**Part I: Multiple-choice questions. Select exactly one alternative for each question. Each correct answer gives 5 points and each incorrect answer -1 point.**

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

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

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

   (c) A way to determine the relevant market.

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

   (e) None of the above.

2. If an industry is characterized by *endogenous sunk costs* (Sutton, 1991):

   (a) Firms can make investments in, for example, quality, advertising, and process innovations, that affect their price-cost margins.

   (b) The $n$-firm concentration ratio tends to zero as the market grows.

   (c) The number of firms tends to infinity as the market grows.

   (d) A firm can recover its fixed cost by exiting the market.

   (e) None of the above.

3. Candice wants to sell two kinds of chocolate bars, Dark and White, to three consumers: A, B, and C. The reservation price for one unit of each bar is given in Figure 1 below (the reservation price is zero for additional units). Candice purchases each bar at a cost of 1. What are the maximum profits Candice can achieve by practicing *mixed bundling,* assuming the consumers buy if they are indifferent between consuming or not?

   (a) 10.

   (b) 9.

   (c) 8.

   (d) 6.

   (e) None of the above.

|       | A | B | C |
|-------|---|---|---|
| **Dark**  | 1 | 4 | 3 |
| **White** | 4 | 1 | 3 |

Fig. 1

4. Firms A, B and C have market shares 0.5, 0.3 and 0.2 respectively. How much would a merger between A and C change HHI (assuming maintained market shares after the merger)?

   (a) 0.7.

   (b) 0.2.

   (c) 0.1

   (d) 0.5

   (e) 0.01.

5. Two firms compete in prices and can each set either a high (H) or a low (L) price. The resulting payoffs are described in the payoff matrix below. What is the critical discount factor $\rho$ below which firms cannot sustain a collusive outcome?

|   | **H** | **L** |
|---|-------|-------|
| **H** | 4,4 | -1,6 |
| **L** | 6,-1 | 0,0 |

    (a) 2/3.

    (b) 3/5.

    (c) 0.5.

    (d) 1/3.

    (e) 1/6.

6. Which of the following alternatives is false.

    (a) A firm would not license a process innovation under Bertrand competition.

    (b) A firm would not license a drastic innovation.

    (c) When spillovers are low, R&D cooperation tends to result in more R&D investment.

    (d) With sequential innovation, first generation patents give rise to hold-up problems.

    (e) Royalty stacking is an example of the tragedy of the anticommons.

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

7. Consider the following version of the Hotelling model where two firms, 1 and 2, are located at the endpoints of a unit interval and consumers are distributed uniformly over this interval. A consumer located at a distance $x$ from firm 1 obtains a utility of $r - x - p_1$ by purchasing one unit from firm 1 at the price $p_1$ and $r - (1 - x) - p_2$ by purchasing one unit from firm 2 at the price $p_2$, where $r > 3$. All consumers have a reservation utility of zero and zero valuation of additional units. Firm 1 has a marginal cost of 1 and firm 2 a marginal cost of 2.

    (a) (10 points) Find a Nash equilibrium of the game where the two firms set prices simultaneously.

    (b) (5 points) Modify the game so that firm 1 sets its price before firm 2 and firm 2 can observe the price of firm 1 before setting its price. Find a subgame-perfect equilibrium of the corresponding game under the assumption that firm 1 can commit to a price.

    (c) (5 points) Without performing any calculations, discuss the implications if firm 1 cannot commit to a price in (b).

8. The monopoly firm Obit is selling a good to two types of customers in equal shares: high income ($H$) and low income ($L$). The individual demand functions for each type of customer are given by $Q_H(p) = 100 - 10p$ and $Q_L(p) = 100 - 20p$ and Obit has a constant marginal cost of 2.

   (a) (5 points) Suppose Obit practices *group pricing*. What are the profit-maximizing prices, $p_H$ and $p_L$, for the two types of customers?

   (b) (10 points) Suppose Obit practices *menu pricing* using a two-part tariff, $(A, p)$. What is the profit-maximizing two-part tariff?

9. Consider a two period model where a monopolist first has the opportunity to invest in capacity $\bar{q}$, at a marginal cost $k$, in order to deter entry. In the second period, entry may occur, in which case firms compete in quantities. The incumbent's marginal cost of production for quantities $q$ below $\bar{q}$ is $c$. Its marginal cost for $q > \bar{q}$ is $c + k$, which is also the marginal cost for the entrant. An entrant also has to pay a sunk entry cost $E$. The inverse demand is $P = 1 - Q$, where $Q$ is aggregate quantity.

   (a) (8 points) Calculate the reaction functions for the firms. (For simplicity, you can skip calculating the threshold $q_I$, as a function of $E$, above which the entrant is better off staying out. Just assume that there is such a threshold which decreases in $E$).

   (b) (8 points) Illustrate the reaction functions in two graphs, reflecting different values of $E$. First, draw a graph illustrating blockaded entry. Second, draw a graph illustrating the quantity choices when the incumbent accommodates entry and when it engages in strategic entry deterrence, respectively.

   (c) (4 points) Suppose, entry deterrence is profitable. How does this strategy fit in the 2x2 taxonomy of strategies based on whether the investment makes the incumbent though or soft, and what type of strategic interaction firms face in the market? Explain.

10. Consider the model of collective switching cost in the book: Firms $a$ and $b$ have competing versions of a new technology, $A$ and $B$. However, they can only get users of the old technology to migrate if they standardize on one of the technologies. The installed base has size $\beta$. Adopting the less preferred technology results in a marginal cost of $c$, instead of 0. The payoffs for firms $a$ (row) and $b$ (column) were given by:

|   | **A** | **B** |
|---|---|---|
| **A** | $\frac{(4+\beta+4c)^2}{108}, \frac{(4+\beta-8c)^2}{108}$ | $\frac{3c}{25}, \frac{3c}{25}$ |
| **B** | $\frac{3(1-c)^2}{25}, \frac{3(1-c)^2}{25}$ | $\frac{(4+\beta-8c)^2}{108}, \frac{(4+\beta+4c)^2}{108}$ |

   (a) (10 points) What inequalities must be satisfied for standardization (either AA or BB) to an equilibrium? Use these to derive a condition, in terms of $\beta$ and $c$, for when standardization is profitable for the firms.

   (b) (5 points) Discuss why consumers could benefit more from standardization than firms.