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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 8 pages, including this page. Complaints about missing pages will not be accepted.
2. Please answer all the questions. You are not 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	6	Total
Maximum	10	20	20	20	20	10	100
Points							

(1) The diaper industry in Albania consists of 5 firms producing identical diapers. Similarly, the diaper industry in Bolivia consists of 6 firms. It has been recently observed that firms' market shares in each country are given by

Country	Firms						Concentration Index	
	1	2	3	4	5	6	I_4	I_{HH}
Albania	40%	15%	15%	15%	15%	0%		
Bolivia	45%	11%	11%	11%	11%	11%		

(1a) [5 points] Fill-in the missing items in the above table (show all your calculations). Then, conclude which industry is more concentrated (and according to which measure).

(1b) [5 points] Suppose the distribution of market shares in the United States is the same as in Bolivia. Use the merger guidelines to conclude whether a merger between firms 5 and 6 is likely to be challenged by the FTC?

(2) The table below displays the profits from a price game between GM and FORD.

		FORD					
		Low Price		Mid Price		High Price	
GM	Low	100	100	150	50	200	0
	Mid	50	150	200	200	350	250
	High	0	200	250	350	300	300

Each firm can set either a high price, p^H, a mid price, p^M, or a low price, p^L, where $p^H > p^M > p^L > 0$. Solve the following problems.

(2a) [5 points] Find which pairs of prices (if any) constitute an equilibrium in *dominant* actions. Prove your answer!

(2b) [5 points] Is the outcome $\langle p_G, p_F \rangle = \langle p^H, p^H \rangle$ a *Nash* equilibrium? Prove your answer!

(2c) [5 points] Suppose the FTC prohibits both firms from setting high prices. That is, setting p^H becomes illegal. Which outcome(s) constitute a *Nash* equilibrium in the restricted game? Prove your answer.

(2d) [5 points] Assuming again that firms are not allowed to set p^H, solve for a subgame-perfect equilibrium price strategies of a two-stage game in which Ford announces its price before GM does.

(3) *Impel*™ is the sole producer of memory chips for supercomputers. Each chip costs $c = 30$ to produce. This monopoly can sell in two markets with the following inverse demand functions:

$$p_1 = 120 - q_1 \quad \text{and} \quad p_2 = 120 - \frac{q_2}{3}.$$

(3a) [10 points] Compute the monopoly's profit-maximizing prices in each market, p_1 and p_2, sales levels q_1 and q_2, and the monopoly's total profit assuming that *Impel*™ can price discriminate between the two markets.

(3b) [10 points] Now, due to a fire that nearly destroyed its factory, this monopoly cannot produce and sell more than 160 units. In other words, assume that the production capacity of *Impel*™ is limited to no more than 160 chips. Compute the monopoly's profit-maximizing prices in each market, p_1 and p_2, sales levels q_1 and q_2, and the monopoly's total profit.

(4) [20 points] A monopoly sells in three markets with the following inverse demand functions:

$$p_1 = 36 - q_1, \quad p_2 = 24 - \frac{q_2}{2}, \quad \text{and} \quad p_3 = 12 - \frac{q_3}{2}.$$

For simplicity, assume that production is costless ($c = 0$). Also, assume that the monopoly is unable to price discriminate, hence it must charge the same price in all three markets, $p = p_1 = p_2 = p_3$. Compute the monopoly's profit-maximizing price, p, aggregate sales, and total profit.

(5) In Ben Barber there are two suppliers of distilled water, labeled firm A and firm B. Distilled water is considered to be a homogenous good. Let p denote the price per gallon, q_A quantity sold by firm A, and q_B the quantity sold by firm B. Firm A and firm B bear a production cost of $c_A = c_B = \$20$ per one gallon of water. Ann Barber's inverse demand function for distilled water is given by

$$p = 140 - 2Q = 140 - 2(q_A + q_B),$$

where $Q = q_A + q_B$ denotes the aggregate industry supply of distilled water in Ben Barber. Solve the two problems on the next page assuming that the firms compete in prices, p_A and p_B.

(5a) [10 points] Write down each firm's price best response function, and solve for the price each firm sets in a Bertrand-Nash equilibrium.

(5b) [10 points] Now, suppose this game is repeated indefinitely in each period $t = 0, 1, 2, \ldots$. Let ρ, where $0 \leq \rho \leq 1$, denote the firms' common time discount factor. Compute the minimum threshold value of ρ that would make it unprofitable for each firm to unilaterally deviate from the collusive outcome assuming that the each firm i adheres to its trigger-price strategy given by

$$p_i(\tau) = \begin{cases} \$80 & \text{if } p_A(t) = p_B(t) = \$80 \text{ in each period } t = 0, 1, 2, \ldots, \tau - 1 \\ \$20 & \text{otherwise.} \end{cases}$$

(6) [10 points] The market inverse demand function for internet connection is given by $p = 120 - Q$, where Q is the number of subscribers. There are three firms labeled as firm 1, firm 2, and firm 3. Assume that internet connection is costless to provide. Formally, assume that the marginal and fixed costs satisfy $c_1 = c_2 = c_3 = 0$ and that $F_1 = F_2 = F_3 = 0$

Consider the following three-stage game. In stage $t = 1$ firm 1 sets its output level, q_1. In stage $t = 2$ firm 2 sets its output level, q_2 after observing q_1. In stage $t = 3$ firm 3 sets its output level, q_3, observing q_1 and q_2. Compute the firms' output and profit levels in a subgame perfect equilibrium. .

THE END