Multiple Choice:

1. When the number of firms producing and selling product X increases, the market supply curve shifts
a. shifts to the right.
b. shifts to the left.
c. does not shift because supply is the same as the marginal cost curve.
d. none of the above

2. In order to produce good X efficiently, it is necessary to use a chemical process that was invented by Smith, Inc. Smith, Inc. holds the patent on this process. They can decide whether to sign a licensing agreement to permit a firm that produces good X to use the chemical process. Smith, Inc, is currently the only firm that produces good X. Does this market have free entry?
a. no, because Smith, Inc is a monopolist
b. no, because the technology is not freely available
c. This market could have free entry if Smith, Inc. announced that it would sign a licensing agreement with any firm that applies. If this happened, any firm could use the chemical process if they pay an annual fee to Smith, Inc. of $5million.
d. both b and c

3. In long-run equilibrium with free entry:
a. the equilibrium price must equal the minimum average total cost.
b. profit is equal to zero.
c. each active firm must produce at its efficient scale of production .
d. All of the above

4. If an individual firm supply function is Q = 2+3P, and there are 5 firms, then the market supply function is:
a. Q = 2+3P
b. 5Q = 2+3P
c. Q = 10 + 15P

5. If demand increases, price will typically (assuming that input prices do not change)
a. increase in the short run and then return to the original level.
b. increase in the short run and stabilize at a new higher level.
c. remain the same in the short run, and increase in the long run.

6. Ski resort condo prices can fall below average total cost because:
a. this market does not have free entry.
b. this market does not have free exit.

7. Aggregate surplus is equal to
a. consumer surplus + producer surplus.
b. consumers' total willingness to pay for a good minus the total avoidable cost of producing the good.
c. the net benefit created by the production and consumption of the good.
d. all of the above

8. Schmalensee, et al. estimate that the trading of pollution allowances
a. increased total SO^2 emissions.
b. reduced the cost of cutting SO^2 emissions by at $225-375 $million per year.
c. increased the profits of large polluters at the expense of consumers.
d. none of the above

9. When aggregate surplus is maximized, deadweight loss is
a. equal to sunk costs.
b. zero.
c. the area under the demand curve.
d. none of the above

10. When the former Soviet bloc countries transitioned from communism to capitalism,
a. the collapse of the old system created immediate disruption that reduced initial efficiency.
b. over time the economies moved toward economic efficiency.
c. it became clear that the legal framework is very important (e.g. protection of private property).
d. All of the above

Answers to Multiple Choice Quiz

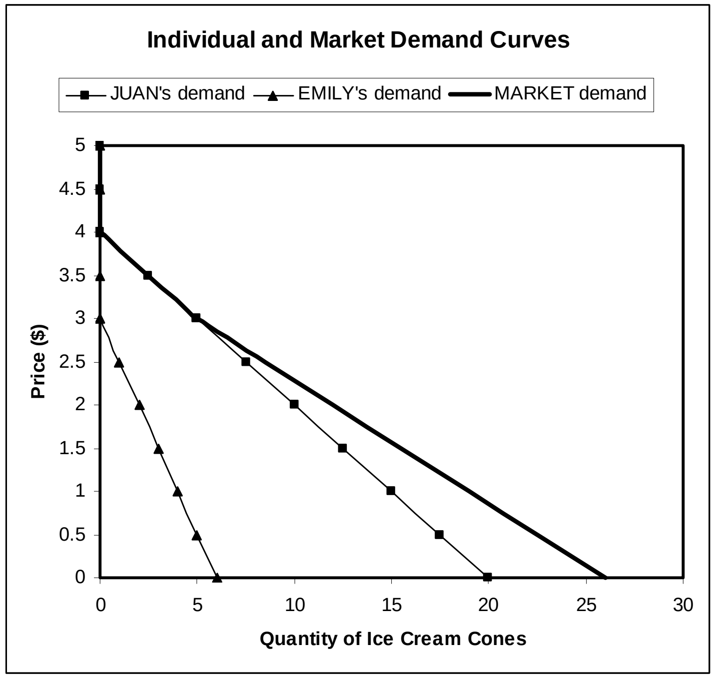
1. a
2. d
3. d
4. c
5. a
6. b
7. d
8. b
9. b
10. d

Answers to In-Text Questions

14.1

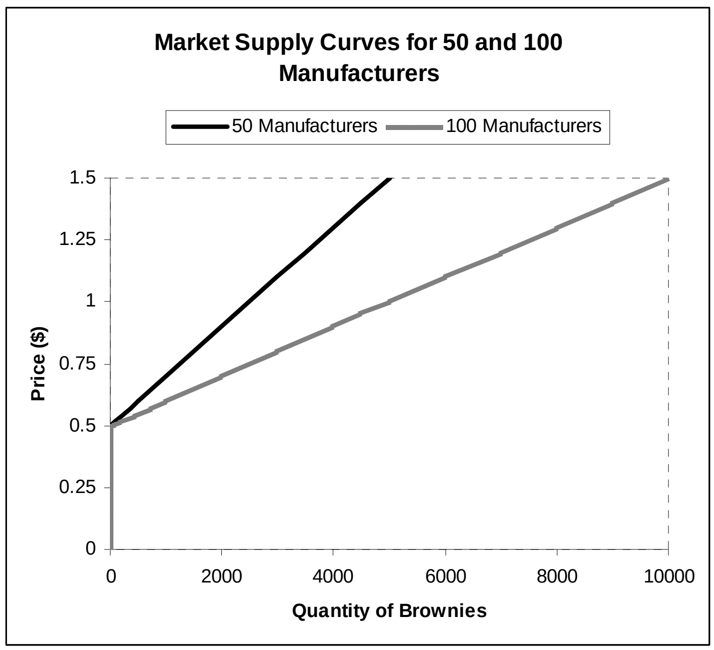
At prices above \$4, no one wants to buy ice cream. At prices below \$4 but above \$3, only Juan wants to buy ice cream. At prices below \$3, both Juan and Emily want to buy ice cream. Therefore,

$$Q^d = \begin{cases} Q^d_{Juan} + Q^d_{Emily} & \text{when } P \leq \$3 \\ Q^d_{Juan} & \text{when } \$3 < P \leq \$4 \\ 0 & \text{when } P > \$4 \end{cases}$$



The sum of Juan's and Emily's demand functions is (20 – 5P) + (6 – 2P) = 26 – 7P. Substituting the demand functions into the expression for Q^d above gives:

$$Q^d = \begin{cases} 26 - 7P & \text{when } P \leq \$3 \\ 20 - 5P & \text{when } \$3 < P \leq \$4 \\ 0 & \text{when } P > \$4 \end{cases}$$



14.2

At prices below \$0.50, no one wants to make and sell brownies, but at prices above \$0.50, all 50 firms want to make and sell brownies. Therefore,

$$Q^s = \begin{cases} 50 \times (100P - 50) = 5{,}000P - 2{,}500 & \text{when } P \geq \$0.50 \\ 0 & \text{when } P < \$0.50 \end{cases}$$

If there are 100 brownie manufacturers, the market supply function would be:

$$Q^s = \begin{cases} 100 \times (100P - 50) = 10{,}000P - 5{,}000 & \text{when } P \geq \$0.50 \\ 0 & \text{when } P < \$0.50 \end{cases}$$

14.3
Since there is free entry into this market, we know that all firms operating in the market will be operating at their efficient scale, which is the quantity that minimizes average cost. The minimum average cost is also where the marginal cost curve crosses the average cost curve, so we can find this efficient scale mathematically by setting *MC* equal to *AC*. First, to find *AC*, we need to sum *VC* and *FC* to get total cost: $Q^2/2 + 50$. Then, *AC* is this total cost divided by Q, or $Q/2 + 50/Q$. Finally, we set $AC = MC$:

$$\frac{Q}{2} + \frac{50}{Q} = Q$$
$$\frac{50}{Q} = \frac{Q}{2}$$
$$Q^2 = 100$$
$$Q = 10$$

Thus, all firms in this market will produce ten pizzas per day. The *AC* (or *MC*) is equal to \$10 at this quantity, so the long-run market supply curve is a horizontal line at the price of \$10. Long-run market supply can be any positive quantity that is a multiple of 10.

14.4
In the long run, because there is free entry, price will equal the minimum of average cost, calculated in In-Text Exercise 14.3 to be \$10. To find out how many pizzas will be bought and sold, we plug this \$10 price into the demand function: $Q^d = 750 - 25P = 750 - 25(10) = 500$. Since we found out in In-Text Problem 14.3 that each firm produces 10 pizzas per day, this means that there are 50 firms, each producing 10 pizzas per day. Market price is \$10 and market quantity is 500 pizzas.

When the demand doubles in the short run, but firms cannot enter the market, the existing firms must produce more to clear the market. First, we need to find the short run supply function for each firm. To do this, we set price equal to marginal cost. This yields $P = Q$, which we can easily solve for Q to show that $Q = P$ (for $P > \$0$). Since there are 50 identical firms in this market, the market supply curve is $Q^s = 50P$ (for $P > \$0$).

The new doubled demand function is 1500 – 50P. To find the new short run market equilibrium, we need to equate supply and demand and solve for the price:

$50P = 1500 - 50P$
$100P = 1500$
$P = \$15$

To find the total number of pizzas produced at this short run equilibrium, we can plug this \$15 price into either the short run market supply or market demand curve to see that short-run equilibrium quantity is 750. Since there are 50 firms in this market, they are each producing 15 pizzas per day. Also, since the new price is higher than the minimum of average cost (\$15 > \$10), these firms are all operating at a profit.

In the long run the price falls back to \$10. Since demand has doubled, the total number of pizzas produced and sold must double as well. Thus, there are now 1,000 pizzas produced by twice as many firms. In the new long run, the price is \$10 per pizza and 100 firms each produce 10 pizzas per day.

14.5
The first step is to set supply and demand equal and to solve for equilibrium price:

$Q^s = Q^d$
$5P - 6 = 15 - 2P$
$7P = 21$
$P = \$3.00$

At a price of \$3, we can see from either supply or demand that quantity will be 9 billion bushels per year. The other two numbers that will be helpful to us are: the highest price at which quantity supplied equals zero and the lowest price at which quantity demanded equals zero. We find these two numbers by plugging in 0 for Q^d and Q^s and solving for the prices that result.

$Q^d = 15 - 2P$	$Q^s = 5P - 6$
$0 = 15 - 2P$	$0 = 5P - 6$
$2P = 15$	$6 = 5P$
$P = \$7.50$	$P = \$1.20$

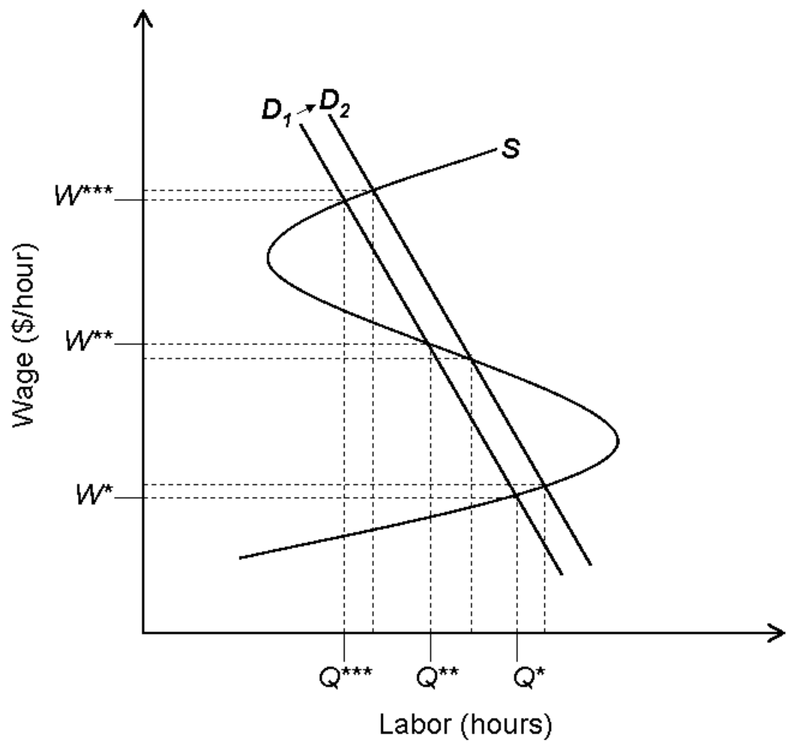
Now we can compute the areas of the triangles.

$CS = ½(Q)(\$7.50 - P)$	$PS = ½(Q)(P - \$1.20)$
$CS = ½(9)(\$7.50 - \$3)$	$PS = ½(9)(\$3.00 - \$1.20)$
$CS = \$20.25$	$PS = \$8.10$

Aggregate surplus is the sum of consumer and producer surplus:

$AS = CS + PS$
$AS = \$20.25 + \$8.10$
$AS = \$28.35$

14.6
When there is a small increase in demand, the effect on equilibrium price and quantity depends on the particular equilibrium being discussed. The two stable equilibria behave as would be expected from an increase in demand: the wage and level of employment both increase. For the unstable equilibrium (W^{**}, Q^{**}), the increase in demand behaves contrary to expectations: the increase in demand leads to lower wages, though it still leads to increased employment. This can be seen in the graph below.



Answers to End-of-Chapter Questions

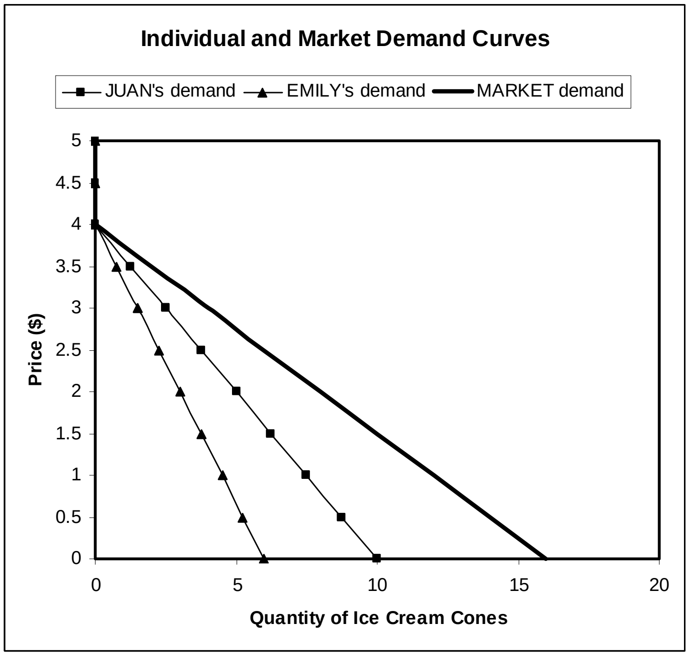
14.1

At prices above $4, no one wants to buy ice cream. At prices below $4, both Juan and Emily want to buy ice cream. Therefore,

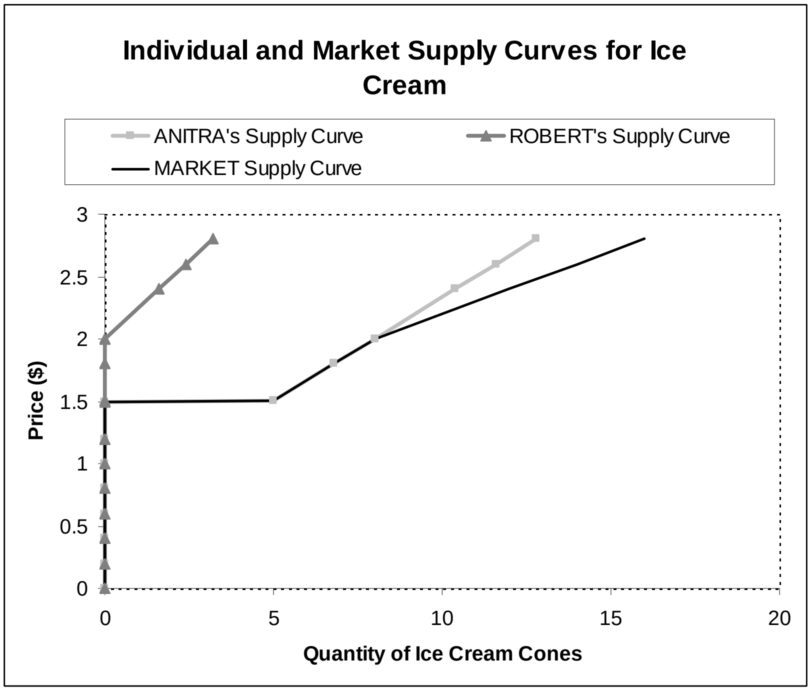
$$Q^d = \begin{Bmatrix} Q^d_{Juan} + Q^d_{Emily} & \text{when } P \leq \$4 \\ 0 & \text{when } P > \$4 \end{Bmatrix}$$

The sum of Juan's and Emily's demand functions is $(10 - 2.5P) + (6 - 1.5P) = 16 - 4P$. Substituting the demand functions into the expression for Q^d above gives:

$$Q^d = \begin{Bmatrix} 16 - 4P & \text{when } P \leq \$4 \\ 0 & \text{when } P > \$4 \end{Bmatrix}$$



14.2



At prices below \$1.50, no one wants to sell ice cream. At prices above \$1.50 but below \$2, only Anitra will sell ice cream. At prices higher than \$2, both Anitra and Robert will sell ice cream. Therefore,

$$Q^s = \begin{cases} 0 & \text{when } P \le \$1.50 \\ Q^s_{Anitra} & \text{when } \$1.50 < P \le \$2 \\ Q^s_{Anitra} + Q^s_{Robert} & \text{when } P > \$2 \end{cases}$$

The sum of Anitra's and Robert's supply functions is (6*P* – 4) + (4*P* – 8) = 10*P* – 12. Substituting the supply functions into the expression for Q^s above gives:

$$Q^s = \begin{cases} 0 & \text{when } P \le \$1.50 \\ 6P - 4 & \text{when } \$1.50 < P \le \$2 \\ 10P - 12 & \text{when } P > \$2 \end{cases}$$

When students draw these supply curves, be sure that they have drawn Anitra's correctly; her supply curve does not touch the Price axis. At a price of \$1.50, she produces 5 units and at prices below that, 0.

14.3
To satisfy the shutdown rule, we need the minimum of *AC*. *AC* is just *C*(*Q*) divided by *Q*, which is 4 + *Q*/40. It is easy to see that the minimum of this function is 4. To satisfy the quantity rule, each firm produces where *P* = *MC*. Substituting in the expression for *MC* given in the problem gives *P* = 4 + (*Q*/20). This gives the supply curve:

$$Q^s = \begin{cases} 20P - 80 & \text{when } P \ge \$4 \\ 0 & \text{when } P < \$4 \end{cases}$$

If there are ten firms in this market, the market supply curve would be:

$$Q^s = \begin{cases} 10 \times (20P - 80) = 200P - 800 & \text{when } P \ge \$4 \\ 10 \times 0 = 0 & \text{when } P < \$4 \end{cases}$$

If there were twenty such firms, the market supply curve would be:

$$Q^s = \begin{cases} 20 \times (20P - 80) = 400P - 1{,}600 & \text{when } P \ge \$4 \\ 20 \times 0 = 0 & \text{when } P < \$4 \end{cases}$$

Under free entry, each firm must produce at the efficient scale.. Therefore, the market supply curve under free entry is just the horizontal line *P* = $4.

14.4

The low-cost bakeries will operate at any price above the price that causes Q^s to be zero, which is a price of $0.50. The high-cost bakeries will likewise produce at any price above the price that causes Q^s to be exactly zero, which is $1.00. Therefore, if the price is $0.75 than only the low cost bakeries will be active. We know that at this price each of the low-cost bakeries will produce 200(0.75) – 100 = 50 bagels. Since there are ten of these bakeries, there will be 500 bagels produced.

If the price rises to $1.25, all of the bakeries will be active, so the market supply will be the sum of all the bagels produced by the low-cost bakeries and the bagels produced by the high-cost bakeries: [200(1.25) – 100]*10 + [200(1.25) – 200]*10 = 1500 + 500 = 2000 bagels.

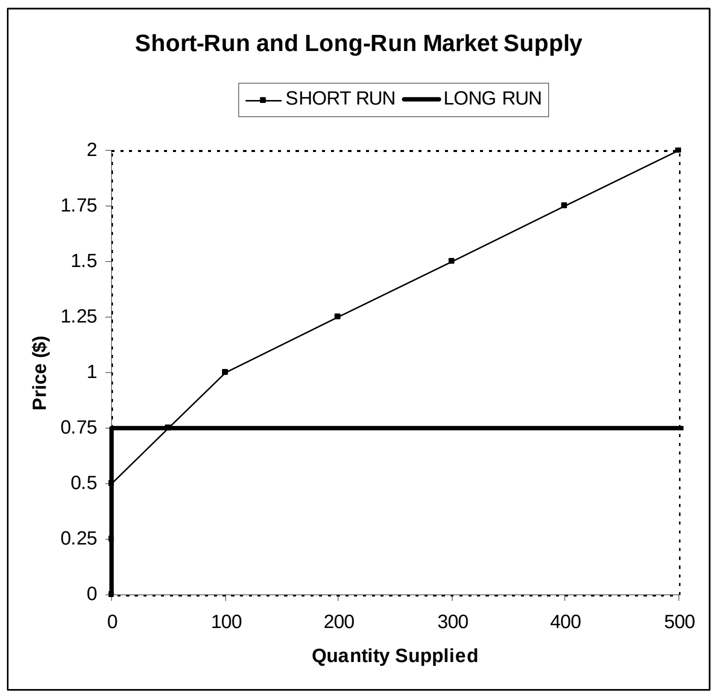
The market supply curve in the short run is:

$$Q^s = \begin{cases} 0 & \text{when } P \le \$0.50 \\ Q^s_{low-cost} \times 10 & \text{when } \$0.50 < P \le \$1 \\ (Q^s_{low-cost} + Q^s_{high-cost}) \times 10 & \text{when } P > \$1 \end{cases}$$

The sum of the low- and high-cost supply curves is (200*P* – 100) + (200*P* – 200) which is 400*P* – 300.

$$Q^s = \begin{cases} 0 & \text{when } P \le \$0.50 \\ (200P - 100) \times 10 & \text{when } \$0.50 < P \le \$1 \\ (400P - 300) \times 10 & \text{when } P > \$1 \end{cases}$$

There is really not enough information to discuss long run supply, unless we assume that the original price of $0.75 was a long-run equilibrium price. If this is the case, than in the long run, we expect the price to return to that price, so the long run market supply curve is a horizontal line at the price *P* = $0.75.



14.5
Long-run market supply curve with free entry is a horizontal line at the minimum of *AC*, which we can find by setting *AC* equal to *MC*. First we need *AC*, which is just $C(Q)$ divided by Q plus the fixed cost divided by Q. $AC = 4 + Q/40 + 10/Q$.

$MC = AC$

$$4+\frac{Q}{20}=4+\frac{Q}{40}+\frac{10}{Q}$$

$$\frac{Q}{40}=\frac{10}{Q}$$

$Q^2 = 400$

$Q = 20$

The minimum of *AC* occurs when $Q = 20$. Plugging this into *AC* (or *MC*) yields a minimum *AC* of $5. So the long-run market supply curve is the horizontal line $P = \$5$.

14.6
From Exercise 14.1, we know that demand is:

$$Q^d = \begin{cases} 16-4P & \text{when } P \le \$4 \\ 0 & \text{when } P > \$4 \end{cases}$$

And from Exercise 14.2, we know that supply is:

$$Q^s = \begin{cases} 0 & \text{when } P \le \$1.50 \\ 6P-4 & \text{when } \$1.50 < P \le \$2 \\ 10P-12 & \text{when } P > \$2 \end{cases}$$

We can set quantity demanded equal to quantity supplied, assuming a price high enough to bring all sellers into the market and low enough to bring all buyers into the market and then adjusting this strategy if the resulting price does not meet that criteria.

$Q^d = Q^s$

$16 - 4P = 10P - 12$

$28 = 14P$

$P = \$2$

This solution works because $2 is low enough to bring buyers into the market and high enough to bring seller into the market. Therefore, we can plug this price of $2 into either supply or demand to get a quantity of $16 - 4(2) = 10(2) - 12 = 8$.

Equilibrium price is $2 and equilibrium quantity is 8 ice cream cones.

14.7
With free entry, the price in the long run is equal to the minimum of *AC*. To find the minimum of *AC*, we set *AC* equal to *MC*. To find *AC*, we divide $C(Q)$ by Q and add it to the fixed cost divided by Q. So $AC = 3 + 0.01Q + 100/Q$.

$MC = AC$

$$3 + 0.02Q = 3 + 0.01Q + \frac{100}{Q}$$

$$0.01Q = \frac{100}{Q}$$

$Q^2 = 10{,}000$
$Q = 100$

The minimum of *AC* occurs at a quantity of 100. We can plug this 100 back into either *AC* or *MC* to find that the minimum of *AC* is $5. So price is $5.

To find out how much is pizza is bought and sold, we put this $5 price into the demand function: $Q^d = 1{,}525 - 5(5) = 1{,}500$. Since each pizza firm is making 100 units, there are 15 firms in the market.

If demand were to increase in the short run, the existing firms would have to produce where price is equal to *MC*:

$P = MC$
$P = 3 + 0.02Q$
$P - 3 = 0.02Q$
$Q^s = 50P - 150$

The individual firms all have short-run supply curves like the one above (for prices higher than the minimum of the average variable cost. The variable part of the cost was $3Q + 0.01Q^2$, so the average variable cost is $3 + 0.01Q$. This is clearly minimized when Q is zero and average variable cost is $3. Therefore, the supply curve above applies only when price is greater than $3.

Since there are 15 such firms, we know the market supply curve in the short run must be:

$$Q^s = \begin{Bmatrix} 15 \times (50P - 150) = 750P - 2{,}250 & \text{when } P \geq \$3 \\ 15 \times 0 = 0 & \text{when } P < \$3 \end{Bmatrix}$$

In the short run, the market will clear, so Q^d must equal Q^s:

$Q^d = Q^s$
$2{,}125 - 5P = 750P - 2{,}250$
$4{,}375 = 755P$
$P = \$5.79$

The demand increase has caused the price to increase to \$5.79, so that the quantity bought and sold is 750(5.79) – 2,250 = 2,125 – 5(5.79) = 2,096. Since there are 15 firms in the market, each must be producing 2,096/15 = 139.733 pizzas per day. Also, notice that this price is above the minimum average variable cost (so the firms do not shut down) and above the minimum average cost (so the firms earn profits).

In the long run, after entry takes place, the price will return to \$5. Therefore, we know the new quantity bought and sold will be equal to quantity demanded evaluated at a price of \$5, which is 2,125 – 5(5) = 2,100. Since each firm produces 100 units at this price, there will be 21 firms—6 more—in the long run.

If instead demand decreased to $Q^d = 925 - 5P$, then the short run the market equilibrium price would equate quantity supplied and quantity demanded:

$Q^d = Q^s$
$925 - 5P = 750P - 2{,}250$
$3{,}175 = 755P$
$P = \$4.21$

The demand decrease has caused the price to decrease to \$4.21, so that the quantity bought and sold is 750(4.21) – 2,250 = 925 – 5(4.21) = 904. Since there are 15 firms in the market, each must be producing 904/15 = 60.266 pizzas per day. Also, notice that this price is above the minimum average variable cost (so the firms do not shut down) but below the minimum average cost (so the firms are incurring losses).

In the long run, after entry takes place, the price will return to \$5. Therefore, we know the new quantity bought and sold will be equal to quantity demanded evaluated at a price of \$5, which is 925 – 5(5) = 900. Since each firm produces 100 units at this price, there will be 9 firms—6 fewer—in the long run.

14.8
The average cost is the sum of fixed and variable costs divided by Q.

$$AC = \frac{FC + VC}{Q}$$
$$AC = \frac{50}{Q} + \frac{Q}{2}$$

In the initial long-run equilibrium we know that $MC = AC$, so we can compute the efficient scale of production for each company:

$$MC = AC$$
$$Q = \frac{50}{Q} + \frac{Q}{2}$$
$$\frac{Q}{2} = \frac{50}{Q}$$
$$Q^2 = 100$$
$$Q = 10$$

We plug this quantity into AC or MC to get the minimum of average cost, which is $10. This is the price in the initial long-run equilibrium, and at the equilibrium price of $10 each company produces 10 pizzas. To figure out the total number of pizzas bought and sold, we use the demand curve: $Q^d = 750 - 25(10) = 500$. Since each firm produces 10 pizzas, there must be 50 firms in this market.

The fixed costs are sunk in the short run, so firms do not consider these costs when making production decisions. This reduction in fixed costs will not affect the firms' marginal costs or average variable costs, so the market equilibrium will not change in the short run in response to this reduction in fixed costs. (The only thing that will change is that firms will be making profit in the short run.)

However, in the long-run, firms will enter the market in response to increased profits opportunity. The *AC* equation would change, because fixed cost has changed, to (18/*Q*) + (*Q*/2). The efficient scale is where *MC* equals *AC*:

$$MC = AC$$
$$Q = \frac{18}{Q} + \frac{Q}{2}$$
$$\frac{Q}{2} = \frac{18}{Q}$$
$$Q^2 = 36$$
$$Q = 6$$

Plugging 6 into *AC* or *MC* reveals that the minimum of *AC* is $6. In the long run, price equals the minimum of average cost, so price in the new long-run equilibrium will be $6. At this price, the new equilibrium quantity is 750 – 25(6) = 600. Since each firm produces 6 pizzas, there will be 100 firms producing 6 pizzas each, and selling them for $6 apiece in the long run.

14.9
From Exercise 14.8, we know that the original long-run equilibrium in this market is one where 50 firms each produce 10 pizzas per day and sell them for $10 each. If *MC* were to rise in the short run, it would become $MC = Q + 6$, and firms choose to produce a quantity where $P = MC$.

$$P = MC$$
$$P = Q + 6$$
$$Q = P - 6$$

This is the short run supply curve for a firm in this market after the increase in marginal cost. It only applies when the shutdown rule is satisfied. In the short run, price must be greater than the minimum of average variable cost. In order for marginal cost to increase by 6, it must be that variable cost has increased by 6*Q*, so variable cost is now $Q^2/2 + 6Q$, and average variable cost is $Q/2 + 6$. The minimum of this function is obviously 6. So the supply curve above applies when price is greater than $6. Since there are 50 identical firms, the short-run market supply curve is:

$$Q^s = \begin{Bmatrix} 50 \times (P - 6) = 50P - 300 & \text{when } P \geq \$6 \\ 50 \times 0 = 0 & \text{when } P < \$6 \end{Bmatrix}$$

Even in the short run, the market must clear, so:

$Q^d = Q^s$
$750 - 25P = 50P - 300$
$1050 = 75P$
$P = \$14$

The price of a pizza is \$14, which is above the \$6 required price for the firm not to shutdown. Whether the firm is earning a profit or not depends on the minimum of the average cost. The new average cost function is $AC = Q/2 + 6 + 50/Q$.

$MC = AC$

$$Q + 6 = \frac{50}{Q} + \frac{Q}{2} + 6$$

$$\frac{Q}{2} = \frac{50}{Q}$$

$Q^2 = 100$
$Q = 10$

The minimum average cost is \$16 (AC or MC evaluated at $Q = 10$), so these firms are losing money in the short-run by selling pizzas for \$14 each.

At a price of \$14, Q^d is $750 - 25(14) = 400$. Since there are 50 firms, each one must be producing 8 pizzas. Therefore, in the short run all 50 firms will produce 8 pizzas each and sell them for \$14 apiece.

Because of these losses, firms will exit in the long run and price will equal the minimum of average cost, \$16. At a price of \$16, Q^d is $750 - 25(16) = 350$. Since each firm produces 10 pizzas, there will be 35 firms left in the new long run.

14.10
In 14.8, firms entered in the long run as usual, so this would not change the result. The 50 firms in the market would earn profits in the short run until the long run, when 50 more firms entered the market and drove the price down.

In 14.9, the 15 firms that leave the market in the long run already have the option of shutting down in the short run. They continue to produce in the short run, even at a loss, because they lose less by producing than they would lose by shutting down. If, however, the statement “active firms could shut down in the short run” is meant to convey that these active firms could recoup their fixed costs in the short run (there are no sunk costs, in other words), then these 15 firms would want to leave immediately in the short run. As they left, price would rise to \$16 and we would end up at the long-run solution sooner.

14.11

To say that an invention increased economies of scale is to say that the invention increased the levels of production over which average cost is falling. If average cost falls for longer as quantity increases, this means that its minimum is reached at a much higher quantity. Since we know that in the long run, price will be equal to the minimum of average cost, this rightward shift of the minimum of average cost means that the efficient scale of the firm has increased, so that all firms produce more in the long run, expanding the size of the typical automobile firm.

14.12

If total cost falls by $1 at every level of output regardless of the level of output, this is basically a $1 reduction in fixed costs. Since fixed costs are not considered in the short run (they do not affect marginal cost), nothing would happen to the equilibrium price or the equilibrium output from the firms in the short run. The only change would be that the currently active firms now enjoy $1 in profit.

In the long run, this profit would inspire outside firms to enter the market. Price would fall to be $1 less than it was previously. There would be more firms, with each firm producing a little less than before, (although total production would be higher) and a lower equilibrium price.

14.13

Bidding with points introduces a market mechanism into the course registration process. Points work as money, and thus pricing is implemented; classes become goods that have prices. The bidding process allows for the most efficient allocation of resources. As does a competitive market, a points system allocates goods to agents who want those goods the most. Courses are "bought" by students who really value them and not by those students who don't. A lottery system might assign classes to students who are not really interested in them.

14.14

If the resale of the tickets in a competitive market was allowed, aggregate surplus would not be higher. As it is now, some concert-goers pay for tickets at the retail price and attend the concert. The concert-goers receive consumer surplus for paying less for the concert than they're willing to; the venue receives producer surplus for being paid more for tickets than the concert costs to put on (actually, producer surplus comes from revenue over variable costs). If the tickets were instead resold in competitive market, nothing would change about producer surplus. Those consumers who purchased the tickets would receive surplus from selling them at a higher price, but this higher price takes away from the surplus of those who actually see the concert.

Likewise, if the venue charged more for the tickets to begin (the competitive equilibrium price, their increased producer surplus would just come at the expense of decreased consumer surplus for the concert-goers.

Because neither of these scenarios would affect concert-goers' willingness-to-pay or the cost structure of putting on the concert (and because the number of concert tickets sold doesn't change), we should expect no change in *aggregate* surplus.

14.15
The first step is to set supply and demand equal and to solve for equilibrium price:

$Q^s = Q^d$
$5P - 6 = 21 - 4P$
$9P = 27$
$P = \$3.00$

At a price of \$3, we can see from either supply or demand that quantity will be 9 billion bushels per year. The other two numbers that will be helpful to us are: the highest price at which quantity supplied equals zero and the lowest price at which quantity demanded equals zero. We find these two numbers by plugging in 0 for Q^d and Q^s and solving for the prices that result.

$Q^d = 21 - 4P$
$0 = 21 - 4P$
$4P = 21$
$P = \$5.25$

$Q^s = 5P - 6$
$0 = 5P - 6$
$6 = 5P$
$P = \$1.20$

Now we can compute the areas of the triangles.

$CS = ½(Q)(\$5.25 - P)$
$CS = ½(9)(\$5.25 - \$3)$
$CS = \$10.125$

$PS = ½(Q)(P - \$1.20)$
$PS = ½(9)(\$3.00 - \$1.20)$
$PS = \$8.10$

Aggregate surplus is the sum of consumer and producer surplus:

$AS = CS + PS$
$AS = \$10.125 + \$8.10$
$AS = \$18.225$