ECN 460/560, Spring 2005
Prof. Bruce Blonigen

NAME: ANSWER KEY
SS#:

FINAL – Version A

Wednesday, June 8, 2005

Multiple choice - pick the most appropriate answer. (5 points each)

1) Which of the following makes limit pricing (overproducing to keep out a rival) more likely to be successful?

a) There are many close substitute products.
b) Market demand is linear.
c) The incumbent firm has irreversibly committed itself to overproducing.
d) Entry costs are zero.

2) Constant returns to scale refers to the situation where

a) demand stays constant as the scale of the firm increases.
b) average costs stay constant as the scale of the firm increases.
c) marginal costs stay constant as the scale of the firm increases.
d) fixed costs stay constant as the scale of the firm increases.

3) When perfectly competitive firms are making losses in the short-run, we should expect

a) the industry price will go up in the long-run.
b) all firms in the industry will shut down operations in the long-run.
c) costs will fall in the long-run.
d) firms will engage in third-degree price discrimination.

4) Which of the following makes it more likely that two firms could sustain collusive prices (escaping the prisoner's dilemma of competitive prices) in a multi-period game?

a) Both firms do not care about future profits.
b) One firm produces a much higher quality product.
c) Technological shocks are constantly leading to new products in the industry.
d) The game has no definite end.

5) Short-run marginal costs curves eventually increase as output increases due to

a) the law of diminishing marginal returns.
b) economies of scale.
c) diseconomies of scale.
d) the nature of sunk costs.

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6) A Stackelberg game is a model of oligopoly where

a) firms pick quantities simultaneously.
b) firms pick prices simultanteously.
c) firms pick either prices or quantities sequentially.
d) firms coordinate their choice of price or quantity to achieve the joint monopoly outcome.

7) The Herfindahl-Hirschmman Index provides an industry index of

a) market power.
b) market concentration.
c) merger power.
d) economies of scale.

8) Which of the following is <u>not</u> an effective way to help ensure managers maximize firm profits?

a) Stock options as a significant part of a manager's compensation.
b) The potential for a takeover by outside parties.
c) Providing incentives to managers for gains in market share of the firm.
d) Monitoring of performance by a Board of Directors.

<u>Short calculations or fill-in-the-blank questions.</u>

9) List three non-pricing strategies to deter entry or drive out a competitor. (3 points per blank)

a) Product Proliferation
b) Excessive Advertising
c) Excessive R+D and Patenting

Lobbying for higher industry costs
Protection-building Trade

10) I will give you ~~$5000~~ $500 next year ~~and~~ $1000 the following year. How much is the present value of these gifts to you if your discount rate is 15%? Show your calculations. (6 points)

$PV = \left(\frac{1}{1+0.15}\right) \times 500 + \left(\frac{1}{1+0.15}\right)^2 \times 1000$ (5)

$\simeq 434.78 + 756.14$

$PV \simeq \$1190.92$ (1)

11) You build a plant in the Competitive Strategy Game that costs $400,000, which depreciates each period by 10% with a scrap value of $220,000 at the end of period 6. (5 points for each calculation below)

How much would money would you get back if you sell the plant ~~after two~~ years of operation?

Value = $(0.90) \times (0.90) \times \$400{,}000 = \$324{,}000$

What are sunk costs of this plant if you run it all six periods?

Sunk costs = $400{,}000 - 220{,}000 = \$180{,}000$

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COMPETITION IN RESEARCH AND DEVELOPMENT. Use the following information to answer questions 12-15 (9 points per question). Two firms compete in research and development (R&D) for designing new features for cell phones, CellFun and RDC. Each firm chooses how many units of R&D activity (not price or quantity) they wish to engage in to maximize current profits. CellFun's cost function is 1000 + $20R_C$, where R_C is the units of R&D that CellFun chooses. Similarly, RDC's cost function is 300 + $40R_R$, where R_R is the units of R&D that RDC chooses.

~~12)~~ Consumers of R&D units cannot distinguish which firm produced it, so there is one overall price for R&D and the inverse demand function is $P = 120 - R_C - R_R$. Total revenues for each firm are equal to the price (P) times the number of R&D units they produce (R_C or R_R). Is this more like a Cournot game or a Bertrand game with differentiated products? Explain.

This is like a Cournot game since consumers cannot distinguish which firm produced an R+D unit – i.e., a homogeneous good.

13) Properly set up RDC's profit function and solve for their best-response function in terms of CellFun's R&D (R_C).

$$\max_{R_R} \pi_R = (120 - R_C - R_R)R_R - [300 + 40R_R] \quad 3$$
$$= 120R_R - R_C R_R - R_R^2 - 300 - 40R_R$$
$$= 80R_R - R_C R_R - R_R^2 - 300$$

F.O.C. $\frac{\partial \pi_R}{\partial R_R}: \quad 80 - R_C - 2R_R \overset{set}{=} 0 \quad 3$

1

$$2R_R = 80 - R_C$$
$$\boxed{R_R^* = 40 - \tfrac{1}{2}R_C} \quad 1$$

14) CellFun's best-response function is $R_C = 50 - ½ R_R$. Solve for the Nash Equilibrium in R&D units for each firm.

Substitute RDC's best-response funct into CellFun's

$$R_C = 50 - \tfrac{1}{2}\left[40 - \tfrac{1}{2}R_C\right]$$
$$R_C = 50 - 20 + \tfrac{1}{4}R_C$$
$$\tfrac{3}{4}R_C = 30$$
$$R_C^* = 40$$

$$R_R = 40 - \tfrac{1}{2}(40)$$
$$R_R^* = 20$$

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COMPETITION IN RESEARCH AND DEVELOPMENT continued

15) Suppose that the government subsidized RDC by $12 for each unit of R&D. (In other words, they are paid 12 for each unit of R&D they produce). Derive RDC's new reaction function and solve for the new Nash Equilibrium in R&D units for RDC and CellFun.

$$\max_{R_R} \Pi_R = (120 - R_C - R_R)R_R - [300 + 40R_R] + \underbrace{12R_R}_{\text{Subsidy}}$$

$$= 120R_R - R_C R_R - R_R^2 - 300 - 40R_R + 12R_R$$

$$= 92R_R - R_C R_R - R_R^2 - 300$$

FOC

$$\frac{\partial \Pi_R}{\partial R_R} = 92 - R_C - 2R_R \overset{set}{=} 0$$

$$\boxed{R_R^* = 46 - \tfrac{1}{2}R_C}$$

New Best-response function for RDC with Subsidy

New N.E. - substitute new RDC best response into Cellfun's best-response

$$R_C = 50 - \tfrac{1}{2}\left[46 - \tfrac{1}{2}R_C\right]$$

$$\Leftrightarrow \quad R_C = 50 - 23 + \tfrac{1}{4}R_C$$

$$\Leftrightarrow \quad \tfrac{3}{4}R_C = 27$$

$$R_C^* = 36$$

$$R_R^* = 46 - \tfrac{1}{2}(36)$$

$$R_R^* = 28$$

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CARTEL IN A PERFECTLY COMPETITIVE INDUSTRY. Use the following information to answer questions 16-19. (9 points each) There are many identical firms in a perfectly competitive situation, each taking a price of \$20. All firms in this industry have the cost function $C(q) = 49 + 6q + q^2$, where q is each individual firm's output.

16) Properly set up an individual firm's profit function and calculate their optimal quantity and profit. Will there be entry or exit in this industry? Explain why or why not.

$$\max_q \pi = Pq - C(q)$$
$$= 20q - [49 + 6q + q^2]$$
$$= 20q - 49 - 6q - q^2$$
$$= 14q - 49 - q^2$$

FOC $\frac{\partial \pi}{\partial q}$: $14 - 2q \overset{set}{=} 0$

$q^* = 7$

$$\pi = 20(7) - [49 + 6(7) + (7)^2]$$
$$= 140 - 49 - 42 - 49$$

$\pi^* = 0$

There will be no entry or exit since profits are zero

17) Now suppose that a trade association is allowed to organize all the firms in the industry to achieve a collective monopoly situation. The cartel tells each firm to produce only 6 units (i.e., q=6) so that the market price rises to \$26. Suppose that this effort is successful - each firm produces 6 units and price rises to \$26. Calculate how much profit is each firm making.

$$\pi_{CAR} = 26(6) - [49 + 6(6) + (6)^2]$$
$$= 156 - 49 - 36 - 36$$

$\pi_{CAR} = \$35$

18) Now assume that 1 firm decides to cheat. How much does this firm produce and how much profit does it make? Show your work.

$$\max_{q_{CH}} \pi_{CH} = 26q - [49 + 6q + q^2]$$
$$= 26q - 49 - 6q - q^2$$
$$= 20q - 49 - q^2$$

FOC $\frac{\partial \pi_{CH}}{\partial q_{CH}}$: $20 - 2q \overset{set}{=} 0 \Rightarrow q^* = 10$

$$\pi^*_{CH} = 26(10) - [49 + 6(10) + (10)^2]$$
$$= 260 - 49 - 60 - 100$$

$\pi^*_{CHEAT} = \$51$

19) How much profit does this firm make if all the firms cheat? Explain.

If all firms cheat, the price will fall a lot and in the short-run they will make a loss. After exits take place, the remaining firms will make zero economic profit.

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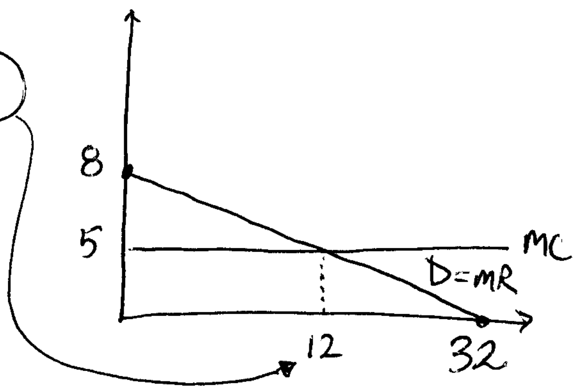
PRICE DISCRIMINATION. Use the following information to answer questions 20-23. (9 points each) Rosie's restaurant serves both lunch and dinner. It costs Rosie \$5 for each meal she prepares, regardless of whether it is lunch or dinner. (in other words, marginal cost is a constant of \$5) However, demand for lunch and dinner differs. At lunch, inverse demand is P = 8 - 0.25Q, while at dinner, inverse demand is P = 15 - Q.

20) Suppose that Rosie could practice first-degree (or perfect) price discrimination at lunch. How many people would she serve at lunch? How much lunchtime profit would she make? Show your calculations.

Remember: MR schedule is the inverse demand schedule in this case!

Q^*_{1st} is where MR=MC: $8 - \frac{1}{4}Q = 5$

$-\frac{1}{4}Q = -3 \Rightarrow Q^*_{1st} = 12$



Profits are equal to the triangular area under the inverse demand curve and above MC

$\pi^{1st} = \frac{1}{2}(8-5)\cdot 12$

$= \frac{1}{2}\cdot 3\cdot 12$

$\pi^{1st} = \$18$

21) Now suppose that Rosie can only charge one price for lunch and another (possibly different) price for dinner (third-degree price discrimination). Derive the price and quantity she would set for both lunch and dinner. Compare lunchtime profits to those you calculated in the previous question.

LUNCH

$\max_{Q_L} \pi_L = (8 - \frac{1}{4}Q_L)Q_L - 5Q_L$

$= 8Q_L - \frac{1}{4}Q_L^2 - 5Q_L$

$= 3Q_L - \frac{1}{4}Q_L^2$

F.O.C

$\frac{\partial \pi_L}{\partial Q_L}: 3 - \frac{1}{2}Q_L \overset{set}{=} 0$

$Q_L^* = 6$

$P = 8 - \frac{1}{4}(6)$

$P^* = 6.5$

DINNER

$\max_{Q_D} \pi_D = (15 - Q_D)Q_D - 5Q_D$

$= 15Q_D - Q_D^2 - 5Q_D$

$= 10Q_D - Q_D^2$

FOC

$\frac{\partial \pi_D}{\partial Q_D}: 10 - 2Q_D \overset{set}{=} 0$

$Q_D^* = 5$

$P = 15 - 5$

$P^* = 10$

Compare lunch profits

3rd: $\pi = 6.5\cdot 6 - 5\cdot 6 = \$9$

$\pi_{3rd} = \$9 < \pi^{1st} = 18$

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ROSIE'S PRICE DISCRIMINATION PROBLEM cont.

22) Calculate the price elasticity of demand for both lunch and dinner at the optimal quantity for the situation where she engages in third-degree price discrimination. (HINT: This relates to the Lerner Index of Market Power)

$$\boxed{\frac{P - MC}{P} = \frac{1}{-\varepsilon}}$$

LUNCH:

$$\frac{6.5-5}{6.5} = \frac{-1}{\varepsilon}$$

$$\Leftrightarrow \frac{1.5}{6.5} = \frac{1}{-\varepsilon}$$

$$-\varepsilon = \frac{6.5}{1.5}$$

$$\varepsilon = -\frac{6.5}{1.5} \text{ or } -4.33$$

DINNER:

$$\frac{10-5}{10} = -\frac{1}{\varepsilon}$$

$$\Leftrightarrow \frac{1}{2} = -\frac{1}{\varepsilon}$$

$$\varepsilon = -2$$

23) Draw Rosie's third degree price discrimination decisions in a graph below with lunch decisions on the righthand side and dinner on the lefthand side. Make sure to draw and label the demand curve, the marginal revenue curve, marginal cost, and the optimal prices and quantities.