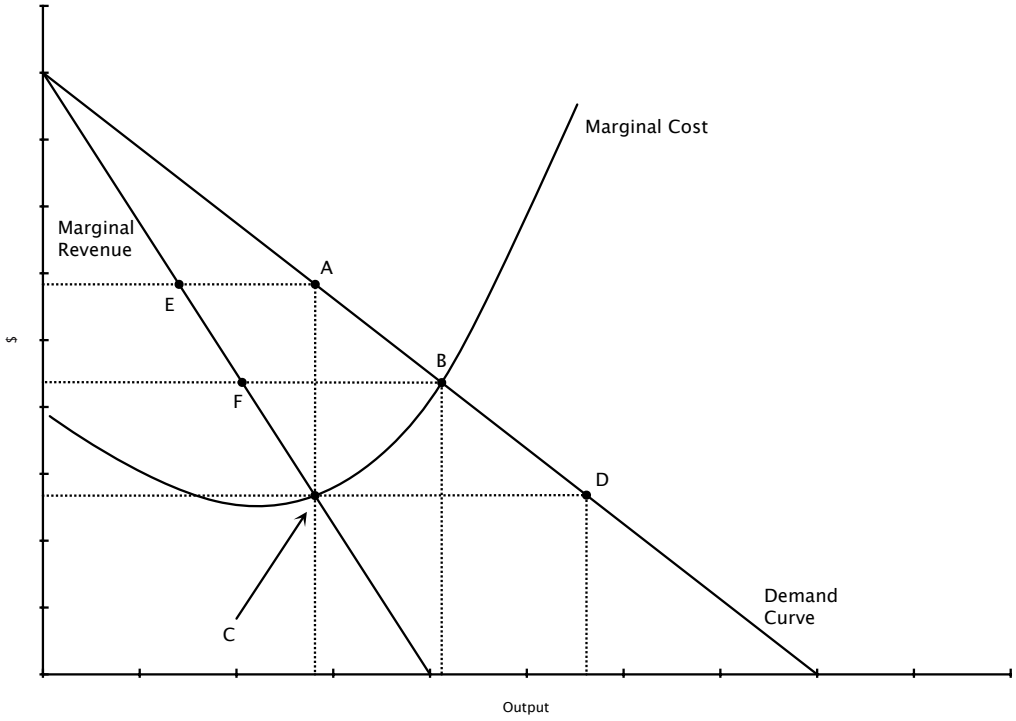
   B. $X =$ up, $Y =$ up

   C. $X =$ stays the same, $Y =$ up

   D. $X =$ down, $Y =$ down

   E. $X =$ down, $Y =$ up

The following two questions refer to the figure below. The figure depicts cost curves for a firm. To answer the questions, simply refer to points labeled by capital letters on the graph.



4. (5 points) If the firm behaves competitively, taking price as given, what level of output and price does it choose?

   4. _____

5. (5 points) If the firm acts as a monopolist, what level of output and price does it choose?

   5. _____

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6. (5 points) Suppose that a consumer considers coffee (C) and tea (T) to be perfect substitutes, but he requires two cups of tea to give up one cup of coffee. This consumer's budget constraint can be written as $2.5C + T = 10$. What should the consumer buy?

   A. 2 cups of tea and no coffee.

   B. 10 cups of tea and no coffee

   C. 2.5 cups of coffee and no tea.

   D. 4 cups of coffee and no tea.

   E. none of the above.

7. (5 points) The market demand curve is $D(p) = 20 - 16 \cdot p$. When the price is \$1, what is the elasticity of demand?

7. _____

Problems

For the following problems, show all your work. Partial credit will be awarded for correct reasoning.

8. Suppose that a consumer likes apples (a) and bananas (b), and has utility function $u(a, b) = a^{2/10} \cdot b^{8/10}$. Suppose that apples cost \$10 a pound and that the consumer has \$100 to spend. Denote the price of bananas as p.

   (a) (5 points) What is the consumer's budget constraint?

   (b) (5 points) What is the consumer's marginal rate of substitution. In 1–2 sentences describe what this quantity represents, aside from just "the slope of the indifference curve."

(c) (5 points) Setting the MRS equal to the slope of the budget constraint, find the consumer's optimal choice of apples in terms of bananas.

(d) (5 points) Plug this result into the budget constraint to find the consumer's demand for bananas.

9. Suppose that a competitive firm has production function $f(K, L) = \sqrt{KL}$, in which K denotes capital and L denotes units of labor. The firm must pay its workers sixteen dollars an hour, and must pay r dollars per unit of capital.

   (a) (5 points) Does the firm have constant, increasing, or decreasing returns to scale? Justify your answer.

   (b) (5 points) Calculate the firm's technical rate of substitution (TRS). In 1–2 sentences, describe what this quantity represents, aside from just "the slope of the isoquant."

   (c) (5 points) Find the firm's conditional demand for labor, $L^*(r, y)$ in terms of the price of capital and the firm's choice of output. (Hint: set the TRS equal to the slope of an iso-cost curve, and solve for capital in terms of labor. Then plug that result into the production function.)

End of exam.