

Final Exam of Intermediate Microeconomics

Problem Set

Fall 2022, Tsinghua University

Name (中国学生填写中文)	
Student ID	

Notice:

Please write your answers on the **Answer Sheet**.

Answers on **Problem Set** will **not** be graded.

Please hand in your **Answer Sheet** at the end of the exam.

True or False (20 points, 2 points each)

- ✓ 1. The long-run average total cost curve is the lower envelope of the short-run average total cost curves.
- ✗ 2. According to the First Theorem of Welfare Economics, every competitive equilibrium is fair.
- ✓ 3. A good is purely public if all consumers can consume the good and anyone can consume all of the good.
- ✗ 4. The Coase Theorem states that the initial delineation of property rights does not have any distributional consequences.
- ✓ 5. Collusion must provide profits at least as large as their Cournot-Nash equilibrium profits. *quasi-profit in money*
- ✗ 6. In a two-players game, the equilibrium will always locate at the interaction point of two players' best response curve.
- ✓ 7. A curve that contains all of the input bundles that cost the same amount is an iso-cost curve.
- ✗ 8. If production technology has increasing returns to scale, we can conclude that this technology has non-decreasing marginal products for at least one input.
- ✓ 9. Regulatory schemes often have to subsidize a natural monopolist to produce the efficient output level without exiting.
- ✓ 10. A 3rd-degree price discrimination means that the price paid by a buyer can vary with the quantity demanded by the buyer. But all customers face the same price schedule.

Single Choice (24 points, 3 points each)

1. An electric power company uses block pricing for electricity sales. Block pricing is an example of
- A. first-degree price discrimination.
 - B. second-degree price discrimination.
 - C. third-degree price discrimination.
 - D. Block pricing is not a type of price discrimination.

2. There are 4 firms in one area. Whenever one firm uses the electricity, it also pollution. The profit function of each firm is defined as $u(x, y) = -x^2 + 7x - y$, where x is electricity used by itself and y is the average amount used by other three firms. What is the social optimal x used by everyone?
- A. 1.5
 - B. 2
 - C. 3
 - D. 3.5

3. Consider a pure exchange economy, with two consumers A and B, endowments of goods 1 and 2 $\omega^A = (1, 3)$, $\omega^B = (4, 2)$. And indifference curve series for consumers A and B are all $I_c: xy = c$, where x and y is the consumption of goods 1 and 2 separately, which means for indifference curve with parameter c , (x_1, y_1) and (x_2, y_2) are indifferent for consumer if $x_1 y_1 = x_2 y_2 = c$, and points on indifference curve with higher c is more preferred. How many points of allocation in the following are in the Core?

- (i) $(x_A, y_A) = (\sqrt{2}, \sqrt{2}); (x_B, y_B) = (5 - \sqrt{2}, 5 - \sqrt{2})$ = $7 - 10\sqrt{2} < 8$
- (ii) $(x_A, y_A) = (2, 2); (x_B, y_B) = (3, 3)$ = $9 > 8$
- (iii) $(x_A, y_A) = (\sqrt{6}, \sqrt{2}); (x_B, y_B) = (5 - \sqrt{6}, 5 - \sqrt{2})$ = $25 + 2\sqrt{3} - 5(\sqrt{6} + \sqrt{2}) > 8$
- A. 3 B. 2 C. 1 D. 0

4. In a Quantity-Cournot competition market which consists of two companies A and B, whose marginal cost of a unit of product is both 1, the demand function is $Q = 21 - P$. Both companies are willing to form a Cartel, to restrict the output level to maximize the cartel's total profit and evenly split the profit. To make the Cartel stable, they decide to rule a breach of contract damages, i.e., the company changing the output level will pay that amount of money to the other company. Specially, this field varies so fast, such that both companies only focus on the revenue in the present period and ignore the future revenue. The least amount of breach of contract

damages they must take is?

- A. $\frac{15}{4}$ B. 5 C. $\frac{25}{4}$ D. $\frac{15}{2}$

A 5. The production function $f(x_1, x_2) = \min \{x_1^{\frac{1}{3}}x_2^{\frac{2}{3}}, x_1^{\frac{2}{3}}x_2^{\frac{1}{3}}\}$. Then the technology demonstrates _____ return to scale.

- A. Constant
B. Strictly Increasing
C. Strictly Decreasing
D. None of the above

D 6. A firm uses a single input to produce its output, which is sold in a competitive market. It gets quantity discounts on purchases of its input. If it buys x units of the input, the price it must pay per unit of input is $\frac{3}{x} + 4$. If it buys no inputs, it does not have to pay anything. The firm's production function is $f(x) = 8x - 2x^2$, where $x \geq 0$. If the price of the firm's output is 1, the profit-maximizing amount of input to buy is:

- A. 1 B. 0 C. 0 or 1 D. 4

C 7. About the 2nd Fundamental Theorem of Welfare Economics, which of the following statements is CORRECT?

- A. A competitive market equilibrium maximize the total utility of consumers.
B. Any competitive market equilibrium is Pareto efficient.
C. Under some certain conditions, every Pareto distribution can achieve a competitive market equilibrium.
D. The competitive market equilibrium exists.

A 8. Suppose that two agents have the following utility functions $U_1(x_1, y_1) = x_1^\alpha y_1^{1-\alpha}$, $U_2(x_2, y_2) = x_2^\beta y_2^{1-\beta}$. So, $\alpha = \beta = 0.5$ is which kind of condition for the contract curve to be the diagonal line of the Edgeworth Box?

- A. Both sufficient and necessary condition
B. Only sufficient but not necessary condition
C. Only necessary but not sufficient condition
D. Neither sufficient nor necessary condition

Filling Blanks (16 points, 2 points each blank)

1. A competitive firm has a three-factor production function $f(x, y, z) = (x + y)^{2/3}z^{1/3}$. The factor prices are $w_x = 5$, $w_y = 2$, and $w_z = 1$. Then the minimum cost to produce one unit of the output is _____.
2. Two firms are competing for new consumers. Firm 1 spends x_1 on advertising and firm 2 spends x_2 on advertising. The profits are $x_1(42 + x_2) - 2x_1^2$ for firm 1 and $x_2(70 + x_1) - x_2^2$ for firm 2. In equilibrium, x_1 is _____ and x_2 is _____. Now if these two universities merge to one and all others remain the same, then the total expenditure is _____.
3. Suppose a perfect competitive firm's production function is $f(x, y) = x^{\frac{1}{2}}y^{\frac{1}{3}}$. The price of the product is 1, the cost of input x is 1, and the cost of input y is $1/3$. x and y are infinite divisible. In the short run, the input y is fixed at 8 unit, to maximize its profit, the firm choose to purchase _____ units of x . In the long run the maximized profit level is _____.
4. There are 2 countries, country A and country B, in the world and both countries produce goods X and Y. The production functions of country A are $x_A = \sqrt{l_x}$ and $y_A = \sqrt{l_y}$. The production function of country B are $x_B = 0.5\sqrt{l_x}$ and $y_B = 0.5\sqrt{l_y}$. The amount of labor are 100 units for each country. Suppose the labor cannot migrate between two countries, the Production Probability Frontier (PPF) for the world is _____. Suppose the labor can migrate freely between two countries, the Production Probability Frontier (PPF) for the world is _____.

Short Answers (40 points, 10 points each)

1. Suppose there are 50 identical firms in a perfectly competitive industry. Each firm has a short-run total cost function of the form

$$C(q) = \frac{1}{300}q^3 + 0.2q^2 + 4q + 5$$

- Calculate the firm's short-run supply curve $q(P)$.
 - On the assumption that there are no interaction effects among the firms in the industry, calculate the short-run industry supply curve $Q_S(P)$.
 - Suppose market demand is given by $Q_D(P) = -100P + 2600$. What will be the equilibrium price and quantity in the short run?
2. There are 10 firms in the industry. Each firm has two variable factors and a production function $y_i = k_i G$, where k_i is the capital used by firm i and G is the public goods used by all firms. G is the sum of all firms' contribution g ($G = \sum_{i=1}^{10} g_i$). The price of output y , capital k and public good g is 1 per unit. The budget of each firm is 10.
- Please find out the value of k_i and G in the symmetric Nash equilibrium.
 - What is the value of k_i and G in the industry optimal situation?
 - We know that the public good will be insufficient in competitive market, so the government decides to use income tax (output tax) to raise funds for public goods G . The tax rate is t . The government makes sure that all firms are still running. Please find out the value of t that makes the government budget balanced. (Hint: $G = t(\sum_{i=1}^{10} y_i)$, now the G is determined by the government, so the firms will take G as given).

3. A price-taking firm's production function is $q = 4X^{\frac{1}{4}}Y^{\frac{1}{2}}$, where X and Y are the amounts of factors that the firm uses as inputs, and q is the amount of the output. The price of the output is 1, the price of factor X is p_X , and the price of factor Y is p_Y .

- Given the quantity produced, what is the optimal ratio of two factors used for production, i.e., $\frac{Y^*}{X^*}$?

Now suppose $p_X = 2, p_Y = 1$.

- How many units of output would the firm produce to maximize its profit? How many units of X and Y are used?
- What is the maximum level of profit?

4. Consider a pure exchange economy, with two consumers A and B, endowments of goods 1 and 2 $\omega^A = (4,7)$, $\omega^B = (12,4)$, utility function of consumer A and B is $u_A(x_A, y_A) = \sqrt{2x_A} + 3\sqrt{y_A}$, $u_B(x_B, y_B) = x_B + y_B$, where x_A, y_A, x_B, y_B are the consumption of goods 1 and 2 for consumer A and B separately. And trade occurs in perfectly competitive markets, where each consumer is a price-taker.
- (a) What is the ratio of equilibrium prices, i.e., $\frac{p_2}{p_1}$?
- (b) What is the equilibrium consumption x_A and y_A ?
- (c) What is the utility of consumers A and B?

Extra Bonus Points

Suppose that you and three of your classmates who are *randomly matched*, are playing the following one-shot 4-person game.

1. When the game starts, you and your classmates will each receive an endowment of 20 points.

2. Firstly, each of you simultaneously decides the default punishment you are willing to pay to engage in a contract for the public good provision. To clarify, we can label the four of you as players 1,2,3,4, you are player i , $i \in \{1,2,3,4\}$, where player j 's claimed default punishment is denoted by w_j , $w_j \in [0,20]$, $j \in \{1,2,3,4\}$. w_j must be an integer. Let $w = \min\{w_1, w_2, w_3, w_4\}$.

3. Then, w will be announced among the four of you. Each of you simultaneously decides how many points out of the 20 points to put into the public account, and the remainder of your point balance will go into your private account. Each player's allocation of points towards the public account is denoted as x_j , $x_j \in [0,20]$, $j \in \{1,2,3,4\}$. x_j must be an integer.

4. The contract for the public good provision says that if **your allocation of points towards the public account is not lower than the minimum default punishment decided by the four of you** ($x_i \geq w$, where $w = \min\{w_1, w_2, w_3, w_4\}$), you will not pay your claimed default punishment w_i . However, if **your allocation of points towards the public account is strictly lower than the minimum default punishment decided by the four of you** ($x_i < w$, where $w = \min\{w_1, w_2, w_3, w_4\}$), your claimed default punishment w_i points will be automatically deducted from your private account. (In order to protect you from bankruptcy, the deducted amount will not be larger than the points in your private account, that is, $\min\{w_i, 20 - x_i\}$ will be deducted.)

5. Each point in the public account generates 1.6 points of payoff in the public

account, and the total accumulated payoff in the public account will be evenly divided among the four of you. Meanwhile, each point in your private account gives you 1 point of payoff.

6. Your payoff of the game will be given by

$$u_i = 20 - x_i + \frac{1.6}{4} \times (x_1 + x_2 + x_3 + x_4) - y_i,$$

$$\text{where } y_i = \begin{cases} 0, & \text{if } x_i \geq w = \min\{w_1, w_2, w_3, w_4\} \\ \min\{w_i, 20 - x_i\}, & \text{if } x_i < w = \min\{w_1, w_2, w_3, w_4\} \end{cases}.$$

7. Please decide: $w_i =$ _____.

8. Now, please decide for each possible w outcome of your group, what your choice of x_i is. Please note that you only need to fill in the blanks where $w \leq w_i$ (decided in step 7), and $x_i \in [0, 20]$.

w	0	1	2	3	4	5	6	7	8	9
x_i										

w	10	11	12	13	14	15	16	17	18	19	20
x_i											

Bonus points calculation:

After the exam, TAs will randomly match your answer with the answers from three of your classmates. Based on the decisions made by the four of you, your payoff will be determined accordingly. Your bonus points earned will be equal to 10% of your payoff in that game.