

SUID:

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Final Exam
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DO NOT OPEN THIS EXAM UNTIL YOU ARE TOLD TO DO SO.

Instructions

1. Write your SUID in the box in upper right corner of this exam. Do NOT write your name.
2. SHOW ALL YOUR WORK. Answers without supporting work will receive little or no credit.
3. There are 100 points possible on this exam. Question 4 is worth twice as much as the others. *Be sure to budget your time accordingly.*
4. Several questions provide blank tables you can use to organize your calculations. Be sure to label the columns clearly and *show the equation for the column in the bottom row of the table.*
5. The tables may have more rows and columns than you actually need.
6. Do all your work on the exam. If you need extra space, write on the backs of the pages. However, if you do write an answer on the back of a page, *be sure you've noted that near the question.*
7. A hint about handling fractional exponents: if $X^{0.4} = Y$ then $X = Y^{1/0.4}$.
8. Some helpful PV formulas:

$$(1) \frac{B}{(1+i)^t}$$

$$(2) \frac{B}{i}$$

9. Some helpful factors in case your calculator can't handle exponents:

T	1	5	10	15	20	25	30	35	40
$(1.05)^t$	1.0500	1.2763	1.6289	2.0789	2.6533	3.3864	4.3219	5.5160	7.0400

Question 1 (20 points)

Suppose a company is thinking about developing a high-efficiency hybrid engine for automobiles. If it goes ahead, the project will cost \$60 million per year for each of the next five years (years 1 to 5). At the end, it will have a patented design that could be licensed to car manufacturers. However, the value of the patent will depend on the future price of gasoline. If gas prices are high, demand for efficient engines will be high and the company could expect to earn \$20 million per year forever starting in year 6. However, if gas prices are low or moderate, there will be much less demand for its engine and it would earn only \$10 million per year forever, also beginning in year 6.

If there is a 60% chance that prices will be high, what is the expected value of the project? Please show all your work. You may assume that the interest rate is 5% and the company is risk-neutral. To keep the problem simple, you may assume that gas prices will be high or low forever: they won't vary from year to year.

Question 2 (20 points)

An organization wants to produce 96 units of output at the lowest possible cost. It had the following production function: $Q = K^{(1/4)} L^{(3/4)}$. The price of capital is \$16 and the price of labor is \$3.

How much capital and labor should it use? What will be its average cost per unit of output at this set of inputs? You may assume that the organization can buy fractional amounts of labor. As a hint to reduce the number of calculations you'll need to do, the amount of capital is between 10 and 20 inclusive.

EQUATION									

Question 3 (20 points)

A non-profit organization operates an elementary school for children with learning disabilities. Its monthly costs that can be summarized by the equation: $TC = 10,000 + 300*Q$ where Q is the number of children enrolled. The demand for its service is given by $P = 1,000 - 10*Q$ and it has no competitors.

The organization wishes to help the maximum number of children it can without running a deficit. What should it charge and how many students should it enroll? As a hint, the value of Q is between 45 and 55, inclusive.

EQUATION									

Question 4, continued.

Now let's add in the time dimension. The patent allows the firm to be a monopolist for 20 years (years 1 to 20; the firm doesn't sell the test in year 0). After year 20, the patent expires and the market then becomes competitive. The interest rate is 5%.

- (b) What is the present value of the profits generated by the test? What is the present value of the consumer surplus it generates? You may assume that once the patent expires, the test can be carried out for free (its price drops to zero).

Question 4, continued.

OK, now we'll add one more element of realism. Suppose that before it can sell the test, FDA rules require the firm to conduct an expensive clinical trial. In deciding whether to proceed with the trial, the firm has the following information beyond that already given in parts (a) and (b):

- The clinical trial will cost \$1 million, which must be paid immediately;
- There is a 75% chance that the trial will be successful;
- The trial would occur in year 0; if successful, the firm could begin production in year 1;
- If the trial succeeds, the firm can sell the test, otherwise, it gets nothing;

(c) Would a risk-neutral firm proceed with the clinical trial? Please show all your work.

Question 4, continued.

- (d) Finally, is the firm's decision in part (c) about whether to conduct the clinical trial efficient? If so, how do you know? If not, propose a policy or financial arrangement that could solve the problem. Please note that the question is about the firm's decision whether or not to conduct the trial, not about the efficiency of the Q it would produce.