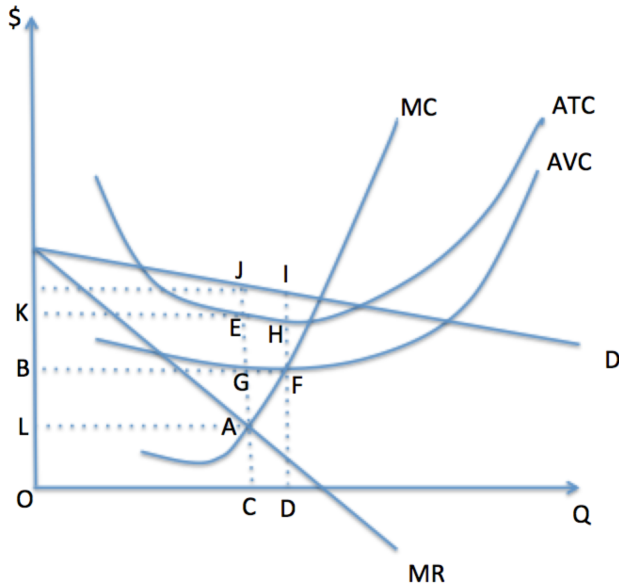*You can use the formula sheet that is given in the last page.*

Multiple Choice Questions (5 points each):

1. For a firm whose cost and revenue structure are represented in the above diagram, which of the following is not correct?

    A. The product whose demand is represented by D has close substitutes.
    B. Total Fixed Cost cannot be zero.
    C. D is higher than the profit maximizing level of quantity.
    D. Marginal cost (MC) crosses ATC at its minimum point.
    E. As Q goes up, for each unit, addition to total revenue is higher than the price.

2. For a firm whose cost and revenue structure are represented in the above diagram, which of the following represents per unit fixed cost at the profit maximizing level of output?

    A. |AJ|
    B. |JE|
    C. |AE|
    D. |EG|
    E. It cannot be determined with the given information.

3. Which of the following is correct?

    A. In a perfectly competitive market, industry supply is obtained by vertically adding individual firm supplies.
    B. For both monopoly and monopolistic competition, a firm maximizes its profit taking into account the firm's cost structure and industry's demand curve.
    C. A firm operating in perfect competition and making zero economic profit must move to another industry.
    D. Price and quantity demanded are inversely related in all markets.
    E. None of the above

4. If a monopolist has zero economic profit at its optimal production level, which of the following does not have to be correct?

    A. Demand is tangent to ATC at optimal Q.
    B. If demand is linear, P and MR are equal at only Q=0.
    C. AFC is below AVC.
    D. All of the above.
    E. None of the above.

5. If a firm chooses to produce a positive quantity,

    A. Firm has to be in the short run.
    B. Firm has to be in the long run.
    C. The firm will increase its profit if it increases its scale.
    D. Price should be higher than AVC at the chosen quantity.
    E. None of the above

6. (30 points) A perfectly competitive firm, operating in the <u>long run</u>, has the following total variable cost function depending on production level Q:

$TVC(Q)\ 10Q^2 + 5Q^4$

If the firm has a fixed cost of 20,000, what is its optimal production level (Q*)?

Since the firm is operating in the long run, the price will be equal to the minimum per unit cost (minimum ATC). Also, the firm will produce where ATC is minimum.

$ATC(Q) = 20,000/Q + 10Q + 5Q^3$

$\partial ATC(Q) / \partial Q = -20,000/Q^2 + 10 + 15Q^2$

At the minimum of ATC $-20,000/Q^2 + 10 + 15Q^2 = 0$

Let $Q^2 = x$
Then, $-20,000/x + 10 + 15x = 0$

$15x^2+10x-20,000 = 0$
Using the quadratic formula,

$$X = \frac{-b \pm \sqrt{b^2-4ac}}{2a} = \frac{-10 \pm \sqrt{10^2+4*15*20,000}}{30} = 36.18$$

$Q^2 = 36.18$
$Q^* = 6.02$

7. A monopolist has the following cost function $1000+30Q+50Q^2$ and faces an industry demand given by 3,000-80Q.

a) (20 points) How many units this monopolist would produce and what would be the price that it would charge per unit?

$30+100Q = 3,000-160Q$
$Q_{monopoly} = 11.42$
$P_{monopoly} = 2,086$

b) (20 points) If the demand stays the same in this industry but instead of a monopolist, the product is produced by 1,000 perfectly competitive firms, each having a total cost function of $50,000Q^2+30Q+1$ how many units would be sold by each firm and what would be the per unit price?

The industry supply would be obtained by horizontal addition of individual firm marginal costs:

$MC = 100,000Q+30 =P$

Therefore at each price the firm would supply a quantity of $Q_{EachFirm}$ = (P-30)/100,000.

If we add 1,000 of these horizontally (that is, add all Qs that will be supplied at a given P),

$Q_{Industry}$ = (P-30)/100 will be the industry supply.

The market price will be determined by the intersection of industry demand and industry supply:

Demand: P=3,000-80Q
Supply: Q=(P-30)/100, P=100Q+30

3,000-80Q=100Q+30
2,970=180Q
Q = 16.5
P = 1,680

Then, each firm would produce where 1680 = 100,000Q+30, Q*=0.0165

c) (5points) Which option is better for the consumer, in the short run and in the long run?

The price is higher under monopoly compared to perfect competition (2,086 versus 1680) however, in perfect competition, each firm makes less profit (each firm making $12.61) than the single firm does in monopoly ($26,561.6). The funds that are available for research&development and innovation are limited. If the monopoly is operating in an environment where there exists threat from other firms to disrupt the industry, it would be in monopoly's best interest to invest its profit on R&D and innovation which will ultimately be beneficial to consumer.

Quadratic Formula: $ax^2+bx+c=0$ $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

TC = TVC+TFC   ATC = TC/Q   AFC = TFC/Q   AVC = TVC/Q

MC = ∂TC/ ∂TC   MR = ∂TR/ ∂Q