1. A firm's demand curve is usually:
   A. to the right of the market demand curve
   B. more inelastic than the market demand curve
   C. the same as the market demand curve
   D. drawn holding supply constant
   E. <u>more elastic than the market demand curve</u>

<u>Note:</u> The only case in which firm demand curves are not more elastic than the market demand curve occurs when the firm is a monopoly (in which case the firm's demand curve and the market demand curve are one and the same consequently have the *same* elasticity). The polar opposite of monopoly is perfect competition, and under perfect competition, firm demand curves are *perfectly elastic*. In all cases other than monopoly, a firm's demand curve is unambiguously more elastic than the market demand curve. Response A is incorrect because 1 firm cannot have more demand than the entire market; B is incorrect because it represents a situation that is mathematically and economically impossible, C is true *only* when the firm is a monopoly, and D is incorrect because supply and demand are independently determined.

2. As we move down a linear demand curve, demand becomes:
   A. more elastic
   B. less elastic at first and then more elastic
   C. steeper
   D. more elastic at first and then less elastic
   E. <u>less elastic</u>

<u>Note:</u> See Figure 2.7 on page 46 of the textbook. As we move from the y-intercept to the x-intercept in the graph, η starts at $-\infty$ and ends at 0; i.e., η is monotonically increasing in Q. D is incorrect because it describes a mathematical impossibility; i.e., the most elastic point is at the y-intercept, where there is perfect elasticity.

3. Suppose that the demand curve for widgets is given by P = 600 - Q and that the supply curve is given by P = 0.5Q, where Q is the quantity of widgets and P is their price. What is the price elasticity of demand at the equilibrium price and quantity?

A. -0.05
B. -0.02
C. -0.20
D. **-0.50**
E. -2.00

> **Note:** $\eta = \frac{dQ}{dP}\frac{P}{Q}$; since $P = 600 - Q, Q = 600 - P$ and $\frac{dQ}{dP} = -1$. Setting demand and supply equal, we obtain $600 - Q = 0.5Q \Rightarrow Q = 400$. Therefore, $P = 600 - Q = \$200$. Thus, $\eta = \frac{dQ}{dP}\frac{P}{Q} = -1(200/400) = -0.5$.

4. A profit-maximizing firm sets its price:

A. to maximize sales
B. where demand is elastic
C. to equate average revenue and average cost
D. at the highest level possible
E. where marginal profit is maximized

> **Note:** Response B is true for *all* firms, irrespective of market structure. The logic behind this is straightforward. In order to maximize profit, firm set *MR* = *MC*. Let's assume that *MC* > 0; in other words, it costs more money to produce one more widget. Then *MR* > 0. Since marginal revenue (*MR*) equals $P(1 + 1/\eta)$, then η <-1; i.e., demand is elastic. A is incorrect because it is only true if *MC* = 0. C is incorrect because it implies that *TR* = *TC*, and we are trying to maximize the difference between *TR* and *TC*. It would be purely coincidental if the D strategy ever worked, and finally, E implies that the firm produces close to 0 widgets.

5. A good whose demand curve shifts to the left as income increases is a(n):
   A. normal good
   B. substitute good
   C. <u>inferior good</u>
   D. inelastic good

> **<u>Note:</u>** A shift to the left in the demand *curve* related to a change in income implies that in the demand *function,* the coefficient associated with income has a negative value. For example, suppose $Q = -700P - 200I$. If income I increases, then demand Q decreases, since $dQ/dI = -200 < 0$. Also, note that the income elasticity of demand is $\eta_I = \frac{dQ}{dI}\frac{I}{Q}$; since the second term is positive, $\eta_I < 0$ if $dQ/dI = < 0$.

6. When average product is at a maximum, marginal product is:
   A. zero
   B. increasing
   C. <u>equal to average product</u>
   D. greater than average product
   E. less than average product

> **<u>Note:</u>** See Figure 4.2 on page 100. The mathematical proof of this is shown in the Quant Option located on p. 101.

7. The law of diminishing marginal returns states that:
   A. the marginal product of labor declines as all inputs are increased
   B. production functions exhibit decreasing returns to scale
   C. the marginal product of labor returns as more capital is used
   D. <u>the marginal product of a factor eventually diminishes as more of the input is used, holding other inputs fixed</u>
   E. the marginal product of a factor always diminishes as more of the input is used, holding other inputs fixed

> **<u>Note:</u>** See definition on p. 101. This is also implied by the math behind calculating the marginal product of an input. For example, suppose $Q = L^{0.5}K^{0.5}$. Then $MP_L = 0.5L^{-0.5}K^{0.5} > 0$ and $\partial MP_L / \partial L = -0.25L^{-1.5}K^{0.5} < 0$. In this case, although the marginal product of labor is positive, it diminishes as L increases, holding the capital input constant. Thus D is the best response in this question!

8. If output is produced according to Q = 3K + 4L, then this production process exhibits:
   A. increasing returns to scale
   B. decreasing returns to scale
   C. first increasing and then decreasing returns to scale
   D. <u>constant returns to scale</u>
   E. first decreasing and then increasing returns to scale

> **<u>Note:</u>** By inspection, doubling inputs doubles output; so this is constant scale returns.

9. Cast-Steel Chairs produces office chairs using steel and labor with $Q = 0.5L^{0.4}S^{0.6}$. If labor costs \$10 per hour and steel costs \$60 per unit, what is the optimal combination of labor and steel if Cast-Steel's budget is \$10,000?

A. S = 75 units, L = 550 hours
B. S = 0 units, L = 1,000 hours
C. S = 25 units, L = 850 hours
D. S = 50 units, L = 700 hours
E. <u>S = 100 units, L = 400 hours</u>

<u>Note:</u> Here, the isocost equation is $M = P_L L + P_S S = 10L + 60S = \$10,000$. According to equation (4.6), the optimal input combination is given by the following equality: $\frac{MP_L}{P_L} = \frac{MP_S}{P_S}$. Since $MP_L = .2L^{-.6}S^{.6}$ and $MP_R = .3L^{.4}S^{-.4}$, $\frac{MP_L}{P_L} = \frac{.2L^{-.6}S^{.6}}{10} = \frac{.3L^{.4}S^{-.4}}{60} = \frac{MP_S}{P_S}$; thus $4S = L$. Substituting $4S = L$ back into the isocost equation, we obtain $10(4S) + 60(S) = 100S = \$10,000 \Rightarrow S = 100$. Thus, $10(L) + 60(100) = \$10,000 \Rightarrow L = 400$.

10. Long-run average cost equals long-run marginal cost whenever:

A. the production function exhibits constant returns to scale

B. fixed costs are zero

C. no factor always has increasing marginal returns

D. the cost of capital is near zero

E. long-run marginal cost is at its minimum

> **Note:** See http://bit.ly/21RweQ, page 7 which establishes the notion that when *LRAC* = *LRMC*, this occurs in a region of the *LRAC* curve where it is flat and exhibits constant returns to scale.

11. If a firm is choosing cost minimizing combinations of inputs, marginal cost can be defined as the price of any:

A. input divided by its average product

B. variable input divided by its average product

C. fixed input divided by its average product

D. variable input divided by its marginal product

E. fixed input divided by its marginal product

> **Note:** On page 135 of the textbook, it is shown that the marginal cost of an input can be determined by dividing the cost per unit of input by the input's marginal product. It follows then that the marginal cost of output at the optimal input combination is given by the price of the variable input (in this case, labor) divided by its marginal product.

12. When average total cost is at its minimum:
   A. average variable cost is declining with increases in output
   B. average variable cost plus average fixed cost is declining with increases in output
   C. average total cost is equal to average variable cost
   D. marginal cost is equal to average variable cost
   E. <u>marginal cost is equal to average total cost</u>

<u>Note:</u> Figure 5.2 on p. 133 shows very clearly that E is the only possible correct response. A is incorrect because when average total cost (ATC) is at its minimum, average variable cost is *increasing* with increases in output. ATC = AVC + average fixed cost (AFC), so B is incorrect because this implies that ATC is *not* at its minimum. C is incorrect because ATC is always greater than AVC. AVC is at its minimum when the condition described in D occurs, but at this point, ATC is still declining with increases in output. On page 137 (just prior to the Quant Option box), the authors provide a nice numeric proof that average total cost is at its minimum when marginal cost is equal to average total cost; thus E is correct.

13. The long-run average cost curve slopes upward if there are:
   A. some factors without diminishing marginal returns
   B. economies of scale
   C. <u>diseconomies of scale</u>
   D. no factors without diminishing marginal returns

<u>Note:</u> As I note in http://bit.ly/4cZWDu, if a production function exhibits increasing/constant/decreasing returns to scale, then the long-run average cost function exhibits positive scale economies/no scale economies/scale diseconomies.

14. Leisure Enterprise's total cost of producing speedboats is given by $TC = 10Q^3 - 4Q^2 + 25Q + 500$. Thus, the marginal cost of producing the 25th speedboat is:

A. \$1,700

B. \$6,050

C. <u>\$18,575</u>

D. \$18,775

E. \$19,075

<u>Note:</u> $MC = 30Q^2 - 8Q + 25 = 30(25^2) – 8(25) + 25 = \$18,575$.

15. Down and Out Co. operates an executive placement service for corporate executives displaced by corporate restructuring. Its monthly total cost of cases is given by $TC = 25Q^{0.5} + 2,500$; the average cost at a caseload of 25 attempted placements per month is:

A. \$100

B. <u>\$105</u>

C. \$200

D. \$205

E. \$225

<u>Note:</u> $AC = 25Q^{-0.5} + 2,500Q^{-1} = 25(25^{-0.5}) + 2,500(25^{-1}) = \$105$.

16. Pace's total cost of producing carbon dioxide cartridges is given by $TC = 0.5Q^3 - 24Q^2 + 144Q$. The level of output that minimizes average total cost is:

A. 12 cartridges

B. 10 cartridges

C. 18 cartridges

D. 20 cartridges

E. <u>24 cartridges</u>

> **<u>Note:</u>** $AC = 0.5Q^2 - 24Q + 144$; $dAC/dQ = Q - 24 = 0$; therefore, $Q = 24$.

17. In the model of perfect competition, firms maximize profits by producing where:

A. the difference between marginal revenue and marginal cost is maximized

B. marginal revenue equals price

C. the difference between price and marginal cost is maximized

D. <u>price equals marginal cost</u>

E. the difference between price and marginal revenue is maximized

> **<u>Note:</u>** In the case of a perfectly competitive firm, by definition marginal revenue and price are one and the same; note that $MR = P(1+1/\eta)$ for all firms and $\eta = -\infty$ for a perfectly competitive firm; therefore $MR = P$. However, this does not imply that response B is correct. In fact, $MR = P$ is clearly *not* the profit maximizing condition, since there is no way to determine optimal quantity from this condition. However, $P = MC$ (response D) *is* the answer that we are looking for, since it enables us to determine the optimal level of output. For example, suppose $TC = 2{,}000 + 20Q + 5Q^2$ and $P = \$220$. Then $MC = 20 + 10Q$; setting $MR = P = MC$, we obtain $220 = 20 + 10Q$, which implies that $Q = 20$ is the profit maximizing quantity!

18. If price is above the average variable cost but below the average total cost of a representative firm in a competitive industry:

A. there will be entry to the industry over time

B. <u>there will be exit from the industry over time</u>

C. the firms in the industry are just earning a normal rate of return

D. the industry is in long-run equilibrium

<u>Note:</u> This is implied by Figure 6.5, p. 181 and the discussion related to the figure.

19. If the perfectly competitive market demand for tanning beds shifts from $Q_D =$ 1,230 - 5P to $Q_D =$ 740 - 5P and the market supply is given by $Q_S =$ -100 + 2P, then the change in equilibrium quantity will be:

A. 140 units

B. 280 units

C. -98 units

D. <u>-140 units</u>

E. -150 units

<u>Note:</u> Initially, 1,230 - 5P = -100 + 2P $\Rightarrow$ P = 190 and Q = 280. After the shift, 740 - 5P = -100 + 2P $\Rightarrow$ P = 120 and Q = 140. Thus the *change* in equilibrium quantity will be -140 units.

20. Suppose all firms in a perfectly competitive industry have long-run total cost given by $TC = 2,000 + 20Q + 5Q^2$. Market demand is given by $Q_D = 10,000 - 40P$. The long-run equilibrium output of each individual firm in this industry will be:

A. 10 units

B. <u>20 units</u>

C. 30 units

D. 35 units

E. 40 units

> **<u>Note:</u>** Under perfect competition, profit-maximizing firms will seek to minimize the long run average cost. Here, $AC = 2,000Q^{-1} + 20 + 5Q$. Therefore, $dAC/dQ = -2,000Q^{-2} + 5 = 0 \Rightarrow Q = 20$.

21. If labor produces output according to $Q = 10L^{0.5}$, labor costs \$10, and output sells for \$120, then the optimal level of L for a perfectly competitive firm is:

A. 18

B. 36

C. <u>3,600</u>

D. 5

E. 80

> **<u>Note:</u>** Conceptually, this problem is very similar to class problem 6.1. As in that problem, we are interested in finding the optimal amount of the variable input (labor), *cet par*. The key to solving this problem is to set the marginal revenue product of labor, $MRP_L = MR(MP_L)$, equal to the marginal expenditure for labor (ME_L). Since $MR = \$120$, $ME_L = \$10$, and $MP_L = 5L^{-.5}$, $MR(MP_L) = \$120(5L^{-.5}) = \$10 = ME_L \Rightarrow \$600L^{-.5} = \$10 \Rightarrow L = 3,600$.

22. At the profit-maximizing level of output for the monopolist:

A. total revenue is equal to total cost
B. total costs are minimized
C. total revenue is maximized
D. <u>marginal revenue is equal to marginal cost</u>
E. average revenue is equal to average cost

> **<u>Note:</u>** *MR* = *MC* is a *necessary condition* for any firm to maximize profit, irrespective of market structure!

23. For the Mickey Mice Company, the price elasticity of demand is -3, average cost is $15, and marginal cost is $30. Mickey's profit-maximizing price is:

A. $10.00
B. $20.00
C. $22.50
D. $30.00
E. <u>$45.00</u>

> **<u>Note:</u>** Since $MR = P(1+1/\eta)$ and profit maximizing firms select quantity *Q* such that *MR* = *MC*, this implies that the profit-maximizing price is $MR = P(1+1/\eta)$ = *MC*; therefore, $P = \frac{MC}{(1+1/\eta)} = 30/(1-1/3)$ = $45.

24. If Harry Doubleday's price elasticity of demand is -2 and its profit-maximizing price is $6, then its:

A. average cost is $3.00
B. average cost is $0.33
C. <u>marginal cost is $3.00</u>
D. marginal cost is $0.33
E. average cost is $5.67

> **<u>Note:</u>** Here, we solve the profit maximizing price equation for *MC*; since $P = \frac{MC}{(1+1/\eta)} \Rightarrow MC = P(1+1/\eta) = 6(1+1/(-1/2)) = \$3.$

25. My Big Banana (MBB) has a monopoly in Middletown on large banana splits. The demand for this delicacy is given by Q = 80 - P. MBB's costs are given by TC = 40 + 2Q + $2Q^2$. Its maximum monopoly profit is:

A. $267

B. <u>$467</u>

C. $627

D. $672

E. $674

> **<u>Note:</u>** $TR = (80-Q)Q$; therefore, $MR = 80 - 2Q$. Furthermore, $MC = 2 + 4Q$. Thus, $MR = MC \Rightarrow 80 - 2Q = 2 + 4Q \Rightarrow Q = 13$. Profit is $\pi = TR - TC = 80(13) - 13^2 - 40 - 2(13) - 2(13^2) = \$467$.

26. If price elasticity of demand is -2, marginal cost is $4, and average cost is $6, a profit-maximizing markup price is:

A. $4

B. $6

C. <u>$8</u>

D. $10

E. $12

> **<u>Note:</u>** $P = \frac{MC}{(1+1/\eta)} = \frac{4}{(1+1/2)} = \$8.$

27. So long as price exceeds average variable cost, in the model of monopolistic competition, a firm maximizes profits by producing where:

A. the difference between marginal revenue and marginal cost is maximized

B. <u>marginal cost equals marginal revenue</u>

C. marginal revenue equals price

D. the difference between price and marginal cost is maximized

E. price equals marginal cost

> **<u>Note:</u>** *MR* = *MC* is a *necessary condition* for any firm to maximize profit, irrespective of market structure. However, if price is less than average variable cost, this means that you are losing money by staying in business, so you would want to exit if this were the case!

28. A market where there are only a few sellers is known as:

A. perfectly competitive

B. monopolistically competitive

C. <u>oligopolistic</u>

D. monopolistic

E. cartelized

> **<u>Note:</u>** See chapter 10 throughout…!

29. Duopolists A and B face the following demand curves: $Q_A = 120\text{-}2P_A\text{+}P_B$ and $Q_B = 120\text{-}2P_B + P_A$. If both firms have zero marginal cost and they form a cartel, what is the profit-maximizing price and quantity for the cartel?

A. P = 30, Q = 180

B. P = 40, Q = 160

C. <u>P = 60, Q = 120</u>

D. P = 80, Q = 80

E. P = 75, Q = 90

<u>Note:</u> Since marginal cost is zero for both firms, this cartel maximizes profit by maximizing total revenue; i.e., each firm selects quantity such that $MR = 0$. Furthermore, there is only one market price P, since these firms are not competing with each other. So $Q_A = 120 - P = Q_B$.

Let's solve for Q_A: $TR_A = PQ_A = (120 - Q_A)Q_A = 120Q_A - Q_A^2$, so that $MR_A = 120 - 2Q_A = 0$; therefore, $Q_A = 60$ and $P = 120 - Q_A = \$60$. By symmetry, $Q_B = 60$. Thus, $Q_A + Q_B = Q = 120$.

30. Two firms (A and B) have marginal costs MC_A and MC_B, marginal revenues MR_A and MR_B, and market marginal revenue MR. If both firms produce as a cartel, they should produce so that:

A. <u>$MC_A = MC_B = MR$</u>
B. $MC_A = MR_A$ and $MC_B = MC_B$
C. $MC_A + MC_B = MR$
D. $MC_A = MC_A = MR_A + MR_B$

<u>Note:</u> See p. 336, where it notes that "If the purpose of the managers is to maximize the profit to the corporate entity, they should allocate sales to cartel members so that the marginal cost of all members is equal (and, in turn, equal to the cartel's marginal revenue)."

31. Oligopoly is the only market structure in which one finds:

A. barriers to entry
B. competing brand names
C. minimum average total cost
D. advertising
E. <u>firm interdependence</u>

<u>Note:</u> See chapter 10 throughout; this firm interdependence property is captured by the duopoly models (Cournot and Stackelberg) we studied, where the rivals play their "best responses" against each other.

32. Along a linear demand curve, total revenue is maximized:

A. where the slope of a line from the origin to the demand curve is equal to the elasticity

B. <u>where the elasticity is -1</u>

C. near the quantity axis intercept

D. near the price axis intercept

E. where the elasticity is 0

> **<u>Note:</u>** See Figure 2.7 on page 46 of the textbook. Also, total revenue is maximized when marginal revenue is 0. Since $MR = P(1+1/\eta)$ this implies that η = -1.

33. Profit-maximizing cartels choose price equal to:

A. marginal cost

B. average total cost of the last unit

C. marginal revenue

D. the monopolistically competitive price

E. <u>the monopoly price</u>

> **<u>Note:</u>** A cartel is a monopoly; the only difference between the two is that a monopoly involves only 1 firm, whereas a cartel involves a number of collusive firms. Therefore, profit-maximizing cartels choose price equal to the monopoly price.

34. (Extra Credit) Refer back to problem #20 in this exam booklet. In the long-run equilibrium, there will be ___ firms in this industry.

A. <u>60</u>
B. 98
C. 106
D. 110
E. 120

<u>Note:</u> Since $Q = 20$, and $P = MC$ in equilibrium, we compute price as $P = MC = 20 + 10Q = \$220$. Therefore, $Q_D = 10{,}000 - 40P = 10{,}000 - 40(220) = 1{,}200$. Since total output is 1,200, there are 1,200/20 = 60 firms.

35. (Extra Credit) If output is produced according to $Q = 4K^{0.5}L^{0.5}$, the price of K is \$3, and the price of L is \$1, then the marginal cost of output at the optimal input combination that costs \$120 in total is:

A. \$0.15
B. \$0.58
C. <u>\$0.87</u>
D. \$1
E. \$3

<u>Note:</u> Here, the isocost equation is $M = P_L L + P_K K = L + 3K = \$120$. According to equation (4.6), the optimal input combination is given by the following equality: $\frac{MP_L}{P_L} = \frac{MP_K}{P_K}$. Thus, $\frac{MP_L}{P_L} = \frac{2K^{.5}L^{-.5}}{1} = \frac{2K^{-.5}L^{.5}}{3} = \frac{MP_K}{P_K}$; therefore, $3K^{.5}L^{-.5} = K^{-.5}L^{.5} \Rightarrow 3K = L$. Substituting $3K$ in place of L in the isocost equation, we obtain $\$120 = 3K + 3K = \$120 \Rightarrow K = 20$; thus, $\$120 = L + 3K \Rightarrow L = 60$. Since marginal cost is calculated by dividing the price of the variable input (in this case, labor) by its marginal product, this means that the <u>marginal</u> cost of output at the optimal input combination that costs \$120 in total is $\frac{P_L}{MP_L} = \frac{\sqrt{60}}{2\sqrt{20}} = 0.87$.