ECN 460/560, Spring 2005
Prof. Bruce Blonigen

NAME: ANSWER KEY
SS#: _____

FINAL – Version B

Wednesday, June 8, 2005

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

1) 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.

2) 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.

3) 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.

4) 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.

5) 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.

ECN 460/560 - Prof. Blonigen **NAME:** _____

6) 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.

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

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

8) 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.

Short calculations or fill-in-the-blank questions.

9) List three conditions necessary for a firm to be able to price discriminate. (3 points per blank)

a) Market Power
b) Ability to Discern Different Groups of Consumers
c) Little or No Arbitrage

10) I will give you $1000 next year and $600 the following year. How much is the present value of these gifts to you if your discount rate is 12%? Show your calculations. (6 points)

$PV = \left(\frac{1}{1+0.12}\right) \cdot \$1000 + \left(\frac{1}{1+0.12}\right)^2 \cdot \$600$

$\approx \$892.86 + 478.32 \approx \$1371.18$

11) You build a plant in the Competitive Strategy Game that costs $500,000, which depreciates each period by 20% with a scrap value of $80,000 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?

$(0.80) \times (0.80) \times 500,000 = \$320,000$

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

Sunk costs = $\$500,000 - \$80,000 = \$420,000$

ECN 460/560 - Prof. Blonigen **NAME:** _____

ECN 460/560 - Prof. Blonigen **NAME:** _____

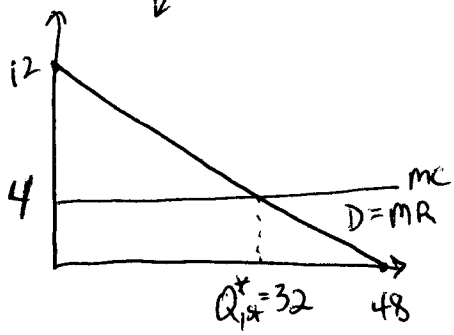
PRICE DISCRIMINATION. Use the following information to answer questions 12-15. (9 points each) Rosie's restaurant serves both lunch and dinner. It costs Rosie $4 for each meal she prepares, regardless of whether it is lunch or dinner. (in other words, marginal cost is a constant $4) However, demand for lunch and dinner differs. At lunch, inverse demand is P = 12 - 0.25Q, while at dinner, inverse demand is P = 20 - Q.

12) 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 curve in this case.

Q^*_{1st} is where $MR = MC$: $12 - \frac{1}{4}Q = 4$

$-\frac{1}{4}Q = -8$ $\Rightarrow Q^*_{1st} = 32$



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

$\Pi^{1st} = \frac{1}{2} \cdot (12-4) \cdot 32$

$\Pi^{1st} = 128$

13) 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.

LUNCH: $\max_{Q_L} \Pi_L = (12 - \frac{1}{4}Q_L)Q_L - 4Q_L$

$= 12Q_L - \frac{1}{4}Q_L^2 - 4Q_L$

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

FOC: $\frac{\partial \Pi_L}{\partial Q_L} \overset{\text{set}}{=} 8 - \frac{1}{2}Q_L \overset{\text{set}}{=} 0$

$Q_L^* = 16$

$P_L = 12 - \frac{1}{4}Q_L$

$= 12 - \frac{1}{4}(16)$

$P_L^* = 8$

DINNER: $\max_{Q_D} \Pi_D = (20 - Q_D)Q_D - 4Q_D$

$= 20Q_D - Q_D^2 - 4Q_D$

$= 16Q_D - Q_D^2$

FOC: $\frac{\partial \Pi_D}{\partial Q_D} \overset{\text{set}}{=} 16 - 2Q_D \overset{\text{set}}{=} 0$

$Q_D^* = 8$

$P_D = 20 - Q_D$

$= 20 - 8$

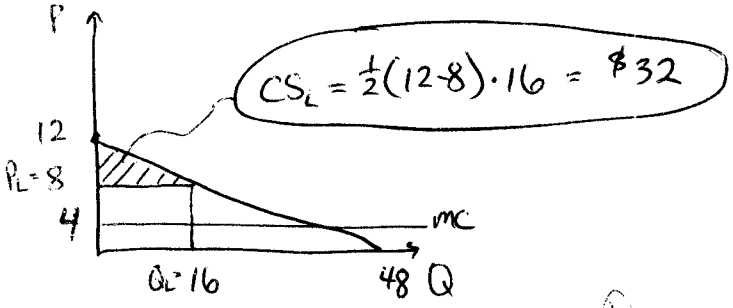
$P_D^* = 12$

ECN 460/560 - Prof. Blonigen **NAME:** _____

ROSIE'S PRICE DISCRIMINATION PROBLEM cont.

14) Calculate the consumer surplus for lunchtime customers when Rosie engages in third-degree price discrimination and when she engages in first-degree price discrimination and compare the two.

CS for 3rd Degree



(1)

Consumer Surplus for first-degree price discrimination is always zero, so consumer surplus will be larger for third-degree price discrimination

(4)

15) 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)

$$\frac{P-MC}{P} = \frac{1}{-\varepsilon_D}$$

LUNCH

$P = 8$

$MC = 4$

$\therefore \frac{8-4}{8} = \frac{1}{-\varepsilon_D}$

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

$\therefore \varepsilon_D = -2$

DINNER

$P = 12$

$MC = 4$

$\therefore \frac{12-4}{12} = -\frac{1}{\varepsilon_D}$

$\Leftrightarrow \frac{8}{12} = -\frac{1}{\varepsilon_D}$

$\therefore \varepsilon_D = -\frac{3}{2}$ or -1.5

COMPETITION IN RESEARCH AND DEVELOPMENT. Use the following information to answer questions 16-19 (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.

16) 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.

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

$$\max_{R_C} \pi_C = (120 - R_C - R_R)R_C - [1000 + 20R_C]$$

$$= 120R_C - R_C^2 - R_R R_C - 1000 - 20R_C$$

$$= 100R_C - R_C^2 - R_R R_C - 1000$$

F.O.C.

$$\frac{\partial \pi_C}{\partial R_C} \overset{\text{set}}{=} 100 - 2R_C - R_R \overset{\text{set}}{=} 0$$

$$\Leftrightarrow 2R_C = 100 - R_R \Rightarrow \boxed{R_C = 50 - \tfrac{1}{2}R_R}$$

18) RDC's best-response function is $R_R = 40 - \frac{1}{2} R_C$. Solve for the Nash Equilibrium in R&D units for each firm.

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

$$R_R = 40 - \tfrac{1}{2}(50 - \tfrac{1}{2}R_R)$$

$$R_R = 40 - 25 + \tfrac{1}{4}R_R$$

$$\tfrac{3}{4}R_R = 15$$

$$\boxed{R_R^* = 20}$$

$$\therefore R_C^* = 50 - \tfrac{1}{2}(20)$$

$$\boxed{R_C^* = 40}$$

ECN 460/560 - Prof. Blonigen **NAME:** _____

COMPETITION IN RESEARCH AND DEVELOPMENT continued

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

subsidy

$$\max_{R_C} \pi_C = (120 - R_C - R_R)R_C - [1000 + 20R_C] + 12R_C$$

$$= 120R_C - R_C^2 - R_R R_C - 1000 - 20R_C + 12R_C$$

$$= 112 - R_C^2 - R_R R_C - 1000$$

F.O.C.

$$\frac{\partial \pi_C}{\partial R_C}: \quad 112 - 2R_C - R_R \overset{set}{=} 0$$

$$R_C = 56 - \tfrac{1}{2}R_R$$

CellFun's New best-response function

Substitute new CellFun best-response into RDC's best response function

$$R_R = 40 - \tfrac{1}{2}(56 - \tfrac{1}{2}R_R)$$

$$R_R = 40 - 28 + \tfrac{1}{4}R_R$$

$$\tfrac{3}{4}R_R = 12$$

$$R_R^* = 16$$

$$R_C = 56 - \tfrac{1}{2}(16)$$

$$R_C^* = 48$$

ECN 460/560 - Prof. Blonigen **NAME:** _____

CARTEL IN A PERFECTLY COMPETITIVE INDUSTRY. Use the following information to answer questions 20-23. (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.

20) 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

$\frac{\partial \Pi}{\partial q} = 14 - 2q \overset{set}{=} 0$

$2q = 16 \Rightarrow q^* = 7$

$\Pi = 20 \cdot 8 - [49 + 6(8) + (8)^2]$

$= 160 - 49 - 48 - 64$

$\Pi^* = \$0$

There will be no exit or entry since firms are making zero profit

21) 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 $30. Suppose that this effort is successful - each firm produces 6 units and price rises to $30. Calculate how much profit is each firm making.

$\Pi_{CAR} = 30(6) - [49 + 6(6) + (6)^2]$

$= 180 - 49 - 36 - 36$

$\Pi_{CAR} = \$59$

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

$\max_{q_{CH}} \Pi_{CH} = 30q - [49 + 6q + q^2]$

$= 30q - 49 + 6q - q^2$

$= 24q - 49 - q^2$

F.O.C.

$\frac{\partial \Pi_{CH}}{\partial q_{CH}} = 24 - 2q \overset{set}{=} 0 \Rightarrow q^* = 12$

$\Pi_{CH} = 30(12) - [49 + 6(12) + (12)^2]$

$= 360 - 49 - 72 - 144$

$\Pi_{CHEAT} = \$95$

23) 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, the remaining firms will make zero economic profit