Economics 203, Fall 2006
Intermediate microeconomics
Instructor: Paul Schure

QUIZ 1
Monday 2 October 2006 (50 minutes)

Quiz 1 is 4 pages long and consists of two parts. Part 1 contains three short-answer questions that are worth 5 marks each. Part 2 has two long-answer questions that are worth 15 and 20 marks, respectively. In total you can earn 50 marks, i.e. a minute per mark. You must fill out your name and student number before you start. Good luck!

Name: ....

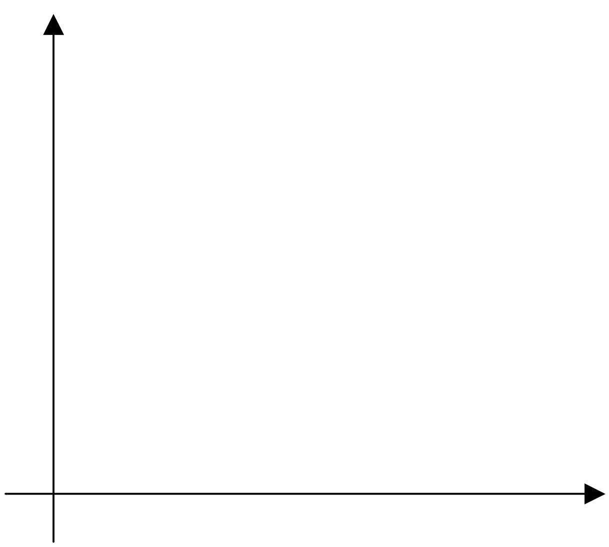
Student #: ....

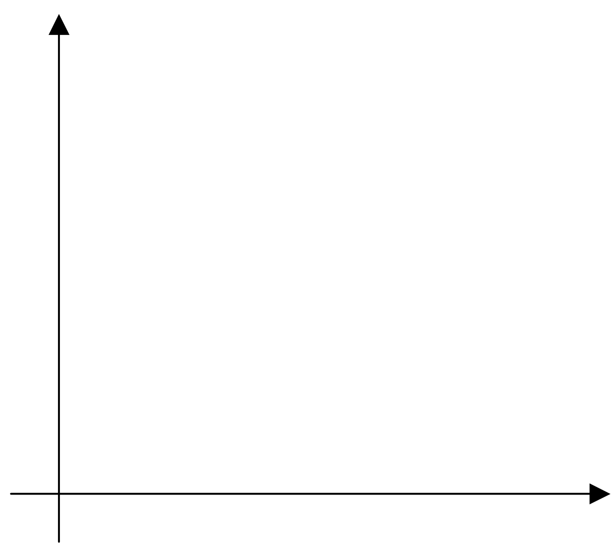
PART 1: SHORT-ANSWER QUESTIONS (15 marks)

The short-answer questions below are worth 5 marks each. **Give your answers on this exam sheet only.**

Question 1-1. Show in the two diagrams below that an inferior good may be a Giffen good or not. [Don't forget to label your axes, and to quickly clarify matters...]

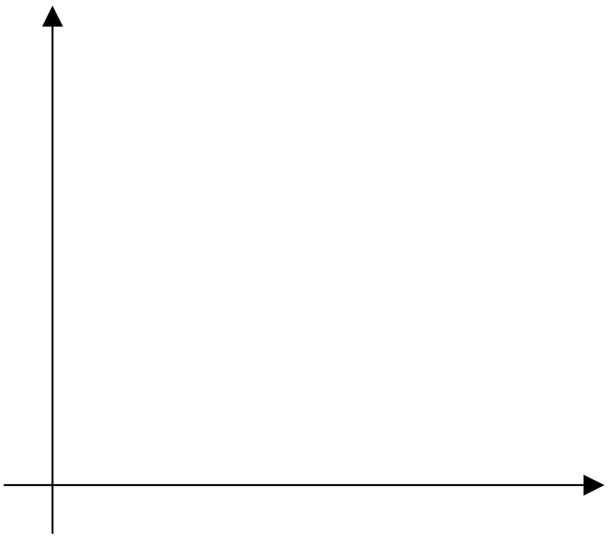
ANSWER:





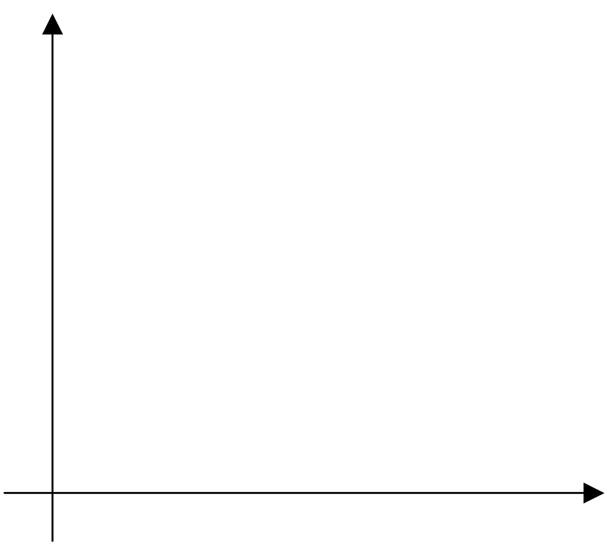
Question 1-2. Prove that two indifference curves of the same person cannot cross each other. I suggest you use the diagram below. Label your axes and clarify briefly what is going on in your diagram. Also state which assumption(s) on preferences your proof relies upon.

ANSWER:



Question 1-3. Demand for whale watching tours of Victorians is given by $p = 5/q_V$ while tourist demand for whale watching tours is given by $p = 10 - q_T$. Derive and graph the (aggregated) demand function for whale watching tours.

ANSWER:



PART 2 (35 marks)

Do each of the following two questions. Answer using your answer booklet.

Question 2-1 (15 percent)

Elizabeth only cares for raspberries *r* and apples *a.* In fact, her utility function is given by $U(r,a) = r^{1/4}a$. Assume Elizabeth has a budget of $M = 50$, and let the price of apples be $p_a = 2$.

(a) Write down the *consumer's problem* that Elizabeth solves in case the price of raspberries is $p_r = 1$. Explain in words what it says.

(b) Derive Elizabeth's *optimum bundle* in case the price of raspberries is $p_r = 1$.

(c) (1) Derive Elizabeth's *individual demand function* for raspberries. (2) Is the law of demand satisfied for Elizabeth's individual demand function? (why or why not?)

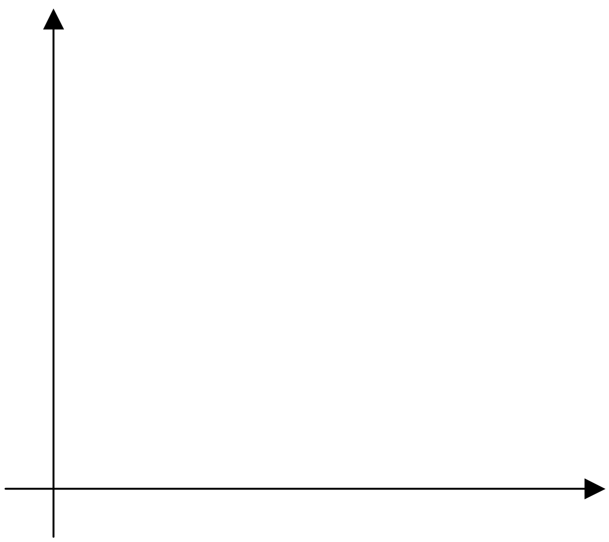
Question 2-2 (20 percent)

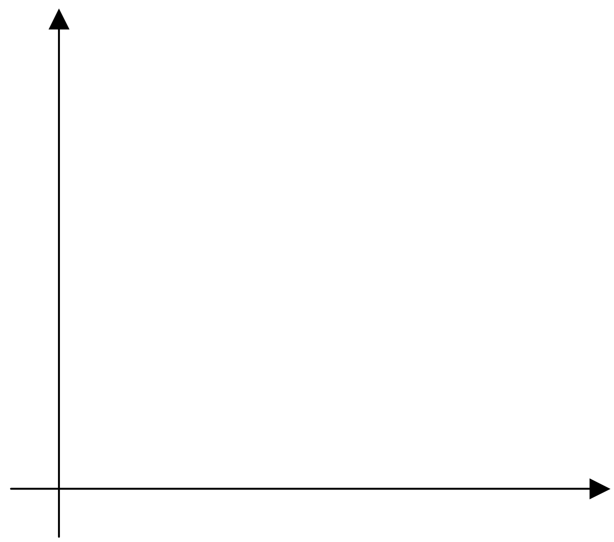
Because of concerns that barbequing meat using charcoal may cause cancer, the government decides to impose a 100 percent tax at the retail level on charcoal briquets. This means that in the future shop keepers will have to transfer *half* of their proceeds from the sale of charcoal briquets to the government. Before the announcement of the government demand for charcoal briquets was given by P=120-2Q and supply by P=30+Q (where P is the price in dollars and Q the number of 10-kg bags of charcoal briquets per day).

(a) Compute the equilibrium price and quantity of charcoal briquets before the tax was imposed.

(b) Show in a graph what is the impact of the tax on the market for charcoal briquets.
(c) Compute the after-tax price and quantity and compute what are the tax revenues
(d) Use computations to show whether buyers or sellers, or both buyers and sellers, carry the tax burden.
(e) Identify a complementary good of charcoal briquets. Draw what could be the demand curve for this complementary good and show in your graph how the tax on charcoal briquets affects demand for your complementary good.

ANSWER:





<end of quiz>

Economics 203, Fall 2006
Intermediate microeconomics
Instructor: Paul Schure

ANSWERS QUIZ 1 (No graphs):

Preliminary note: it is important to outline your argument in all these questions. The logic logic behind the steps must be made clear, but to the point.

Question 1-1. Show in the two diagrams below that an inferior good may be a Giffen good or not. [Don't forget to label your axes, and to quickly clarify matters...]

ANSWER: Fig 4-8 (page 100) shows the income and substitution effect of an inferior good which is not a Giffen good. The income effect for an inferior good works in the opposite way as the substitution effect. A Giffen good is an inferior good for which the income effect is stronger than the substitution effect.

Question 1-2. Prove that two indifference curves of the same person cannot cross each other. I suggest you use the diagram below. Label your axes and clarify briefly what is going on in your diagram. Also state which assumption(s) on preferences your proof relies upon.

ANSWER: Picture like Fig 3-11 [1 mark]. Explanation: By "transitivity" [1 mark] points D, E, and F have same utility. However F has more of good 1 and more of good 2 than E. Hence "nonsatiation" [1 mark] implies that F has higher utility than E. Contradiction [explanation sound: 2 marks]. Axes not labeled –1 mark.

Question 1-3. Demand for whale watching tours of Victorians is given by $p = 5/q_V$ while tourist demand for whale watching tours is given by $p = 10 - q_T$. Derive and graph the (aggregated) demand function for whale watching tours.

ANSWER: Steps: 1. Rearrange demand functions in proper form for aggregation: $q_V = 5/p$ and $q_T = 10 - p.$ Aggregate demand function is $q^{agg} = 5/p$ if $p > 10$ and $q^{agg} = 5/p + 10 - p$ if $0 \le p \le 10.$ Picture: make clear there is a bend at p=10 and, as usual, labels the axes.

Question 2-1

Elizabeth only cares for raspberries *r* and apples *a.* In fact, her utility function is given by $U(r,a) = r^{1/4}a$. Assume Elizabeth has a budget of $M = 50$, and let the price of apples be $p_a = 2$.

(a) Write down the *consumer's problem* that Elizabeth solves in case the price of raspberries is $p_r = 1$. Explain in words what it says.

A: $\max_{r,a} r^{1/4} a$

Subject to $2a + r \le 50$

In words: Elizabeth maximizes her utility by choosing r and a subject to her budget restriction [and taking the price for a and r as well as her budget given]. Note: Students must work with the actual utility function, not with the generic form.

(b) Derive Elizabeth's *optimum bundle* in case the price of raspberries is $p_r = 1$.

Two conditions must hold: "slope condition" and budget line:

$$\frac{MU_a}{p_a} = \frac{MU_r}{p_r} \Rightarrow \frac{r^{1/4}}{2} = \frac{\frac{1}{4} r^{-3/4} a}{1} \Rightarrow r = \frac{1}{2} a$$

$$2a + r = 50$$

Combining delivers: 2.5a=50, so a=20, so r=10. The optimum bundle is (a,r)=(20,10)

(c) (1) Derive Elizabeth's *individual demand function* for raspberries. (2) Is the law of demand satisfied for Elizabeth's individual demand function? (why or why not?)

A: Same two equations, but with p_r unknown:

$$\frac{MU_a}{p_a} = \frac{MU_r}{p_r} \Rightarrow \frac{r^{1/4}}{2} = \frac{\frac{1}{4} r^{-3/4} a}{p_r} \Rightarrow r = \frac{1}{2p_r} a$$

$$2a + p_r r = 50$$

Combining delivers: 2.5a=50, so a=20, so r=10/ p_r. The demand function is r=10/ p_r.

This is a regular downward-sloping demand function, i.e. the law of demand is satisfied.

Question 2-2

Because of concerns that barbequing meat using charcoal may cause cancer, the government decides to impose a 100 percent tax at the retail level on charcoal briquets. This means that in the future shop keepers will have to transfer *half* of their proceeds from the sale of charcoal briquets to the government. Before the announcement of the government demand for charcoal briquets was given by P=120-2Q and supply by P=30+Q (where P is the price in dollars and Q the number of 10-kg bags of charcoal briquets per day).

(a) Compute the equilibrium price and quantity of charcoal briquets before the tax was imposed.
(b) Show in a graph what is the impact of the tax on the market for charcoal briquets.
(c) Compute the after-tax price and quantity and compute what are the tax revenues
(d) Use computations to show whether buyers or sellers, or both buyers and sellers, carry the tax burden.

(e) Identify a complementary good of charcoal briquets. Draw what could be the demand curve for this complementary good and show in your graph how the tax on charcoal briquets affects demand for your complementary good.

ANSWER:

(a) solve for P and Q, for instance 120-2Q=30+Q so 3Q=90 so Q=30 so P=60.

(b) Old supply schedule is P=30+Q. So, with tax we get P^X=30+Q, where P^X is the price excluding tax. The tax T= 0.5*P, where P is the price incl tax. And also P^X=0.5*P. Thus the new schedule is 0.5P=30+Q, i.e. P=60+2Q, a non-parallel shift.

(c) From P=60+2Q and P=120-2Q we obtain P=90 and Q=15. Tax receipts: Q*T=Q*0.5*P=15*45=675.

(d) Buyers and Sellers share the tax burden. Buyers pay 90 now and before they paid 60, so the share of the tax burden they carry is (90-60)/45=2/3. Seller now obtains 45 and before 60, so the share of their tax burden is (60-45)/45=1/3

(e) BBQ stake or Charcoal BBC grills are two examples. The demand curve shifts inward.

<end of quiz>

Economics 203, Fall 2006
Intermediate microeconomics
Instructor: Paul Schure

QUIZ 2 (50 minutes)
Monday 30 October 2006

Quiz 1 is 4 pages long and consists of two parts. Part 1 contains two short-answer questions that are worth 5 marks each. Part 2 has two long-answer questions that are worth 20 marks each. In total you can earn 50 marks, i.e. a minute per mark. You must fill out your name and student number **before** you start. Give your answers **only** on this exam sheet. Good luck!

Name: ....

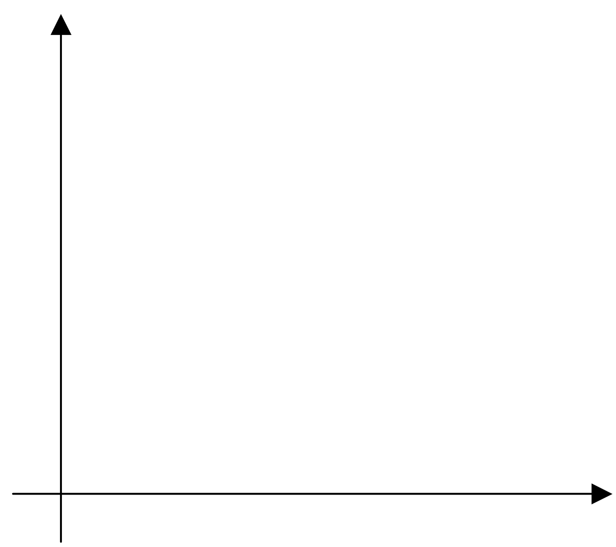
Student #: ....

PART 1: TWO SHORT-ANSWER QUESTIONS [5 marks each]

Question 1-1. [Give your answers on this exam sheet only, not in your answer booklet]

In the diagram below, demonstrate with an example that a firm’s short-run costs typically exceed the long-run costs. On the left-hand side quickly clarify what is going on in your graph. Don’t forget to label the axes.

ANSWER:



Question 1-1. In an economy with three agents (A, B, and C) and two goods (X and Y), define what is meant by a *Pareto-efficient allocation* between A, B, and C. Use no more than 50 words.

ANSWER:

PART 2: TWO SHORT-ANSWER QUESTIONS [20 marks each]

Question 2-1 (20 marks)

Consider an exchange economy with only 2 agents, Arnold and Brigitte, and 2 goods, X and Y. Let Arnold have utility function $U_A(X_A, Y_A) = X_A Y_A^{1/3}$ and Brigitte $U_B(X_B, Y_B) = X_B Y_B$. Here (X_A, Y_A) and (X_B, Y_B) represent the good bundles of Arnold and Brigitte, respectively. Let Arnold have an initial endowment of $(X_A^E, Y_A^E) = (8/3, 0)$ and Brigitte $(X_B^E, Y_B^E) = (1/3, 5)$.

(a) Draw the initial endowment, as well as a few indifference curves of Arnold and Brigitte in an Edgeworth box. Prove graphically (i.e. using the Edgeworth box) whether or not the initial endowment is *Pareto-efficient*.
(b) To avoid confusion, draw up a new Edgeworth box and indicate clearly the *contract curve*, the *set of individually rational trades* between Arnold and Brigitte, and the *core* of this economy.
(c) Let the price of X be 3 and the price of Y be 1. Derive Arnold's optimum bundle graphically —do this again in a fresh Edgeworth box— and mathematically.
(d) Prove mathematically that the prices given in (c) constitute competitive equilibrium prices, and find the competitive equilibrium allocation.

ANSWERS:

ANSWERS 2-1 (continued):

Question 2-2 (20 marks)

Consider a firm with production function $F(K,L) = KL^{1/2}$, where K represents the production factor capital and L labour. Let the price of capital be $r = 2$ and the price of labour be $w = 2$.

(a) Give an expression of an *isocost line* for this firm using the factor prices given above. Graph all input combinations that lead to a cost level of $100,000.
(b) Give a mathematical representation of the *cost minimization problem* that this particular firm solves. Assume that the firm intends to produce *q* units of output.
(c) Derive the optimum amounts of capital and labour for this firm as a function of *q.*
(d) Give the *cost function* for this firm.
(e) Print the correct version of the following line in your answer booklet: “The firm’s average cost *decreases / increases / stays constant* because the production technology exhibits *constant / decreasing / increasing* returns to scale.”

ANSWERS:

<end of quiz>

Economics 203
Intermediate microeconomics
ANSWERS QUIZ 2

Question 1-1
Sketch: Draw an isoquant (nice and convex, and downward sloping) and an isocost curve (downward-sloping line) in a L-K diagram. Mention that production function is $F(K, L)$ and that in the SR $K = \overline{K}$. Then first find the combination of L and K with minimum costs, i.e. the point where the isocost line just touches the isoquant. This is the LR optimum bundle. This isocost line characterizes the long-run minimum cost level. Second, mark the point that crosses the isoquant and with $K = \overline{K}$. This is the SR optimum bundle. The isocost line through this point represents the SR minimum cost level. Remark that the latter isocost line is further away from the origin, so represents higher costs.

Question 1-2
A PE allocation between A, B, and C is an allocation between A, B, and C such that it is *not* possible to re-allocate/re-distribute the available goods X and Y among A, B, and C such that A, B, and C are all better off.

Question 2-1
(a) Picture as in the labs but the initial allocations differs. The two orange ICs in the picture are those that run through the initial allocation E. Now point to an allocation in the box that is utility improving trades for both agents (it lies in the interior of the set of IR trades). The presence of such an allocation proves that the initial allocation is not Pareto-efficient. [You could also point to the fact that the slopes of the ICs are not identical so that there must be utility improving trades for both A and B.]
Some remarks:

- Here is what I told the TAs regarding grading: "Make sure that students get the box right, with the axes labeled and the lenght of the axis about right (x-axis: 3 units,y-axis 5 units). The initial allocation is of course just a single point. The indifference curves should be bowed inward when your perspective is the origin of each respective agent."
- In general, I recommend figuring out *one* indiff curve pretty precisely, while the rest can be sketchy. Find a few easy points. For example, one of Arnold's ICs is $X_A Y_A^{1/3} = 1$ and the points $(X_A, Y_A) = (1, 1)$, $(2, 1/8)$, $(3, 1/27)$ are on it. From this and your knowledge that this is a convex-shaped function you can graph the IC $X_A Y_A^{1/3} = 1$ "pretty precisely". With one precise IC you know more or less what the other curves look like as well.
- Using more colors for your lines works great when working with Edgeworth boxes.

(b) Create a new picture. Note that the IR trades are actually a bit tricky. Since Arnold has a zero endowment of good Y, he (weakly) prefers *all* allocations in the box to his initial endowment. As a result the set of IR allocation are all allocations that lie "above" (i.e. towards the bottom-left in the E-box) Brigit's IC that runs through the initial allocation. The exact shape of the contract curve is not so easy to figure out, but the picture should made clear that it consists of points for which the ICs of Arnold and Brigit are tangent. The contract curve runs below the diagonal from A to B, by the way. The core is the part of the contract curve that are also in the set of IR allocations.

(c) (c1: graphically) First draw the BL in the Edgeworth box. With prices $p_X = 3$ and $p_Y = 1$ the slope of the BL is -3 and it must of course go through the initial allocation E. Next take Arnold's highest IC that still has a point on the budget line. (c2: mathematically) With prices 3 and 1 we have the following budget restriction (BR) $3X_A + Y_A \leq M_A = X_A^E * 3 + Y_A^E * 1 = \frac{8}{3} * 3 = 8$, i.e. $3X_A + Y_A \leq 8$. One condition for Arnold's optimum is the budget line, i.e. $3X_A + Y_A = 8$. The other condition is the "slope" condition also holds, i.e. $MRS_A = p_x/p_y = 3$ or, equivalently, $\frac{MU_X^A}{p_X} = \frac{MU_Y^A}{p_Y}$, i.e. $\frac{Y_A^{1/3}}{3} = \frac{\frac{1}{3}X_A Y_A^{-2/3}}{1}$, i.e. $X_A = Y_A$. Combining the two equations gives $X_A = Y_A = 2$.

(d) STEP 1: <A optimizes> From (c2) we know that $p_X = 3$ and $p_Y = 1$ implies $(X_A, Y_A) = (2, 2)$. STEP 2: <B optimizes> We can show through the same procedure for Brigit (i.e. combine B's budget line $3X_B + Y_B = M_B = X_B^E * 3 + Y_B^E * 1 = \frac{1}{3} * 3 + 5 * 1 = 6$ and $MRS_B = p_x/p_y = 3$) to show that $(X_B, Y_B) = (1, 3)$ STEP 3 <market equilibrium>: Check whether for both goods we get that demand = supply. Good X : demand = $X_A + X_B = 2 + 1 \stackrel{?}{=} X_A^E + X_B^E = \frac{8}{3} + \frac{1}{3} = 3 =$ supply <check!>. Good Y : demand = $Y_A + Y_B = 2 + 3 \stackrel{?}{=} Y_A^E + Y_B^E = 0 + 5 = 5 =$ supply <check!>. SUMMARY: We have first shown (Steps 1+2) that optimization of A and B with prices $p_X = 3$ and $p_Y = 1$ implies the allocation will be $(X_A, Y_A) = (2, 2)$ and $(X_B, Y_B) = (1, 3)$. We have next (Step 3) seen that this allocation is a feasible allocation. Thus, the prices $p_X = 3$ and $p_Y = 1$ are competitive equilibrium prices, and the competitive equilibrium allocation is $(X_A, Y_A) = (2, 2)$ and $(X_B, Y_B) = (1, 3)$.

Question 2-2

(a) Isocost line $2K + 2L = C$. With $C = 100{,}000$ we have $K = -L + 50{,}000$. Picture is trivial.

(b) $\min_{K,L} 2K + 2L$ subject to $KL^{1/2} = q$.

(c) Two conditions should hold in the optimum: (1) "slope condition" and (2) isoquant. The slope condition can be written down as

$$\frac{MP_K}{r} = \frac{MP_L}{w} \Leftrightarrow \frac{L^{1/2}}{2} = \frac{\frac{1}{2}KL^{-1/2}}{2} \Leftrightarrow L = \frac{1}{2}K$$

Substituting this into the isoquant gives $K(\frac{1}{2}K)^{1/2} = q \Leftrightarrow \left(\frac{1}{2}\right)^{1/2} K^{3/2} = q \Leftrightarrow 2^{-1/2}K^{3/2} = q \Leftrightarrow K^{3/2} = 2^{1/2}q \Leftrightarrow K^* = (2^{1/2}q)^{2/3} = 2^{1/3}q^{2/3}$. So $L^* = \frac{1}{2}2^{1/3}q^{2/3}$. If you like, change $2^{1/3}$ into $\sqrt[3]{2}$.

(d) $C(q) = 2K^* + 2L^* = 3\sqrt[3]{2}q^{2/3}$

(e) The firm's average cost $AC(q) = \frac{C(q)}{q} = 3\sqrt[3]{\frac{2}{q}}$ decreases because the production technology exhibits increasing returns to scale.

Economics 203, Fall 2006
Intermediate microeconomics
Instructor: Paul Schure

QUIZ 3
Monday 20 November 2006 (50 minutes)

Quiz 1 is 3 pages long and consists of two parts. Part 1 contains two short-answer questions that are worth 5 marks each. Part 2 has two long-answer questions that are worth 20 marks each. In total you can earn 50 marks, i.e. a minute per mark. You must fill out your name and student number **before** you start. Give your answers **only** on this exam sheet. Good luck!

Name: ....

Student #: ....

PART 1: TWO SHORT-ANSWER QUESTIONS [5 marks each]

Question 1-1.

Consider a monopolistic firm facing *identical* consumers. Consider the following three statements and tell me whether they are TRUE, FALSE or UNCERTAIN. Please, briefly clarify (only) if you answer UNCERTAIN.

(a) If the monopolist charged a single price to each consumer, the price would be higher than the welfare-maximizing price
(b) In case arbitrage is *not* possible, the monopolist could well choose a two-part tariff to capture all consumer surplus
(c) For the two-part tariff in (b) welfare is maximized

Question 1-2.

Consider the following three statements in connection to a *perfectly competitive market* which is in equilibrium. For each of the statements tell me whether they are TRUE, FALSE or UNCERTAIN. Please, briefly clarify (only) if you answer UNCERTAIN.

(a) In the short run firms may be profitable or loss-making
(b) In the long run all firms make zero profits
(c) There is no excess demand or excess supply, both in the short run or in the long-run

PART 2: TWO SHORT-ANSWER QUESTIONS [20 marks each]

Question 2-1

In this question consider a monopolist for UVic sweaters with cost function $C(Q) = 0.5Q^2 + 275.$ Here Q represents the numbers of sweaters sold.[1]

(a) (1) Formulate the *monopolist's problem* in case demand were given by $Q = 60 - P.$ (2) Compute the monopoly price and quantity. (3) Show the solution to the monopolist's problem in a graph and indicate what represents the consumer surplus and the producer surplus.

(b) In reality the monopolist sells to UVic personnel and UVic students. Demand by UVic personnel is given by $Q_A = 55 - P_A$, and UVic student demand is given by $Q_B = 70 - 2P_B$. (1) In case the monopolist can divide up the market into these two segments, how many sweaters would the monopolist sell to UVic personnel and how many to UVic students? (2) What exact assumption about the *cost of arbitrage* must you make in order to make third-degree price discrimination work?

[1] Right! This monopolist is actually the UVic book store.

Question 2-2

The government of a country called "Regula" currently promises its 10,000 wheat farmers a price of *P=20* per bushel of wheat. The government currently does not allow new farmers to start growing wheat and makes sure that Regula does not import or export wheat. The (short-run and long-run) cost function of each farm in Regula is $C(q_i) = \frac{q_i^2}{2} - 4q_i + 200$. Here q_i is the farm's output in bushels of wheat. Aggregate demand for wheat is given by $Q = -10{,}000P + 400{,}000$.

A UVic economics student that worked for a coop term at the Regula government advises to allow farmers to produce wheat under competitive circumstances. In this question you investigate what would happen according to this proposal. [Assume that Regula stays a closed economy, i.e. assume there will be no import or export of wheat.]

(a) Clarify what the proposal of the coop student means in practical terms.
(b) Compute the current supply (at the price *P=20*) of wheat produced in Regula.
(c) Compute the price per bushel of wheat immediately after the proposal of the coop student gets implemented (i.e. in the short run)
(d) Compute the price per bushel of wheat in the long run if the proposal of the coop student gets implemented.

<end of quiz>

Economics 203, Fall 2006
Intermediate microeconomics
Instructor: Paul Schure

ANSWERS QUIZ 3

Question 1-1

(a) TRUE
(b) TRUE
(c) TRUE

In this question and the next +2 for correct answers, -1 for wrong answers, 0 for unanswered answers or UNCERTAIN with a reasonable story.

Question 1-2

(a) TRUE [See e.g. Figure 11.15]
(b) TRUE [See e.g. Figures 11.6 + 11.7]
(c) TRUE [See defn equilibriums in the SR and LR]

Question 2-1

(a1) (3 marks) $\max_Q \Pi(Q) = (60 - Q)Q - 0.5Q^2 - 275$. [Alternatively: $\max_P \Pi(P) = P(60 - P) - 0.5(60 - P)^2 - 275$.]
(a2) (3 marks) The FOC is $60 - 2Q - Q = 0$. This yields $Q^M = 20$, so that $P^M = 60 - 20 = 40$.
(a3) (4 marks) See the picture. CS in yellow (light) and PS in blue (dark)

(b1) (total:7 marks)
STEP 1: (3 marks) You can depart from the monopolists problem, or do things directly. There are two paths you can follow: (1) formulate the monopolists problem as to maximize profits by choosing prices optimally, (2) formulate the monopolists problem as to maximize profits by choosing quantities optimally. The last is the easiest. Reward students that write up the monopolist's problem correctly by 3 points because they have got a very good start. If students skip this step but arrive at the next, that is fine too.
STEP 2. (2 marks) Going the quantity way is the easiest and you arrive at the following two conditions:

$$MR_A(Q_A) = MC(Q)$$

$$MR_B(Q_B) = MC(Q)$$

where $Q = Q_A + Q_B$. In this case the equations are:

$$55 - 2Q_A = Q_A + Q_B$$

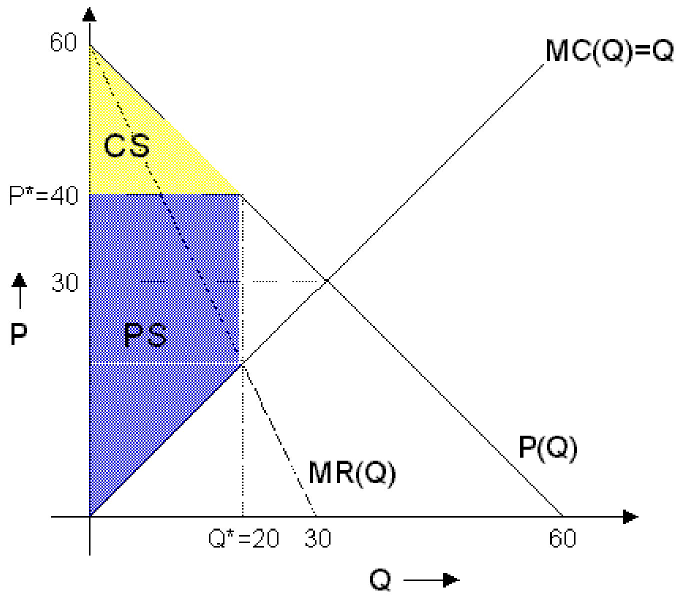


Figure 1: The consumer and producer surplus

$35 - Q_B = Q_A + Q_B$

STEP 3 (3 marks) Figure out the total quantity that the monopolist produces. That is solve the two equations. For example substitute eqn (2) in (1) to get $55 - 3(35 - 2Q_B) - Q_B = 0$. This delivers $Q_B^* = 10$. Substitute back in eqn (2) to see that $Q_A^* = 15$.

(b2) (3 marks). The optimal prices with price discrimination are $P_A^* = 55 - 15 = 40$ and $P_B^* = 35 - \frac{1}{2} * 10 = 30$. The cost or arbitrage must therefore exceed \$10 per unit to make this form of price discrimination work.

Question 2-2

(a) (4 marks) It means two changes (1) getting rid of the price guarantee of $P = 20$ per bushel (That is, do not interbene in the market by offering $P = 20$. Market forces will determine the price); (2). Allow farmers to start growing wheat (i.e. allow entry).

(b) (6 marks) with a price of $P = 20$ individual firms offer q_i such that $P = MC(q_i) = q_i - 4$. Since the supply of an individual firm is given by $P = q_i - 4$ or $q_i = P + 4 = 24$ the market supply is given by $Q = 10,000P + 40,000$. With $P = 20$ we get $Q = 240,000$.
Two remarks [not needed in your answer]

- Another way: individual supply determined by $P = q_i - 4$ so $q_i = 24$ if $P = 20$. Hence with 10,000 firms supply is $10,000 * 24 = 240,000$

- We know that the price must be higher than the minimum level of the average variable cost for firms to be willing to produce in the SR. The AVC is given by $VC(q_i)/q_i = 0.5q_i - 4$. The minimum level of the AVC is hence -4 (BTW, what would this mean?). Thus $P = q_i - 4$ applies for all prices $P \geq 0$ because even at $P = 0$ the firm would like to stay in business in the short run.

(c) (4 marks) [In this question you need to derive the market supply curve if you have not yet in (b)]. Immediately after the coop student's proposal gets implemented supply and demand determine the price. Supply is given by $Q = 10,000P + 40,000$, demand is given by $Q = -10,000P + 400,000$. Hence the equilibrium price is given by $10,000P + 40,000 = -10,000P + 400,000 \Rightarrow 20,000P = 360,000 \Rightarrow P = 18$. [Each firm now offers $q_i = 22$ BTW]

(d) (6 marks) In the long run firms can enter or exit the market. In this case firms enter entry because they are profitable in the SR with $P = 18$. Entry or exit will take place until firms operate at the quantity for which the average total cost (ATC) is minimal. The prevailing market price will be equal to the ATC at its minimum level (e.g. Figure 11-15) There are two ways to find the point where the ATC is minimal: (1) Find the point where MC=ATC. (2) Directly find the point where ATC is minimal. I like the second way better. $ATC(q_i) = C(q_i)/q_i = 0.5q_i - 4 + 200/q_i$. At the minimum the derivative is 0 so we get the FOC $0.5 - 200/q_i^2 = 0$. This gives $q_i = 20$ and hence in the LR equilibrium we have $P^{LR} = 0.5 * 20 - 4 + 200/20 = 16$.