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Last Name (Please PRINT): ....

First Name (PRINT): ....

Your UM I.D. Number: ....

INSTRUCTIONS (please read!)

1. Please make sure that you have 6 pages, including this page. Complaints about missing pages will not be accepted.
2. Please answer all the questions. You are <u>not</u> allowed to use any course material. Calculators are permitted.
3. Maximum Time Allowed: 1 hour and 20 minutes (8:40–10:00).
4. Your grade depends on the arguments you develop for supporting your answers. Each answer must be justified by using a logical argument consisting of a model/graph. An answer with no justification will not be given any credit.
5. You must provide all the derivations leading you to a numerical solution.
6. When you draw a graph, make sure that you label the axes with the appropriate notation.
7. Maximum Score: 100 Points
8. Budget your time. If you cannot answer a certain question, skip to the next one.
9. Please always bear in mind that "somebody" has to read and understand your handwriting. Please make sure that your ink is "visible" and that your sentences are properly organized and fit into the designated blank space. If you think that your handwriting is poor, please print each word!
10. Good Luck !

Instructor's use only

Problem #	1	2	3	4	5	Total
Maximum	20	20	20	20	20	100
Points						

(1) Firms A and B can choose to adopt a new technology (N) or to adhere to their old technology (O). Formally, firms' action sets are: $t_A \in \{N, O\}$ and $t_B \in \{N, O\}$. The table below exhibits the profit made by each firm under different technology choices.

		Firm B	
		NEW TECHNOLOGY (N)	OLD TECHNOLOGY (O)
Firm A	NEW	100 | 50	40 | 200
	OLD	50 | 100	200 | 60

(1a) [5 points] Write down the best-response functions of firms A and B, $t_A = R_A(t_B)$ and $t_B = R_B(t_A)$, and conclude which outcome(s) (if any) constitute an equilibrium in dominant actions.

(1b) [5 points] Which outcome(s) (if any) constitute a Nash equilibrium? Prove!

(1c) [5 points] Are the outcomes $\langle N, N \rangle$ and $\langle O, O \rangle$ Pareto optimal? Prove!

(1d) [5 points] Suppose that both firms choose to adopt the new technology. Is this a case of *excess inertia* or *excess momentum*. Explain!

(2) Consider a service with no network externalities (such as car repair services). There are two service providers labeled A and B. The unit production cost of provider A and provider B are $\mu_A = \$1$ and $\mu_B = \$4$, respectively. Let p_A denote the price charged by provider A, and p_B the price charged by provider B.

There are $\eta_A = 200$ consumers who are A-oriented, and $\eta_B = 200$ consumers who are B-oriented. Let q_A be the number of consumers who buy service A, and q_B the number of consumers who buy service B. Formally, the utility of an A-oriented and a B-oriented consumer are given by

$$U_A \stackrel{\text{def}}{=} \begin{cases} 9 - p_A & \text{buys service } A \\ 9 - p_B - 3 & \text{buys service } B \end{cases} \quad \text{and} \quad U_B \stackrel{\text{def}}{=} \begin{cases} 9 - p_A - 3 & \text{buys service } A \\ 9 - p_B & \text{buys service } B \end{cases}$$

(2a) [15 points] Using this information, compute the UPE prices and profit of each provider.

(2b) [5 points] Compute the equilibrium aggregate consumer surplus CS^U, and social welfare W^U.

(3) The online dating industry consists of two online service providers labeled A and B. Assume production is costless ($\mu_A = \mu_B = 0$). Let p_A denote the price charged by provider A, and p_B the price charged by provider B.

There are $\eta_A = 120$ consumers who are A-oriented, and $\eta_B = 120$ consumers who are B-oriented. Let q_A be the dating network size of those who subscribe to A, and q_B the dating network size of those who subscribe to B. Formally, the utility of an A-oriented and a B-oriented consumer are given by

$$U_A \stackrel{\text{def}}{=} \begin{cases} \frac{1}{2}q_A - p_A & \text{subscribes to } A \\ \\ \frac{1}{2}q_B - p_B - 50 & \text{subscribes to } B \end{cases} \quad \text{and} \quad U_B \stackrel{\text{def}}{=} \begin{cases} \frac{1}{2}q_A - p_A - 50 & \text{subscribes to } A \\ \\ \frac{1}{2}q_B - p_B & \text{subscribes to } B \end{cases}$$

The dating services are one-way compatible in the sense that A subscribers can access (offer a date) to A and B subscribers, whereas B subscribers can access only B subscribers.

(3a) [15 points] Compute the UPE prices and profit levels. Which provider charges a higher price? Explain why.

(3b) [5 points] Compute the equilibrium aggregate consumer surplus CS^U, and social welfare W^U.

(4) Consider a system composed of two components labeled X and Y. There are two firms producing two different systems (different brands), at zero production cost. Firm A produces components X_A and Y_A, and firm B produces X_B and Y_B. In this market there are 100 consumers labeled AA, and 100 consumers labeled AB. The utility function of each type of consumers is

$$U_{AA} = \begin{cases} 10 - \left(p_A^X + p_A^Y\right) & \text{buys system } X_A Y_A \\ 10 - \left(p_B^X + p_A^Y\right) - 1 & \text{buys system } X_B Y_A \\ 10 - \left(p_A^X + p_B^Y\right) - 1 & \text{buys system } X_A Y_B \\ 10 - \left(p_B^X + p_B^Y\right) - 2 & \text{buys system } X_B Y_B \end{cases} \quad U_{AB} = \begin{cases} 10 - \left(p_A^X + p_A^Y\right) - 1 & \text{buys system } X_A Y_A \\ 10 - \left(p_B^X + p_A^Y\right) - 2 & \text{buys system } X_B Y_A \\ 10 - \left(p_A^X + p_B^Y\right) & \text{buys system } X_A Y_B \\ 10 - \left(p_B^X + p_B^Y\right) - 1 & \text{buys system } X_B Y_B \end{cases}$$

(4a) [16 points] Derive the undercut-proof equilibrium prices and the profit of each firm when each firm sells exactly 100 systems, assuming that the components produced by different firms are incompatible.

(4b) [4 points] Conclude which firm charges a higher price and earns a higher profit. You must provide an explanation for the difference in prices and profit.

(5) Consider a market for a popular tax preparation software TaxMe^{TM}. There are 100 (one-hundred) support-oriented (type-O) users, and 200 (two-hundred) support-independent (type-I) users, with utility functions given by

$$U^O \stackrel{\text{def}}{=} \begin{cases} 400 + 2q - p & \text{buys the software} \\ 2q & \text{pirates (steals) the software} \\ 0 & \text{does not use this software,} \end{cases} \quad U^I \stackrel{\text{def}}{=} \begin{cases} 2q - p & \text{buys the software} \\ 2q & \text{pirates (steals) the software} \\ 0 & \text{does not use this software,} \end{cases}$$

where q denotes the number of users of this software (which includes the number of buyers and the number of pirates, if piracy takes place). Suppose that the software is costless to produce and costless to protect. Also, assume that TaxMe^{TM} provides support only to those consumers who buy the software.

(5a) [8 points] Suppose that TaxMe^{TM} is *not* copy protected, so piracy is an option for every consumer. Calculate the software seller's profit-maximizing price and the corresponding profit level.

(5b) [8 points] Suppose that TaxMe^{TM} is copy protected, so piracy is impossible. Calculate the software seller's profit-maximizing price and the corresponding profit level. Does TaxMe^{TM} benefit from protecting its software against piracy?

(5c) [4 points] Are support-oriented consumers better off when software is protected compared with the case in which software is unprotected? Prove by computing the equilibrium utility levels.

THE END