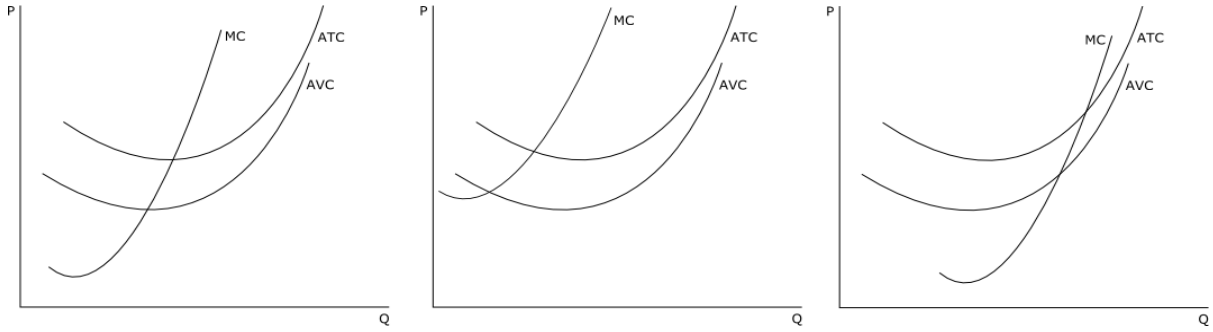
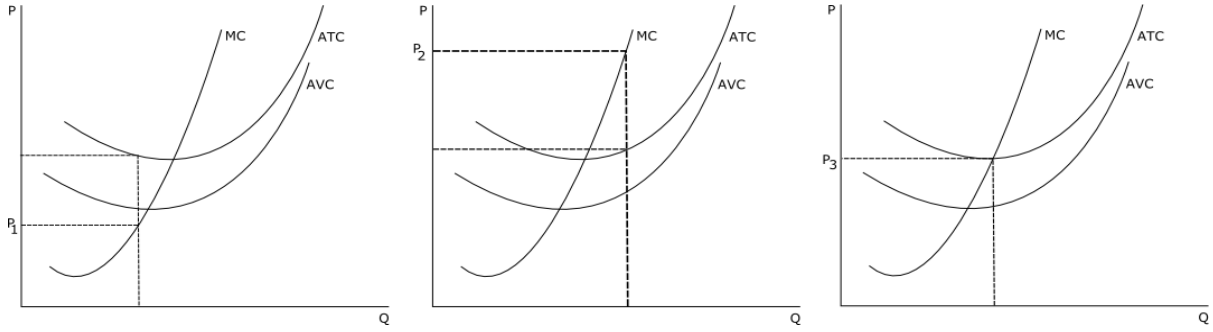
**AAU - Microeconomics (ECO 120/2) - Spring 2010**

Which of the pictures below is a correct representation of marginal and average costs?




Which of the pictures below depicts a situation with positive profit? Zero profit?



**Problem 1 - Long Run Equilibrium**

There are several identical firms in the perfectly competitive market; each of them has the following cost curves:

$TC(q) = 32 + 10q + 2q^2$

$MC(q) = 10 + 4q$

The market demand function is the following: $P = 106 - 2Q$

What is the long run price in this market? How many firms will there be in the long run?

**Solution:** The key information here is that the market is perfectly competitive (P=MC) and in the long-run equilibrium (profit of each firm is zero). This means that even if the firm is maximizing its profit (choosing quantity such that MC equals the price) it makes no money at all. This happens only in one case, when price equals ATC. Putting these two conditions together we get that the optimality condition for this problem is:

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Using the optimality condition we can find the level of output of each firm:

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The individual level of output of each firm is ..... units. And the price can be determined from the optimality condition $MC = P$:

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If the market price is P=.....; then market demand is:

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This means, that there are ..... firms in the market.

**Problem 2 - Monopoly and Fixed Cost**

Consider an industry with market demand $P = 100 - Q$. Corresponding $MR$ is $100 - 2Q$. Consider two scenarios for the firm's total cost function: $TC_1(q) = 100 + 4q + q^2$, $TC_2(q) = 16 + 4q + q^2$, marginal cost function is given by $MC(q) = 4 + 2q$ (the same in both scenarios).

(a) Compute the equilibrium price and quantity for both scenarios if this was a monopoly market.

(b) Compute the equilibrium price and quantity if this was a competitive market (in a LR equilibrium).

(c) Illustrate both a) and b) and discuss the relationships between monopoly and competitive market results and the role of fixed costs.

**Solution:** The key information here is that there is only one firm in the market - a monopolist. For this firm, profit maximizing level of output is determined by the condition .....:

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Knowing the quantity that the monopolist produces we can determine the price that can be charged from the demand function:

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Note that the optimal level of output and the price does not change if we use $TC_1$ or $TC_2$. This is because the fixed cost does not affect the optimal choice of output. Only variable cost matter for this decision.

If this market is **perfectly competitive** and in a long run equilibrium, then the optimality condition reads .....:

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The individual level of output of each firm is ..... units. And the price can be determined from the optimality condition $MC = P$:

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If the market price is P= ..... ; then market demand is:

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In this part of the problem, fixed cost matter for the result so let's look at the second type of total cost: $TC_2(q) = 16 + 4q + q^2$

$$MC = ATC$$
$$MC = \frac{TC}{Q}$$
$$4 + 2q = \frac{16}{q} + 4 + q$$
$$q = \pm 4 \quad \text{only positive quantity matters}$$

The individual level of output of each firm is 4 units. And the price can be determined from the optimality condition $MC = P$:

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If the market price is .....; then market demand is:

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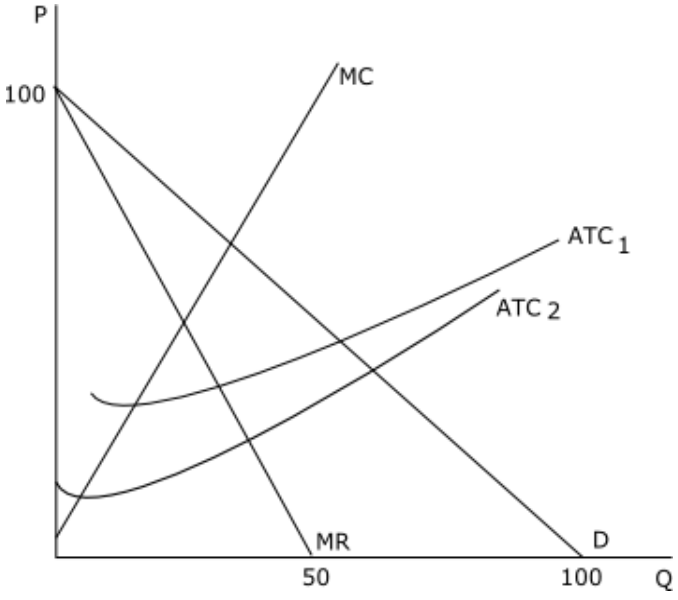
Use the figure below to show all three results of this problem.



**Problem 3 - Perfect Competition:**

There are 24 identical firms in the market, each has the following costs: $TC(Q) = 64 + 16Q + Q^2$; $MC(Q) = 16 + 2Q$.

(a) In the short run, what is the lowest price at which the firms will produce positive amount of output?

(b) Identify the market short-run supply curve.

(c) Compute the profit of one firm, if we know that the market demand in the short-run is $P = 458 - Q_D$.

**Solution:**

(a) The lowest acceptable price at which the firms will produce positive amount of output is minimum of ATC. This can be found as intercept of MC and ATC:

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Then the corresponding price is: .....

(b) Market short-run supply curve is simply MC above ATC: $S : P = 16 + 2Q$ if price is higher than 32, zero otherwise.

(c) First, we need to determine equilibrium price and individual and market supply. Demand is given by $D : P = 458 - Q_D$. Individual supply is: $P = 16 + 2Q$ or $Q = P/2 - 8$. Market supply is the sum of individual supplies of 24 firms:

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The equilibrium price and quantity is:

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Each firm makes the following profit:

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**Problem 4 - Perfect Competition:**

The market with shoes is perfectly competitive. The lowest point at the long-run average total cost function for any of the identical producers is 4. The output corresponding to these costs is 1000 pairs of shoes/month. Currently, the companies produce 1150 pairs of shoes/month, the short-run average cost of production is 5.

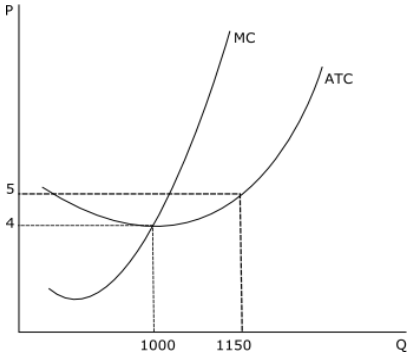
Market demand for shoes is $Q_D = 140000 - 10000P$; market supply of shoes is $Q_S = 80000 + 5000P$.

(a) What is the equilibrium price for a pair of shoes? How many firms will be in the market in the LR equilibrium? Is this industry in its long-run equilibrium?

(b) Suppose the market demand shifts to $Q_{D2} = 150000 - 5000P$, what is the new equilibrium price and quantity? Compute it for the market and for the individual company given that the number of firms is the same as in part (a).

(c) Are firms in (b) making profit? (Assume the number of firms stays as in the previous case). Is this a long-run equilibrium?

**Solution:**




(a) In equilibrium, supply equals demand:

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There are

(a) 80
(b) 100
(c) 120

firms in the market.

This market is in the long run equilibrium: True / False

(b) In equilibrium, supply equals demand: .....

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There are still 100 firms and together their output is ..... which means that every firm produces ..... pairs of shoes.

(c) (i): In part (b) all firms are making positive profit, because for their level of output the ATC is lower than P, and their profit is:

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(ii): In part (b) all firms are making negative profit, because for their level of output the ATC is higher than P, and their loss is:

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**Problem 5 - Perfect Competition:**

Consider a perfectly competitive market with 20 identical firms producing identical productslet's say bakeries in Prague producing Sumava bread. Each of the bakeries has costs represented by the following cost functions: $TC(q) = 100 + 25q + q^2$, $MC(q) = 25 + 2q$.

(a) Identify the shut-down condition, i.e., the price at which the bakery would choose to shut-down the operation temporarily.

(b) Identify the exit condition, i.e., the price at which the bakery would choose to exit the market for good (long-run decision).

(c) What is the short-run supply function of an individual bakery? (Compute and illustrate).

(d) Compute the short-run equilibrium in the market, if the demand for Sumava bread is represented by the following demand function: $Q_D = 170 - P$. Remember there are 20 identical companies producing the bread.

(e) What is the production of one firm in the short-run equilibrium?

(f) Is the business profitable? (Do the bakeries earn positive profits in the current situation.)

**Solution:**

**Problem 6 - Perfect Competition in Short Run:**

Consider a perfectly competitive industry. Each firm's marginal cost function is $MC = 5 + 2q$, $q$ is the output of one firm in a day.

(a) Identify the short-run supply of one company.

(b) Derive the short-run market supply if there are 1000 (identical) firms in the industry.

(c) If the price for the good was 7, what would be the production in the industry? (Individual company & market).

(d) Assume the market demand is $Q_D = 1850 - 20P$, compute the equilibrium. What is the production of one company in the equilibrium?

**Solution:**

(a) The short-run supply of one company is its marginal cost curve: $P = 5 + 2q$ or $q = \frac{5-P}{2}$.

(b) If there are 1000 (identical) firms in the industry the supply function is $Q = 1000\frac{5-P}{2} = 500P - 2500$.

(c) .....

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(d) .....

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**Problem 7 - Monopoly:**

Consider a monopoly firm with the following marginal cost function, $MC = 100 + 10q$. Marginal revenue is $MR = 1000 - 20q$, market demand function is $P = 1000 - 10Q_D$.

(a) What would be the level of production, if the firm set the price as a monopolist? What would be the price?

(b) What would be the price and level of output if this firm is owned by a government that is concerned about achieving the maximum possible level of economic efficiency?

**Solution:**

(a) The monopolist chooses a profit maximizing level of output by the following rule: $MR = MC$:

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(b) To achieve economic efficiency price equals marginal cost and the level of output equals demanded quantity for that price:

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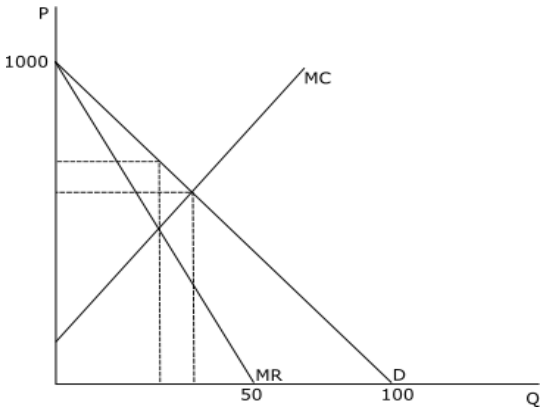


**Problem 8 - Opportunity Cost and Trading**

American and Japanese workers can each produce 4 cars a year. An American worker can produce 10 tons of grain a year, whereas a Japanese worker can produce 5 tons of grain a year. To keep things simple, assume that each country has 100 million workers.

(a) For this situation, construct a table as we did in class.

(b) Graph the PPF of American and Japanese economies.

(c) For the US, what is the opportunity cost of a car? Of grain? For Japan, what is the opportunity cost of a car? Of grain? Put this info in the table.

(d) Which country has an absolute advantage in cars? In grain?

(e) Which country has a comparative advantage in cars? In grain?

(f) Without trade, half of each countrys workers produce cars and half produce grain. What quantities of cars and grain does each country produce?

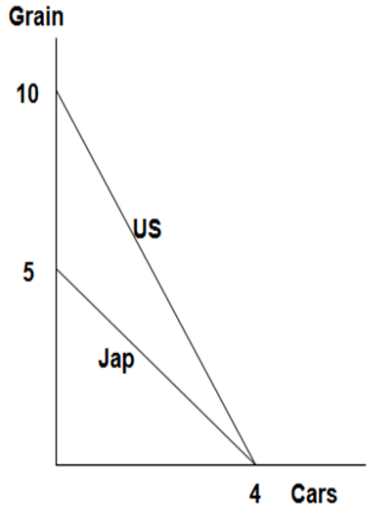
(g) Starting from a position without trade, give an example in which trade makes each country better off.

**Solution:**

(a) Summary table (Simplify and consider there was 1 worker, unless explicitly specified otherwise):

| | Cars | Grain |
|---|---|---|
| USA | 4 | 10 |
| Japan | 4 | 5 |

(b) Graph of the PPF of American and Japanese economies.



(c-e) **Opportunity costs:**

| | Cars | Grains | OC of Cars | OC of Grains |
|---|---|---|---|---|
| USA | 4 | 10 | 2.5 | 0.4 |
| Japan | 4 | 5 | 1.25 | 0.8 |

**Absolute advantage?**

- USA has AA in grain
- Neither of the countries has AA in cars

**Comparative advantage?**

- USA has CA in grain
- Japan has CA in cars

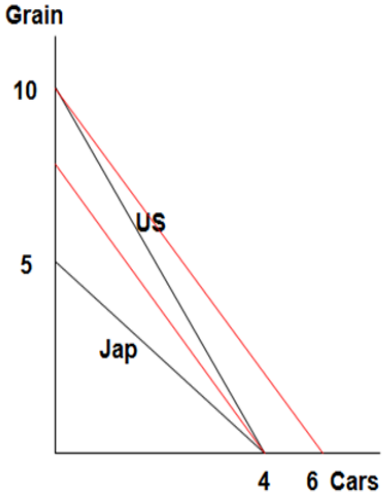
(f) No trade:

| | Cars | Grains | Total Cars | Total Grains |
|---|---|---|---|---|
| USA | 4 | 10 | 2 mil. | 5 mil. |
| Japan | 4 | 5 | 2 mil. | 2.5 mil. |

(g) If USA produces grain & Japan cars, there is no increase in cars production and consumption (nothing to gain from) and increase in grain production  room for trade:

| | Cars | Grains | Production of Cars | Production of Grains | Consumption of Cars | Consumption of Grains |
|---|---|---|---|---|---|---|
| USA | 4 | 10 | 0 mil. | 10 mil. | 2 mil. | 7 mil. |
| Japan | 4 | 5 | 4 mil. | 0 mil. | 2 mil. | 3 mil. |

Terms of trade: It is possible to trade? What are the potential prices?




- Price of grain = .6 = 6/10 car
- Car = 10/6 grain
- Japan can trade 4 cars for 4 x 10/6 grain = 20/3
- USA can trade 10 grain for 10 x .6 cars = 6