

Final Exam

Full name:

Student number:

Class:

1. This exam consists of two parts. Part A consists of 16 multiple-choice questions and is worth 10 points. Part B consists of 2 open questions and is also worth 10 points.
2. Part A must be completed in 60 minutes and Part B in the remaining 40 minutes.
3. Indicate your answers to part A with an “X” in the table below. Each correct answer is worth 10/16 (= 0.625) points and each wrong answer is penalized by (10/16) /3 (≈ 0.210) points.
4. Any kind of consultation is not allowed.
5. Turn off mobile phones, computers, tablets, and smartwatches. Their use will be considered fraud. The use of a non-graphical calculator is allowed.
6. Write your full name and student number on every answer sheet.
7. Return this answer sheet even if you withdraw from the exam.

ANSWER TABLE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a
b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b
c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c
d	d	d	d	d	d	d	d	d	d	d	d	d	d	d	d

English – Version A

PART A**MULTIPLE CHOICE (10 points / 60 min)**

1. Suppose the government wants to correct a negative production externality caused by pollutant emissions. Consider three policies:

1. A Pigouvian tax equal to the marginal external cost at the social optimal quantity;
2. An emissions cap equal to the efficient level, applied uniformly to all firms;
3. A market for tradable emission permits, with the total number of permits set at the efficient pollution level.

Which statement best describes the differences between these instruments?

- a. Policies 1, 2, and 3 always lead to the same level of pollution and the same distribution of abatement costs across firms.
- b. Policy 1 may achieve the efficient pollution level at the lowest total abatement cost if the tax is correctly set, because firms with lower marginal abatement costs reduce emissions more.
- c. Policy 2 is always more cost-effective than policies 1 and 3 because it treats all firms identically.
- d. Policy 3 necessarily leads to pollution below the efficient level because firms are always incentivized to buy fewer permits than necessary.

2. A factory produces noise that negatively affects a nearby family. Assume that property rights over the noise level are well defined and that transaction costs are sufficiently low. Which of the following statements is correct about the Coase theorem?

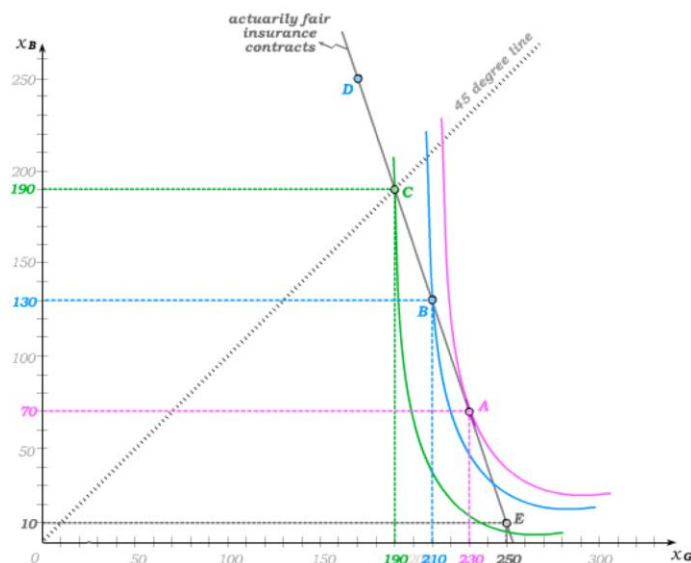
- a. If property rights are well defined and transaction costs are sufficiently low, negotiation leads to an efficient outcome, regardless of who holds the property rights.
- b. The Coase Theorem requires that transaction costs are negative; if transaction costs are zero or positive, negotiation becomes impossible and only government intervention can achieve efficiency.
- c. Only when the property rights are assigned to the party causing the externality (i.e., the factory), the efficient outcome is achieved, even when transaction costs are positive.
- d. When transaction costs are positive, the allocation of property rights may affect both the efficiency of the outcome and the distribution of surplus.

3. An individual faces lotteries with two possible states, and his utility function over income is concave. Which statement correctly describes his attitude toward risk?

- a. The individual is risk neutral, so he always prefers the lottery to its certain equivalent.
- b. The individual is risk seeking, so the expected utility of the lottery is always lower than the utility of expected income.
- c. The individual is risk averse, so the certain equivalent of any risky lottery is lower than its expected value.
- d. The individual is risk averse, but the certain equivalent always equals the expected value because concavity does not affect decisions without insurance.

4. Which statement correctly explains the consumer's optimal choice in the figure below regarding the level of insurance coverage? Let x_B and x_G denote consumption in the bad and good states of nature, respectively.

- a. The optimal coverage corresponds to point A because, with state-dependent preferences, perfect coverage does not necessarily equalize marginal utility across states. Therefore, equal consumption across states is no longer necessarily the efficiency condition.
- b. The optimal coverage corresponds to point A because insurers never offer full coverage, even when contracts are actuarially fair and consumers prefer full coverage.
- c. The optimal coverage corresponds to point C because, with state-dependent preferences, the consumer is always risk neutral in one state, making coverage irrelevant.
- d. The optimal coverage corresponds to point C because coverage is complete, the contract is actuarially fair, and the consumer reaches maximum utility.



5. In a health insurance market, each consumer knows his own risk, but the insurer cannot distinguish high-risk from low-risk consumers. Suppose annual insurance premiums are set in a pooling equilibrium. Which statement correctly describes what may happen?

- a. High-risk consumers leave the market because they pay more than the actuarial value of their own risk.
- b. Low-risk consumers may leave the market because the premium is too high for them, generating adverse selection.
- c. The pooling equilibrium is always stable because low-risk and high-risk consumers face the same price, ensuring participation by all consumers.
- d. The pooling equilibrium always increases consumer surplus, regardless of the distribution of risk in the population.

6. The insurer Tranquility wants to offer two different insurance contracts for automobile drivers: (i) a cheaper contract with partial coverage versus (ii) a more expensive contract with high coverage. The aim is that low-risk drivers choose the partial-coverage contract and high-risk drivers choose the high-coverage contract. Which statement is true?

- a. The purpose of offering two contracts is to make both types of drivers choose the high-coverage contract, reducing administrative costs and guaranteeing positive profits.
- b. Separating drivers through different contracts is impossible because high-risk drivers will always choose the cheapest contract, regardless of coverage.
- c. For this strategy to work, the contract intended for low-risk consumers must be sufficiently unattractive to high-risk consumers, so that different consumer types choose different contracts.
- d. Screening through two contracts completely eliminates information inefficiency and always leads to the same outcome as under perfect information.

7. Consider a Rock R , Paper P , Scissors S game between two players. Which statement correctly describes the role of mixed strategies in this game?

- a. The game has no equilibrium, either pure or mixed, because each strategy is always strictly dominated by another.
- b. Mixed strategies are only used when a player wants to deceive the opponent, but they are not formal equilibria.
- c. There is a mixed-strategy equilibrium in which each player randomizes between R , P , and S , making the opponent indifferent between the three actions.
- d. A mixed-strategy equilibrium requires each player to choose one pure strategy with probability one.

8. A golf club uses a pricing scheme with two components: a fixed access fee and a price per round of golf. This allows the club to capture (part of) consumer surplus while maintaining efficiency in the marginal consumption decision. Which statement about a two-part tariff is true?

- a. The club should set the price per round above marginal cost and set the fixed fee equal to zero.
- b. A two-part tariff is equivalent to charging different prices to different groups, as in third-degree price discrimination.
- c. A two-part tariff always reduces consumption below the efficient level because the unit price is above marginal cost.
- d. The club can set the price per round equal to marginal cost and use the fixed fee to capture consumer surplus, increasing profit without distorting the consumption decision.

9. Consider a simultaneous game between the two firms Pharma and Medicare. The possible actions and corresponding payoffs are shown in the matrix below, where the payoffs are (Pharma, Medicare). Which answer is correct about the pure strategy Nash equilibrium in this game?

		Medcare	
		Cooperate	Defect
Pharma	Cooperate	5,5	6,4
	Defect	8,7	2,8

- a. The pure strategy NE are (Cooperate, Defect) and (Defect, Cooperate).
- b. The pure strategy NE is (Cooperate, Cooperate).
- c. The pure strategy NE is (Defect, Defect).
- d. There is no pure strategy NE in this game.**

10. A theatre is the only theatre in town. It sells tickets in two separate markets: students and non-students. The theatre can identify students by a student card. The theatre knows the demand elasticity of each group and chooses different prices for the two groups. Which statement correctly describes the theatre's pricing decision?

- a. The theatre charges a higher price in the market where demand is less elastic, because the quantity reduction caused by a higher price is relatively small.**
- b. The theatre charges a lower price in the market where demand is less elastic, to ensure a higher volume of sales.
- c. The theatre charges the same price in both markets because the marginal cost of producing the theatre performance is the same.
- d. The theatre charges lower prices in the more elastic market because those consumers value the product less.

11. In an oligopoly, firms may collectively benefit from a collusive agreement. However, such agreements are often unstable. Which statement correctly explains this instability?

- a. Collusion is unstable because each firm is indifferent between complying with and deviating from the agreement.
- b. Firms never benefit from collusion because the collusive price is always below the competitive price.
- c. Each firm has an incentive to deviate by secretly increasing output, because this raises its individual short-run profit even though it reduces joint profit.**
- d. Instability occurs because, in equilibrium, joint profit equals competitive profit.

12. Consider a market with one incumbent firm making large profits. Potential entrants observe the market and may enter if they see an opportunity. Suppose that entry requires a large initial investment in equipment that cannot be resold. This investment is a sunk cost: if the firm exits, the cost is fully lost. Technology and information are available to all firms. Which statement correctly describes the effect of sunk costs on competition?

- a. High sunk costs increase competition because they discourage the incumbent from setting prices above average cost, knowing that entrants have invested too much to exit quickly.
- b. Sunk costs do not affect competition because only the number of active firms, not the ease of

exit, determines competitive discipline.

c. High sunk costs make the market fully competitive because they commit entrants to remaining in the market, increasing rivalry.

d. High sunk costs reduce competition because potential entrants may make losses, while incumbents make profits, as the price can be below average cost but above marginal cost.

13. Consider two firms located on a circle, such as two bakeries in a city centre. Consumers are uniformly distributed across the city centre and face travel costs that increase with distance from the seller. Each firm chooses its location in the first stage of the game, after which they compete on prices in the second stage. Which statement correctly describes the predicted outcome?

a. Firms have an incentive to choose different locations, as this softens price competition and increases profits.

b. Firms' initial locations are irrelevant because both firms earn equal profits regardless of location, since the market is divided between them.

c. Firms choose locations that minimize consumers' total travel costs, making the equilibrium socially efficient.

d. Firms choose locations very close to each other to capture larger market shares.

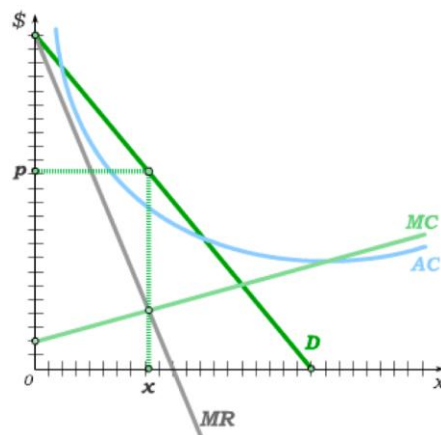
14. Consider the graph below is for an incumbent of a monopolistic competitive market. Which of the following statements best describes the situation and the likely adjustment?

a. The market is in a short-run equilibrium; incumbent firms make losses, some will exit the market, shifting the demand curves of those remaining inwards until price equals marginal cost.

b. The market is in a long-run equilibrium; despite the price being above average cost, product differentiation allows incumbent firms to make large profits.

c. The market is in a short-run equilibrium; since price is above average costs, entry of new firms will shift demand inward until price equals average cost.

d. The market is in a long-run equilibrium with price being equal to marginal cost.



15. In a group of three individuals, each consumes the same quantity of a public good G . Individual i has marginal benefit MB_i of public good consumption. Provision is left to the private sector through voluntary contributions. Which statement correctly explains why private provision is generally inefficient?

- a. Private provision tends to be excessive because each individual contributes until his marginal benefit equals total social cost.
- b. Private provision ignores that the sum of individual marginal benefits should equal marginal cost. As a result, voluntary provision is generally below the social optimum.
- c. Private provision is efficient whenever the good is non-rival, regardless of whether it is excludable.
- d. Private provision equals the optimum when individuals have different valuations, provided there are no externalities.

16. With voluntary contributions to public goods, individuals choose how much to contribute (a continuous decision). Everyone benefits from the total amount provided, but each person bears only the cost of their own contribution. How does the outcome of this model relate to the Prisoner's Dilemma, where individuals choose between cooperating and defecting (a discrete decision)?

- a. They are equivalent because both models predict that individuals will not contribute at all.
- b. It is a smoother version of the Prisoner's Dilemma: individuals defect by contributing too little, since they ignore benefits to others.
- c. The voluntary contribution model leads to efficient provision, while the Prisoner's Dilemma leads to underprovision.
- d. Defecting in the voluntary contribution model always means contributing zero, which implies zero provision of the public good.

PART B
OPEN QUESTIONS (10 points / 40 min)**Question 1**

SpaceLink US is the only provider of satellite internet in Greenland. It faces the market demand curve

$$Q = 240 - 6P.$$

Its total cost function is

$$TC(Q) = 15Q + 50.$$

a) Determine the price and quantity that maximize SpaceLink's profit. Define the mark-up as $P - MC$, and evaluate the mark-up at SpaceLink's optimal quantity. Explain why the mark-up is a relevant measure of market power. (1 point)

b) SpaceLink identifies two separate market segments, with no possibility of resale between them:

$$Q_R = 180 - 9P_R$$

for the residential segment, and

$$Q_B = 80 - 2P_B$$

for the business segment.

The CEO decides to use third-degree price discrimination. Determine the quantities Q_R and Q_B , and the prices P_R and P_B , in both segments that maximize profits. In which segment does the firm have greater market power? Justify your answer. (2 points)

c) Suppose the newly hired CEO changes the pricing strategy and introduces a two-part tariff in the business segment. Use the business demand function and cost function given above. Determine the unit price P_B and the fixed fee F that maximize SpaceLink's profit in this segment. (2 points)

Question 2

One of Greenland's main economic activities is wild shrimp fishing. The market is dominated by two large firms: Imaq (Firm 1) and Anori (Firm 2). The two firms compete in quantities and market demand is given by

$$P(Q) = 250 - 2Q,$$

where

$$Q = q_1 + q_2.$$

Both firms have constant marginal costs:

$$MC_1 = MC_2 = 10.$$

a) Determine the Cournot equilibrium quantities, price, and profits. (2 points)

b) After analysing the Arctic seas, it is noted that industrial wild shrimp fishing generates an external cost to biodiversity, given by

$$EC(Q) = Q^2.$$

In response to concerns about biodiversity, the government of Greenland seeks to determine the socially optimal level of shrimp fishing. The government defines social welfare as the sum of consumer surplus and firm profits, minus the external cost of biodiversity degradation:

$$SW(Q) = CS(Q) + \pi_1(Q) + \pi_2(Q) - EC(Q).$$

Note that consumer surplus is given by the area of a triangle, where the height is the difference between the inverse demand curve and the price, and the base is the quantity. Thus,

$$CS(Q) = \frac{1}{2} (250 - P(Q)) Q = Q^2.$$

Determine the socially efficient total quantity. Compare it with the Cournot equilibrium quantity found in part a) and explain the difference. (2 points)

c) The two shrimp fishing firms are considering a collusive agreement to restrict output. In a one-shot interaction game, however, each firm has an incentive to deviate from this agreement, even though both would earn higher profits if they cooperated. Now suppose the interaction is repeated indefinitely. Explain intuitively when the two firms can sustain cooperation in this infinite setting? (1 point)

Question 1

a. Obtain inverse demand

$$Q = 240 - 6P \Rightarrow P = 40 - \frac{1}{6} Q$$

Obtain total revenue and marginal revenue

$$TR = P(Q)Q = \left(40 - \frac{1}{6} Q\right) Q = 40Q - \frac{1}{6} Q^2$$

$$MR = 40 - \frac{1}{3} Q$$

Obtain marginal cost

$$TC = 15Q + 50 \Rightarrow MC = 15$$

Profit maximization implies MR=MC:

$$40 - \frac{1}{3} Q = 15$$

$$Q = 75$$

$$P = 40 - \frac{75}{6} = 27.5$$

Calculate mark-up: $P - MC = 27.5 - 15 = 12.5$. So SpaceLink charges 12.5 above marginal cost. This is relevant because the ability to set price above marginal cost reflects market power.

b. For the residential segment

$$Q_R = 180 - 9P_R \Rightarrow P_R = 20 - \frac{1}{9} Q_R$$

$$MR_R = 20 - \frac{2}{9} Q_R$$

Set MR=MC

$$20 - \frac{2}{9} Q_R = 15$$

$$Q_R = 22.5$$

$$P_R = 20 - \frac{22.5}{9} = 17.5$$

For the business segment

$$Q_B = 80 - 2P_B \Rightarrow P_B = 40 - \frac{1}{2} Q_B$$

$$MR_B = 40 - Q_B$$

Set MR=MC,

$$40 - Q_B = 15$$

$$Q_B = 25$$

$$P_B = 40 - \frac{25}{2} = 27.5$$

The firm has greater market power in the business segment, because it charges a higher mark-up:

$$P_B - MC = 27.5 - 15 = 12.5$$

$$P_R - MC = 17.5 - 15 = 2.5$$

You can also see this from the elasticities of demand in both segments, which are equal to:

$$\epsilon_B = \frac{\partial Q_B}{\partial P_B} \frac{P_B}{Q_B} = -2 \frac{27.5}{25} = -2.2$$

$$\epsilon_R = \frac{\partial Q_R}{\partial P_R} \frac{P_R}{Q_R} = -9 \frac{17.5}{22.5} = -7$$

As the elasticity of demand in the business segment is lower, asking higher prices in this market reduces demand by less.

c. With a two-part tariff that maximizes profits:

$$p = MC = 15$$

Business demand:

$$Q_B = 80 - 2p$$

At $p = 15$:

$$Q_B = 80 - 30 = 50$$

The fixed fee equals consumer surplus at $p = 15$. Inverse demand:

$$P_B = 40 - \frac{Q_B}{2}$$

At $p = 15$, quantity is 50. Hence, consumer surplus is equal to:

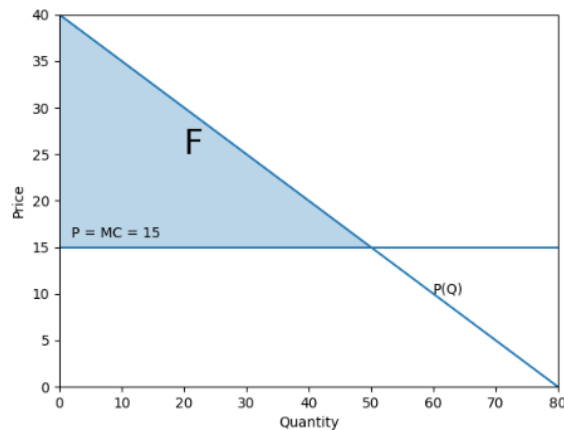
$$F = \frac{1}{2} (40 - 15)(50)$$

$$F = 625$$

So the optimal two-part tariff is:

$$p = 15, F = 625$$

See for a graphical illustration of the optimal two-part tariff the graph below:



Question 2

a. Firm 1 maximizes

$$\pi_1 = (P - MC)q_1 = (P - 10)q_1 = (250 - 2q_1 - 2q_2 - 10)q_1$$

$$\pi_1 = (240 - 2q_1 - 2q_2)q_1$$

Taking the derivative and setting it to zero (FOC):

$$240 - 4q_1 - 2q_2 = 0$$

The problem is symmetrical, so for firm 2 we have:

$$240 - 4q_2 - 2q_1 = 0$$

We can solve this to obtain:

$$\begin{aligned} q_1 &= q_2 = 40 \\ P &= 250 - 2(40 + 40) = 90 \\ \pi_1 &= \pi_2 = (90 - 10)40 = 3200 \end{aligned}$$

b. Social welfare is:

$$SW = CS + \pi_1 + \pi_2 - EC$$

Given that $CS = EC = Q^2$, we have that social welfare simplifies to:

$$SW = \pi_1 + \pi_2$$

Hence, maximizing social welfare implies maximizing total profit. Total profit is simply the monopoly profit:

$$\begin{aligned}\pi &= \pi_1 + \pi_2 = (P - MC)Q = (P - 10)Q \\ &= (250 - 2Q - 10)Q \\ &= 240Q - 2Q^2\end{aligned}$$

Taking the derivative and setting it to zero (FOC):

$$\begin{aligned}240 - 4Q &= 0 \\ Q &= 60\end{aligned}$$

This is lower than the total Cournot quantity: $60 < 80$. One reason is that firms do not take into account the external cost of shrimp fishing on biodiversity. Therefore, the market produces too much relative to the social optimum.

c. In a one-shot game, each firm has an incentive to deviate from the collusive agreement because deviating increases its current profit. However, if the game is repeated indefinitely, cooperation may be sustained if firms care enough about future profits. The short-run gain from deviating must be smaller than the future loss from triggering permanent competition. So, collusion can be sustained when firms are sufficiently patient: they value future cooperative profits enough to make deviation unattractive.