Part I: Multiple-choice questions. Select exactly one alternative for each question. Each correct answer gives 5 points and each incorrect answer 0 points.

1. A market has 5 firms. One of them has a market share of 50%, a second 20%, and the other three 10% each. Which of the following statements is true?

   (a) The 3-firm concentration ratio is 70%

   (b) The 4-firm concentration ration is 80%

   (c) The firm has a *Herfindahl-Hirschman Index* (measured from 1 to 10,000) of 3,200

   (d) The Herfindahl-Hirschman Index of the market is lower than in a market with 5 firms with a market share of 20% each.

   (e) None of the above.

2. What is a *SSNIP (Small but Significant Non-transitory Increase in Price)* test?

   (a) A way to determine the relevant market.

   (b) A way to test if an innovation is drastic.

   (c) A way to test if an equilibrium in a market with network externalities is stable.

   (d) A way to test if firms are colluding.

   (e) None of the above.

3. Candice wants to sell two types of chocolate bars, Dark (D) and White (W) to three consumers: A, B, and C. Each consumer's reservation price for each bar is given in Figure 1 below. Candice purchases each bar at a cost of 1. What are the maximum profits Candice can achieve by practicing either *mixed or pure bundling*?

   (a) 6.

   (b) 5.

   (c) 4.

   (d) 3.

   (e) None of the above.

	A	B	C
Dark	0	3	2
White	3	0	2

Fig. 1

4. Suppose the game in Figure 2 is repeated infinitely and that the players have common discount factor ρ, where $0 < \rho < 1$. (The row player's payoff is to the left in each cell.) Suppose further that each player uses the following strategy: i) start playing A, ii) continue playing A as long as no one has played B, iii) play B forever after if someone has played B. Under what condition is this a Nash equilibrium?

   (a) $\rho \leq 1/2$.

   (b) $\rho \geq 1/2$.

   (c) $\rho \leq 1/4$.

   (d) $\rho \geq 1/4$.

   (e) None of the above.

	A	B
A	3, 3	0, 4
B	4, 0	2, 2

Fig. 2.

5. What is the meaning of the *merger paradox*?

   (a) Rational oligopoly firms merge more seldom than predicted by theory.

   (b) The outcome of a vertical merger can be achieved also through a franchise contract.

   (c) Vertical mergers are more profitable than horizontal mergers.

   (d) In simple economic models, horizontal mergers between some, but not all firms, are not very profitable.

   (e) None of the above.

6. What is meant by the *sunk cost effect* of innovation?

   (a) Efficient, innovative firms are more likely to survive in the long run.

   (b) A monopolist undervalues innovation since its output is suboptimal from a welfare perspective.

   (c) A firm that has made a technology investment that cannot be recovered is less likely to adopt a new technology than one that has not.

   (d) For a monopoly, replacing oneself is better than being replaced by a newcomer.

   (e) None of the above.

Part II: Questions that require answers with calculations/motivation.

7. The monopoly firm Discro is selling a good to two types of customers, high income (H) and low income (L). The individual demand functions for each type of customer are given by $Q_H(p) = 11 - p$ and $Q_L(p) = 9 - p$ and Discro has a unit cost of 1.

   (a) (10 points) Suppose Discro practices *first-degree price discrimination* using two-part tariffs. What are the optimal tariffs, (F_H, p_H) and (F_L, p_L)?

   (b) (10 points) Suppose Discro practices *second-degree price discrimination* using a two-part tariff. What is the optimal two-part tariff, (F, p), assuming the fraction of H-types is $1/2$?

   (c) (10 points) Suppose Discro practices *third-degree price discrimination*. What are the optimal prices, p_H and p_L, for the two types of customers?

8. Alfa (A) and Beta (B) are competing in quantities in the market for truffel oil. The two firms face the inverse demand function $P(q_A, q_B) = 12 - q_A - q_B$. Alfa has a constant marginal costs of 1 and Beta a constant marginal cost of 2.

   (a) (15 points) What are the Nash-equilibrium quantities if the two firms set quantities simultaneously?

   (b) (15 points) What are the quantities in a subgame perfect equilibrium of the game where Alfa sets its quantity before Beta and Beta can observe Alfa's choice before deciding on its own production?

9. (10 points) Suppose a monopoly is selling access to a highway for a price of p. The marginal cost of giving a consumer access to the highway is 0. Consumers' valuation of the access are given by $\tilde{v} - f$, where f is the fraction of consumers served and $\tilde{v}$ is distributed uniformly between 0 and 1 across consumers. A consumer only buys access if her valuation is greater than or equal to the price. Hence, consumers have different valuations of the access, but due to congestion they all value it less the higher the fraction of users. What is the price p that maximizes total profits?