# Chapter 7, Efficiency and Exchange

## Monday, July 12

# QUESTION 1 (equilibrium price)

**MB = 18 – 2Q**

**MC = 6 + Q**

**What is the price in equilibrium?**

**A) 0**
**B) 6**
**C) 12**
**D) 10**
**E) 18**

# answer to question 1

**MB = 18 – 2Q**

**MC = 6 + Q**

**What is the price in equilibrium?**

A) 0
B) 6
C) 12
**D) 10**
E) 18

$$18 - 2Q = 6 + Q$$

$$3Q = 12$$

$$Q = 4$$

$$MB = 18 - 8 = 10$$

$$MC = 6 + 4 = 10$$

# QUESTION 2 (consumer surplus)

**MB = 18 – 2Q**

**If the price is 10, then how much consumer surplus is there?**

**A) 16**
**B) 32**
**C) 24**
**D) 19**
**E) 3**

# answer to question 2

**MB = 18 – 2Q**

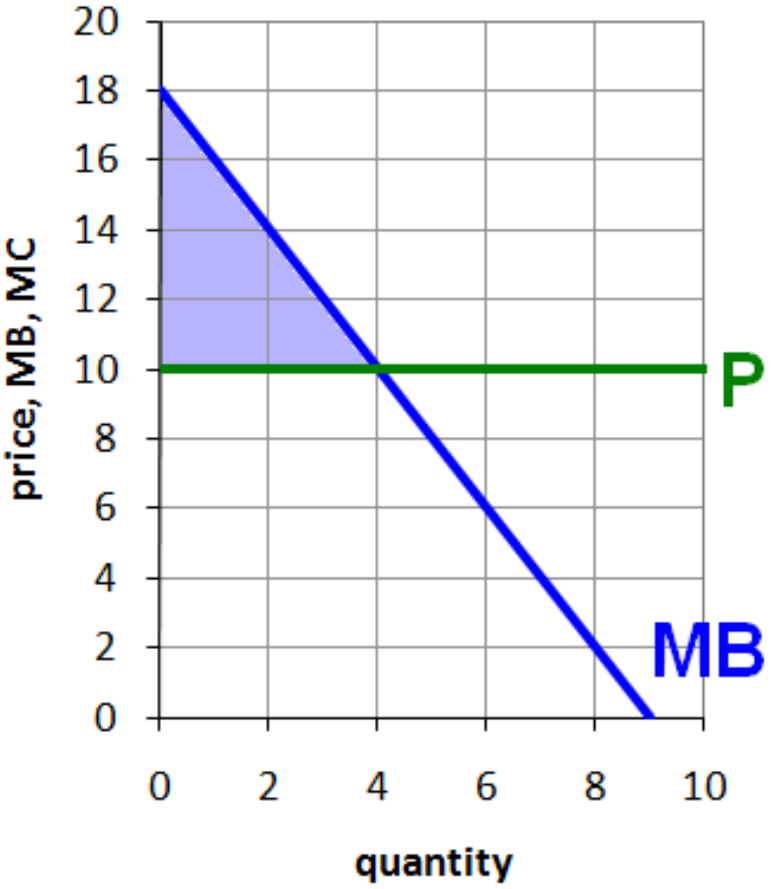
**If the price is 10, then how much consumer surplus is there?**

**A) 16**
**B) 32**
**C) 24**
**D) 19**
**E) 3**

**.5×b×h**

**= .5×4×8**

**= 16**



# FINDING CONSUMER SURPLUS USING TOTAL BENEFIT

$MB = 18 - 2Q$

$TB = 18Q - Q^2$

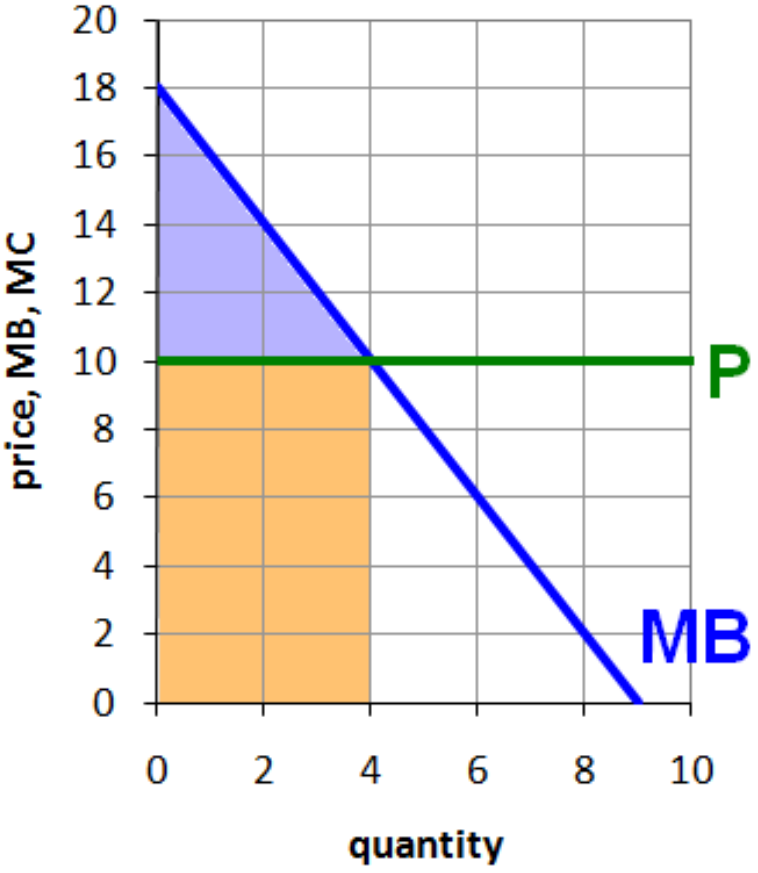
$CS = TB - P \times Q$

**If the price is 10, then how much consumer surplus is there?**

$P = 10, Q = 4$

$TB = 18(4) - (4)^2 = 56$

$CS = TB - P \times Q = 56 - 40 = 16$



# PRODUCER SURPLUS

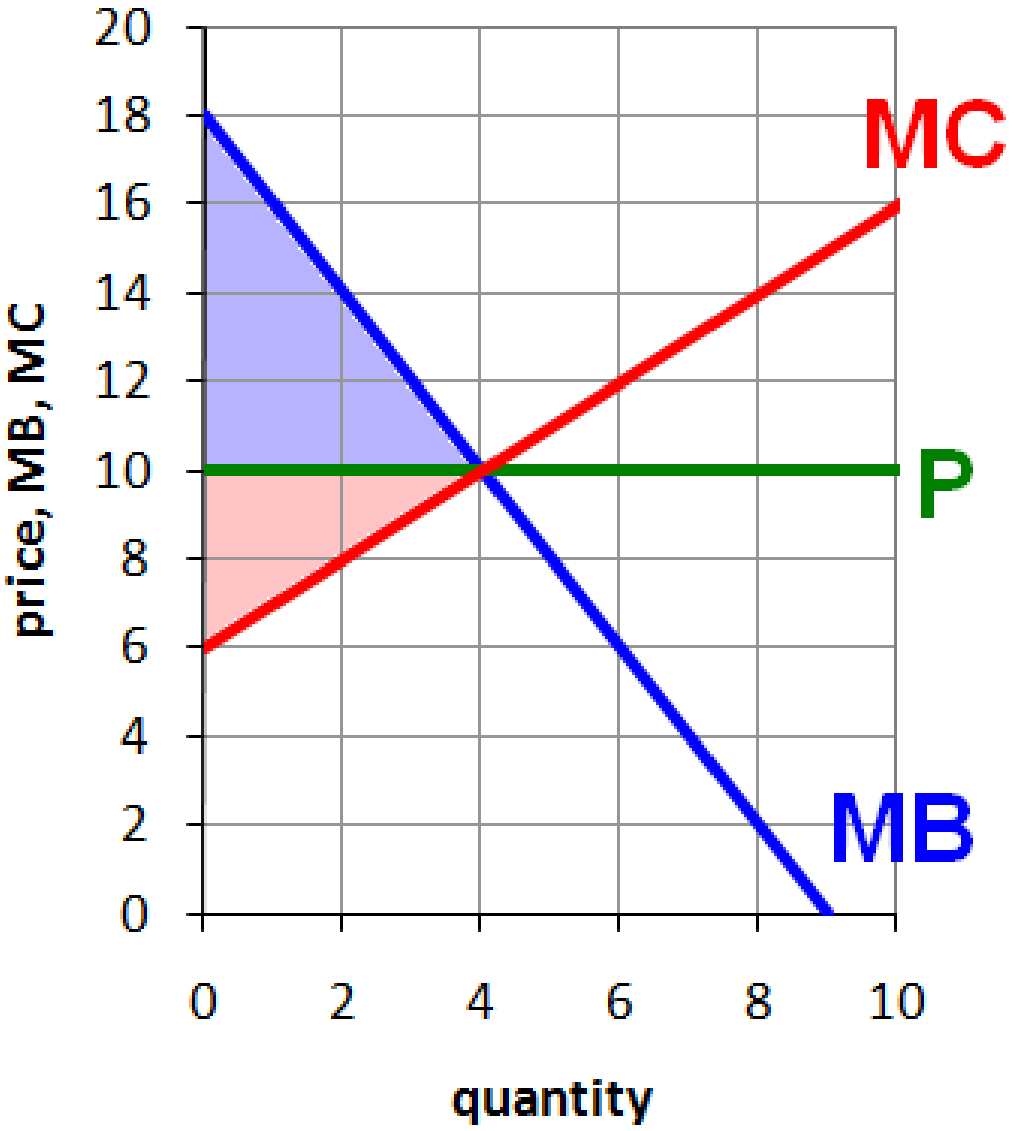
**MB = 18 – 2Q**

**MC = 6 + Q**

**P = 10**

**Q = 4**

**PS = .5×b×h**
**= .5×4×4**
**= 8**



# FINDING PRODUCER SURPLUS USING VARIABLE COST

$MC = 6 + Q$

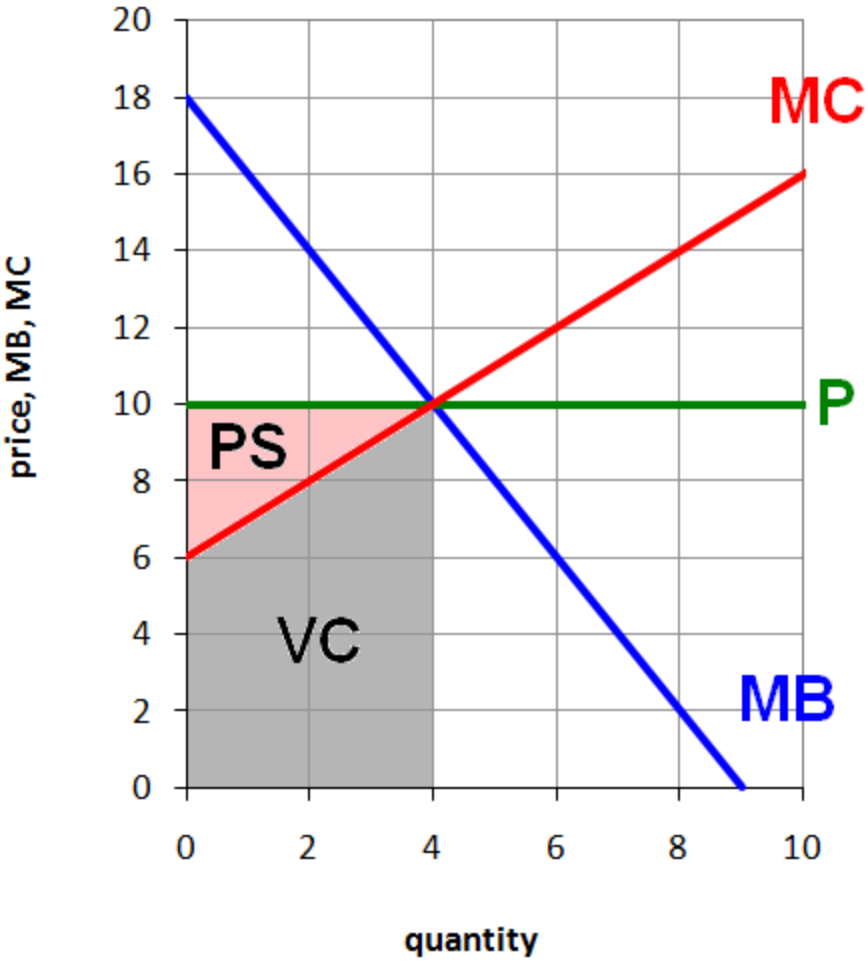
$VC = 6Q + .5Q^2$

$P = 10, Q = 4$

$VC = 6(4) + .5(4)^2$
$= 24 + 8 = 32$

**Producer surplus is revenue minus variable cost**

$PS = P \times Q - VC$
$= 40 - 32 = 8$



# PRODUCER SURPLUS AND PROFIT

**Producer surplus is revenue minus variable cost**

$$PS = P \times Q - VC$$

**Total cost is variable cost plus fixed cost**

$$TC = VC + FC \quad \rightarrow \quad VC = TC - FC$$

$$PS = P \times Q - (TC - FC)$$

$$PS = P \times Q - TC + FC$$

**Profit is revenue minus total cost**

$$\Pi = P \times Q - TC$$

**So…** $PS = \Pi + FC$ **or** $\Pi = PS - FC$

**If there is no fixed cost, PS = Π**

# QUESTION 3 (producer surplus)

$MC = 10 + .5Q$

$VC = 10Q + .25Q^2$

**If P = 40, how much is producer surplus?**

A) 900
B) 60
C) 1800
D) 40
E) 600

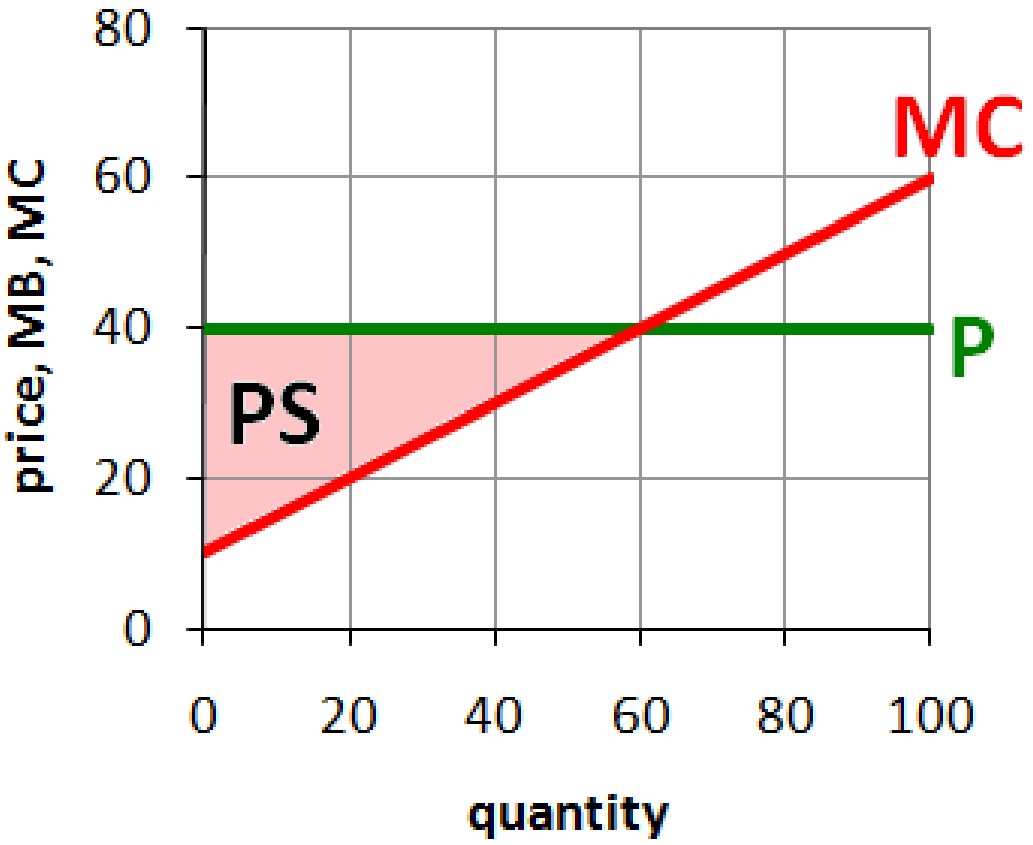
# answer to question 3 (graphical method)

**MC = 10 + .5Q**

**VC = 10Q + .25Q²**

**PS = .5×60×30**

**A) 900**
**B) 60**
**C) 1800**
**D) 40**
**E) 600**



# answer to question 3 (using variable cost)

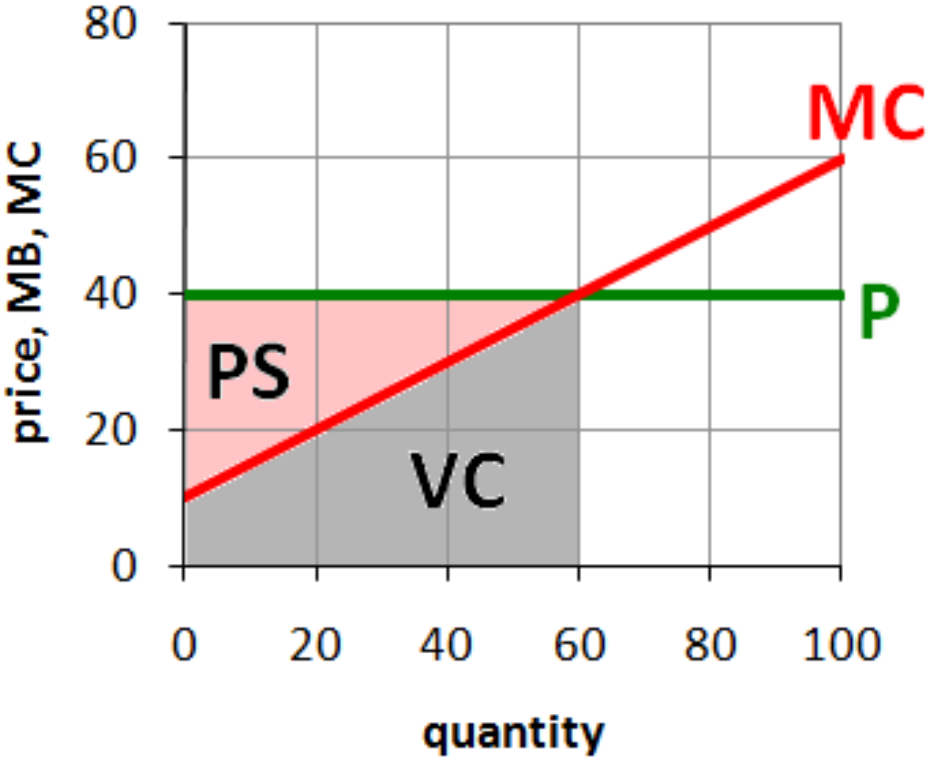
$MC = 10 + .5Q$

$VC = 10Q + .25Q^2$

$PS = P \times Q - VC$

$VC = 10(60) + .25(60)^2$
$= 600 + 900 = 1500$

$PS = 2400 - 1500$
$= 900$



# QUESTION 4 (producer surplus)

$MC = 100 + 2Q$

$VC = 100Q + Q^2$

**If P = 400, how much is producer surplus?**

A) 30000
B) 45000
C) 200
D) 100
E) 22500

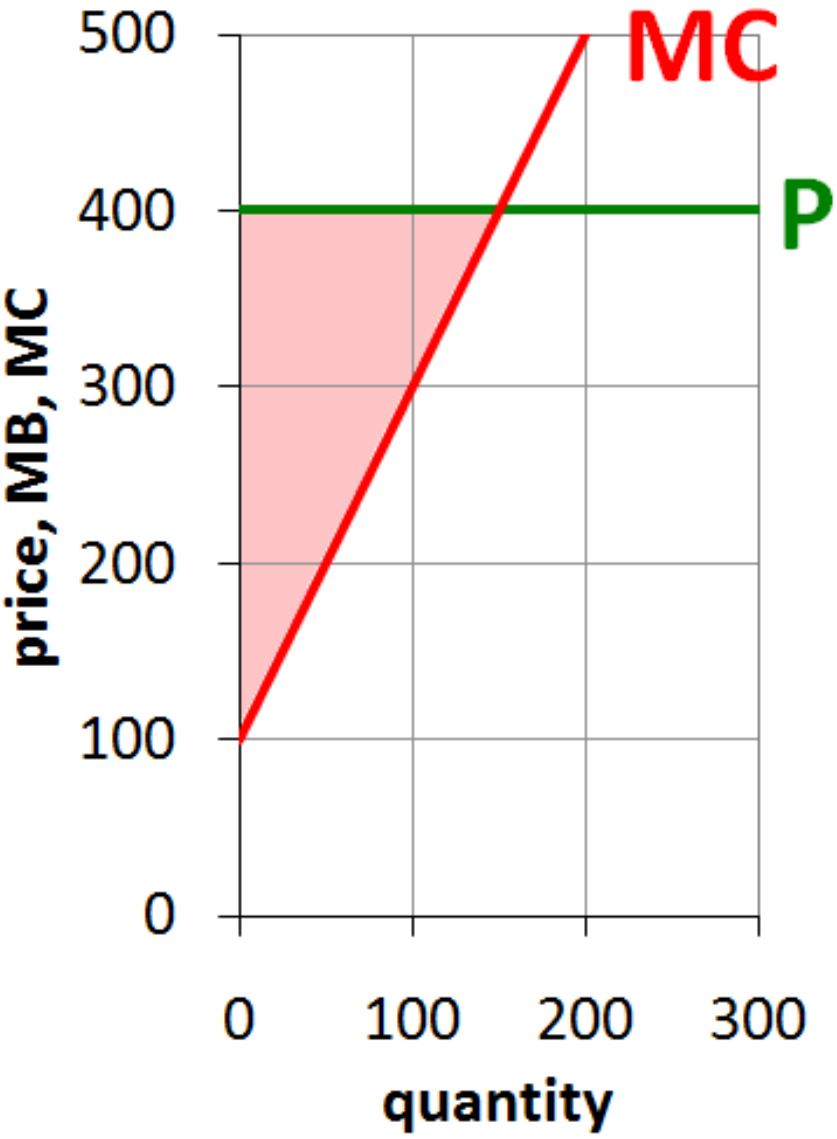
# answer to question 4

**MC = 100 + 2Q**

**VC = 100Q + $Q^2$**

**PS = .5×150×300 = 22500**

**A) 30000**
**B) 45000**
**C) 200**
**D) 100**
**E) 22500**



# TOTAL ECONOMIC SURPLUS

**We'll define total economic surplus (TES), or the total gains from trade, to be the sum of consumer surplus and producer surplus, plus government revenue (if there is any).**

$$TES = CS + PS + G$$

**Note that (when G=0) this is equivalent to the consumers' total benefit, net of the sellers' variable cost**

$$TES = (TB - P \times Q) + (P \times Q - VC)$$

$$TES = TB - VC$$

# TOTAL ECONOMIC SURPLUS

**MB = 18 – 2Q**

**MC = 6 + Q**

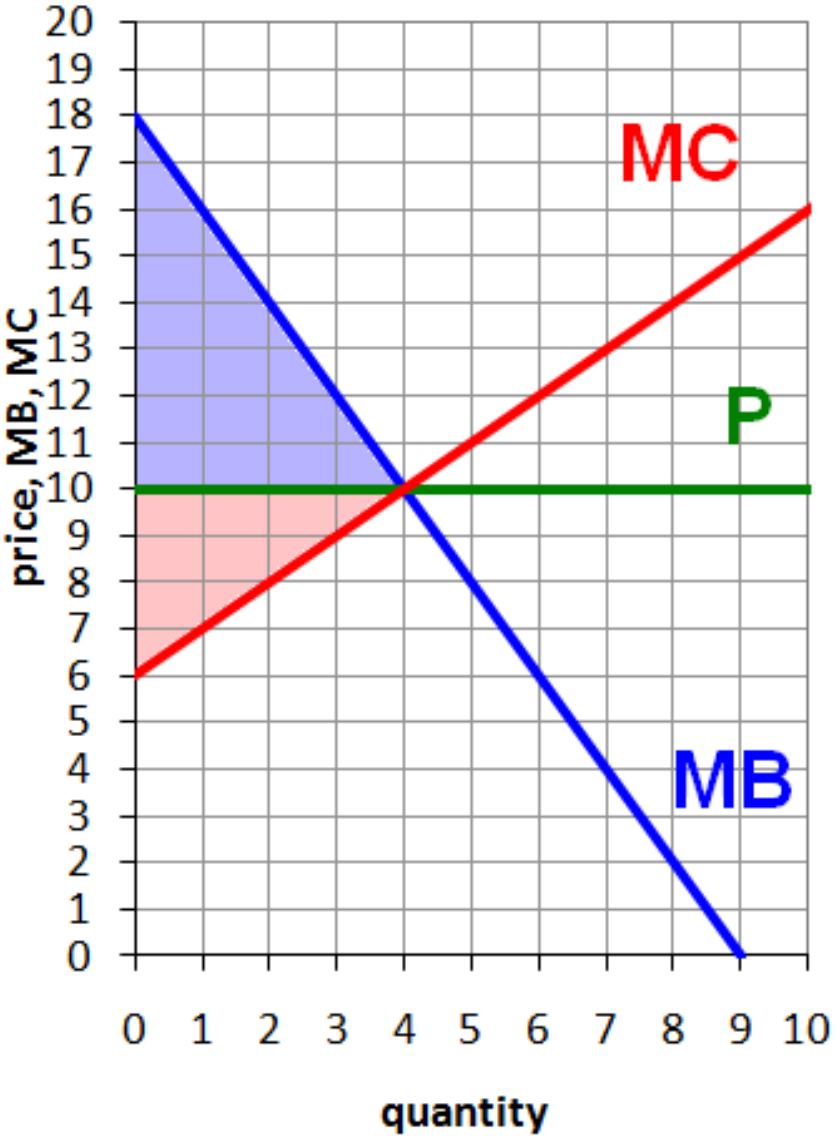
**P = 10**

**Q = 4**

**CS = 16**

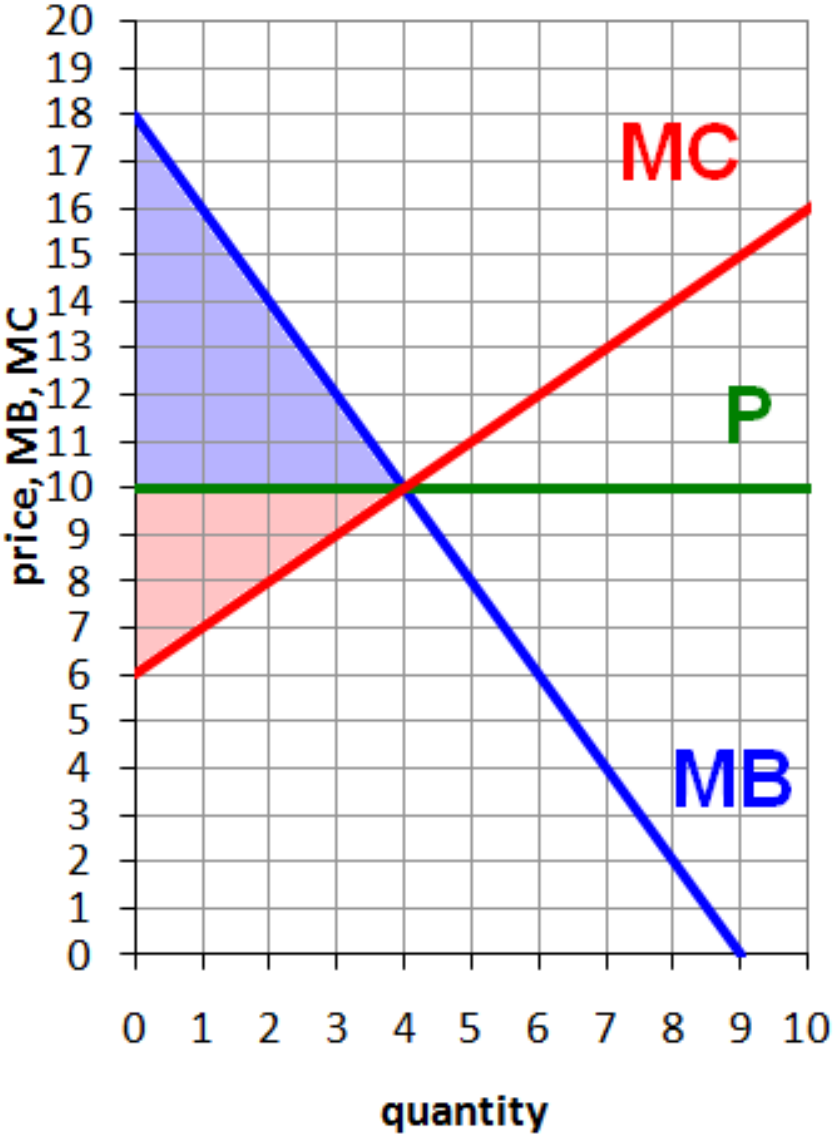
**PS = 8**

**TES = 24**



# TOTAL ECONOMIC SURPLUS AND MARKET EQUILIBRIUM

**Given a perfectly competitive market with no externalities, etc., the market equilibrium price and quantity maximize total economic surplus.**



# TOTAL ECONOMIC SURPLUS AS A FUNCTION OF Q

$MB = 18 - 2Q$

$MC = 6 + Q$

$TB = 18Q - Q^2$

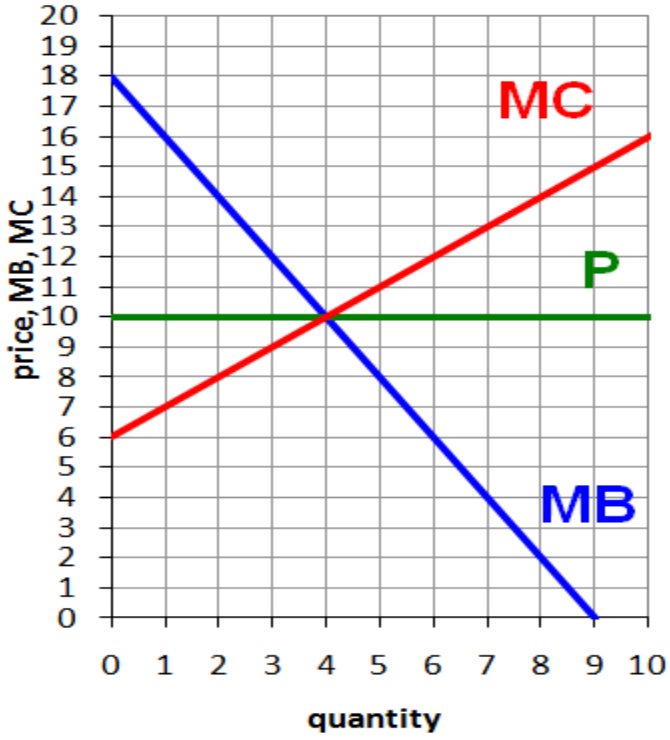
$VC = 6Q + .5Q^2$

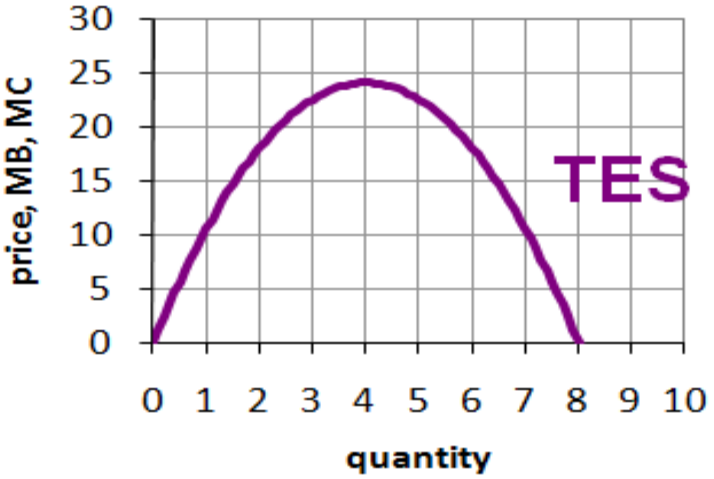
$TES = TB - VC$

$TES = (18Q - Q^2) - (6Q + .5Q^2)$

$TES = 12Q - 1.5Q^2$

**Notice that the TES function peaks at Q = 4**



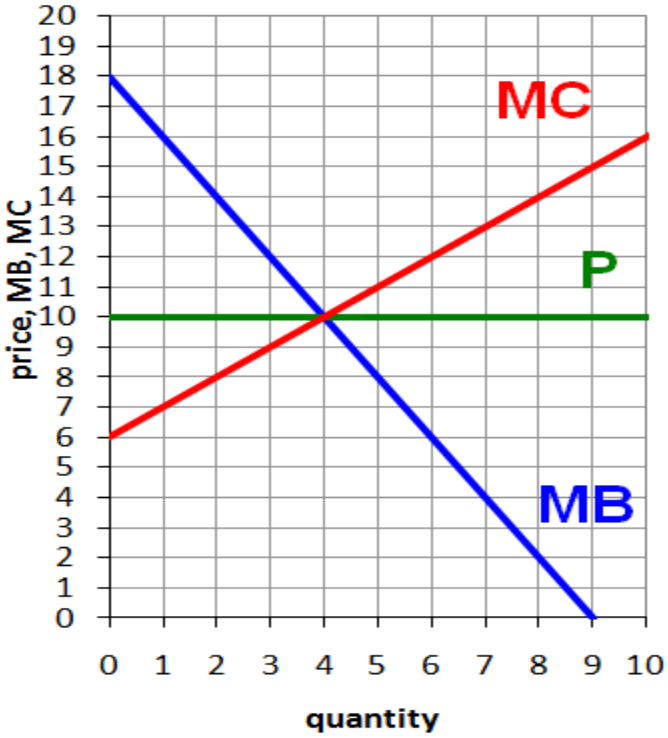



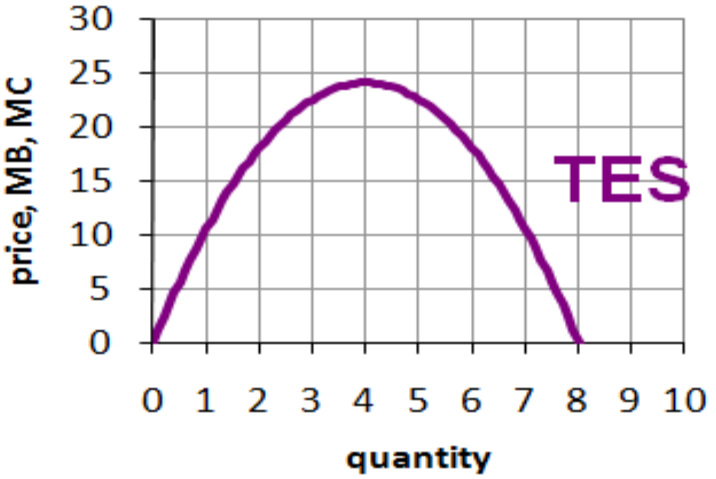
# EQUILIBRIUM Q AND OPTIMAL Q: INTUITION

**As long as marginal benefit is greater than marginal cost, then producing an extra unit will do more good than harm.**

**When there is such a potential for gains from trade, then buyers and sellers will see it and act on it. ("Scraping cash off the table")**

**These transactions can make everyone better off.**



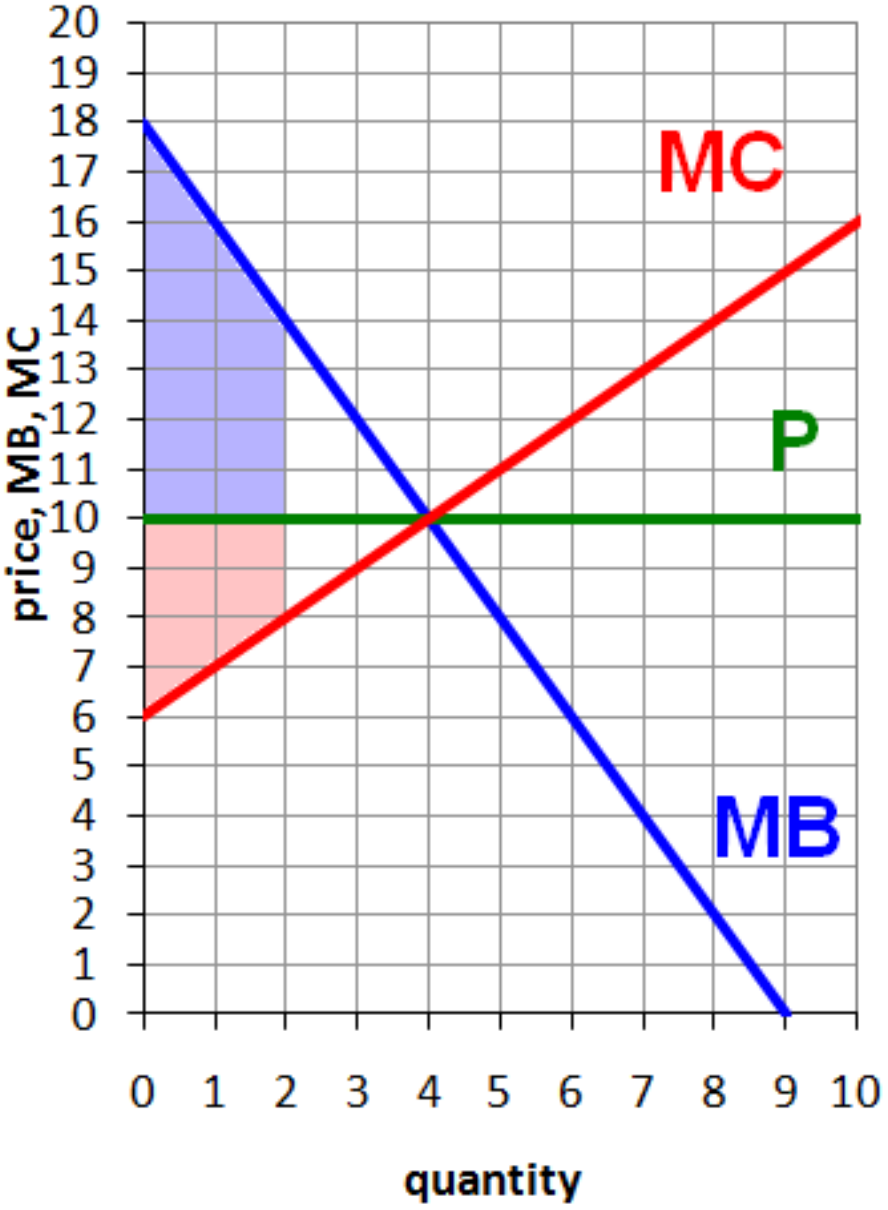



# PARETO IMPROVEMENTS AND PARETO EFFICIENCY

**A Pareto improvement is a change that makes some people better off without making anyone worse off.**

**If we are in a state where no Pareto improvement can be made, then we say that this state is "Pareto efficient".**

**For example, if only two units have been produced, then producing more can make everyone better off. Under these assumptions (competitive markets, no externalities), only the market equilibrium quantity is Pareto optimal.**



# QUESTION 5 (equilibrium price)

$MB = 30 - Q$

$MC = 6 + 2Q$

**What is the equilibrium price?**

A) 6
B) 18
C) 20
D) 22
E) 30

# answer to question 5

**MB = 30 – Q**

**MC = 6 + 2Q**

**What is the equilibrium price?**

A) 6
B) 18
C) 20
**D) 22**
E) 30

$$30 - Q = 6 + 2Q$$

$$3Q = 24$$

$$Q = 8$$

$$MB = 30 - 8 = 22$$

$$MC = 6 + 16 = 22$$

# QUESTION 6 (total economic surplus)

$MB = 30 - Q$ $TB = 30Q - .5Q^2$

$MC = 6 + 2Q$ $VC = 6Q + Q^2$

**What is the total economic surplus (consumer surplus plus producer surplus) at market equilibrium?**

**A) 108**
**B) 30**
**C) 36**
**D) 64**
**E) 96**

# answer to question 6

$MB = 30 - Q$ $TB = 30Q - .5Q^2$

$MC = 6 + 2Q$ $VC = 6Q + Q^2$

**What is the total economic surplus (consumer surplus plus producer surplus) at market equilibrium?**

A) 108
B) 30
C) 36
D) 64
**E) 96**

# answer to question 6, continued

$MB = 30 - Q$

$MC = 6 + 2Q$

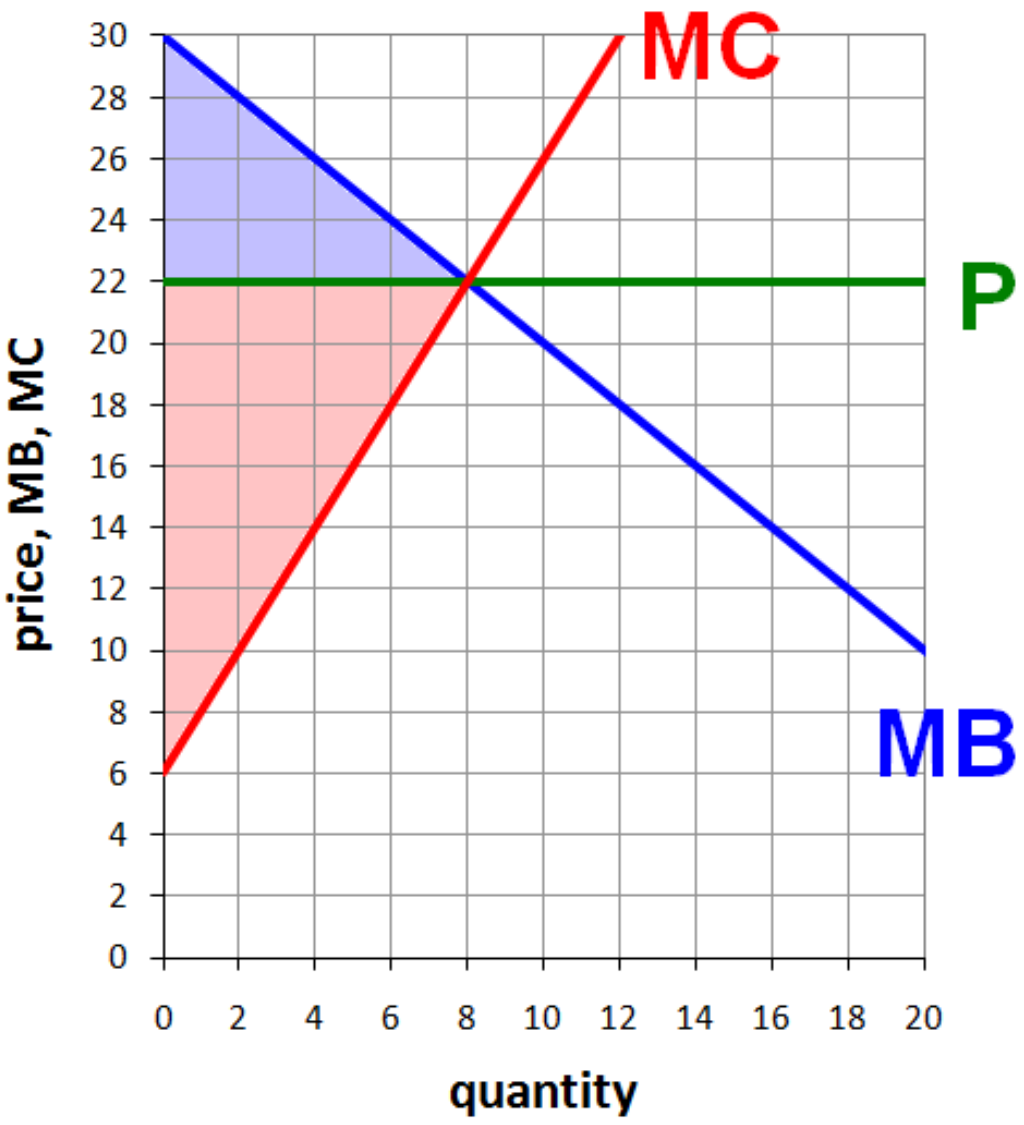
$Q = 8$

$P = 22$

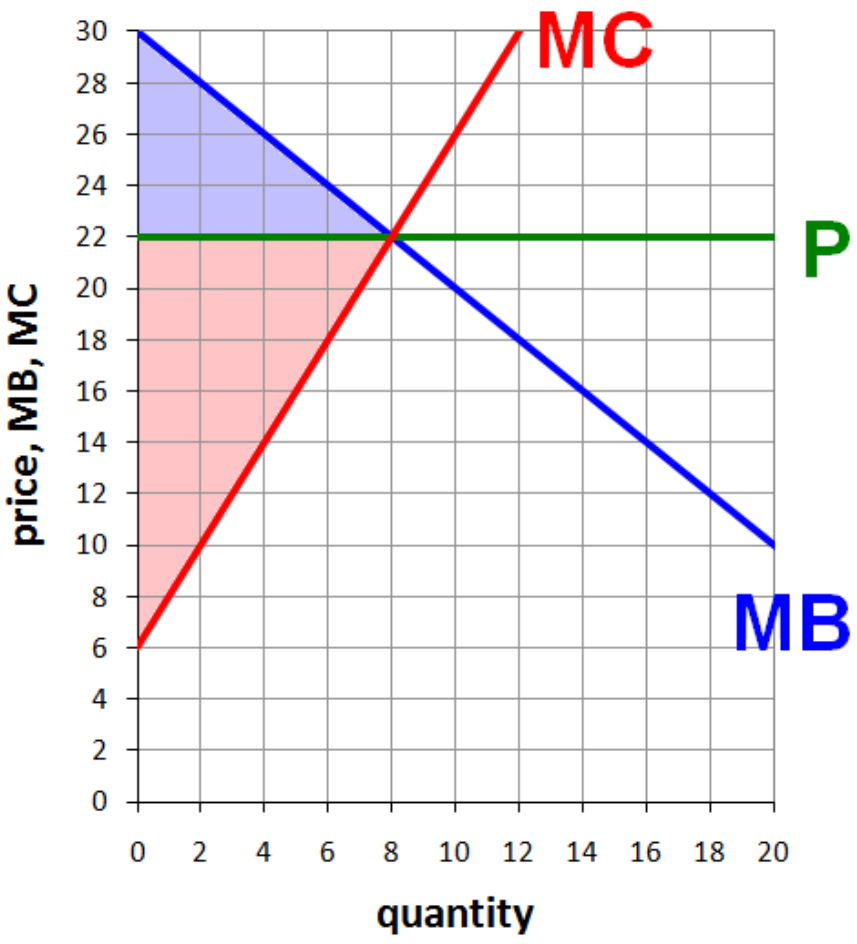
$CS = .5 \times 8 \times 8 = 32$

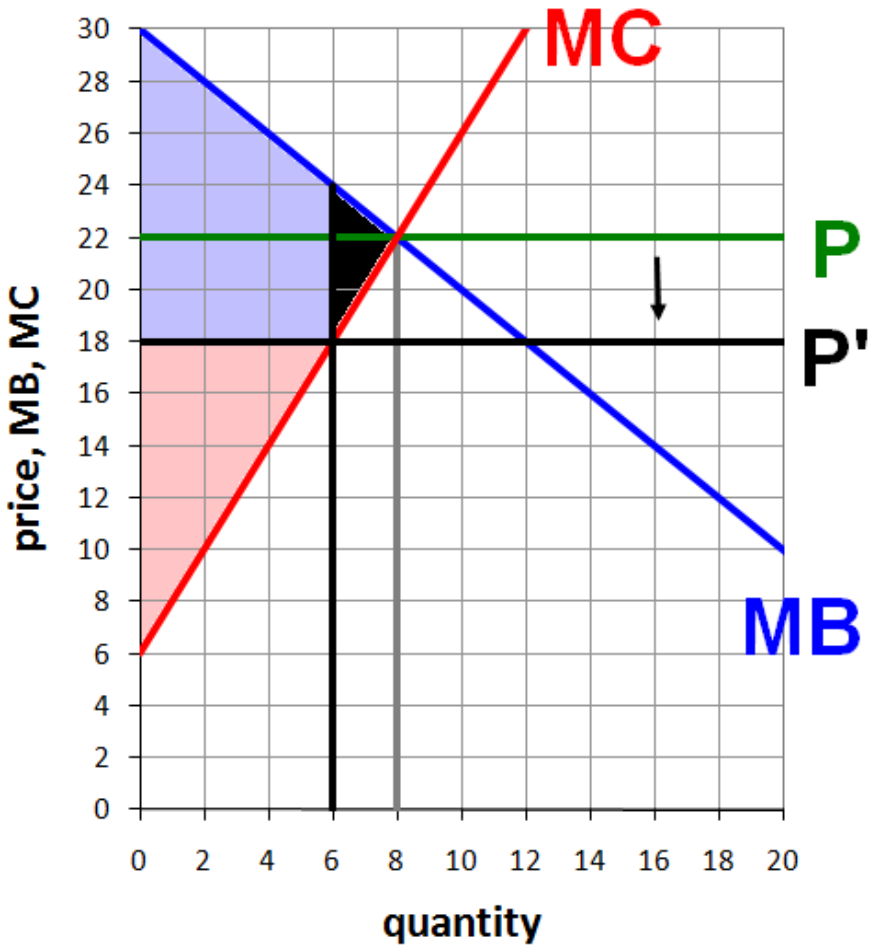
$PS = .5 \times 8 \times 16 = 64$

$TES = 96$



# PRICE CEILING




**What if it is made illegal to charge a price higher than 18? Consumers gain, but producers lose...**

# PRICE CEILING: FINDING CS

$MB = 30 - Q \rightarrow Q_d = 30 - P$

$TB = 30Q - .5Q^2$

$MC = 6 + 2Q \rightarrow Q_s = -3 + .5P$

$VC = 6Q + Q^2$

$P = 18$ (price ceiling)

$Q_d = 12, Q_s = 6 \rightarrow Q = 6$

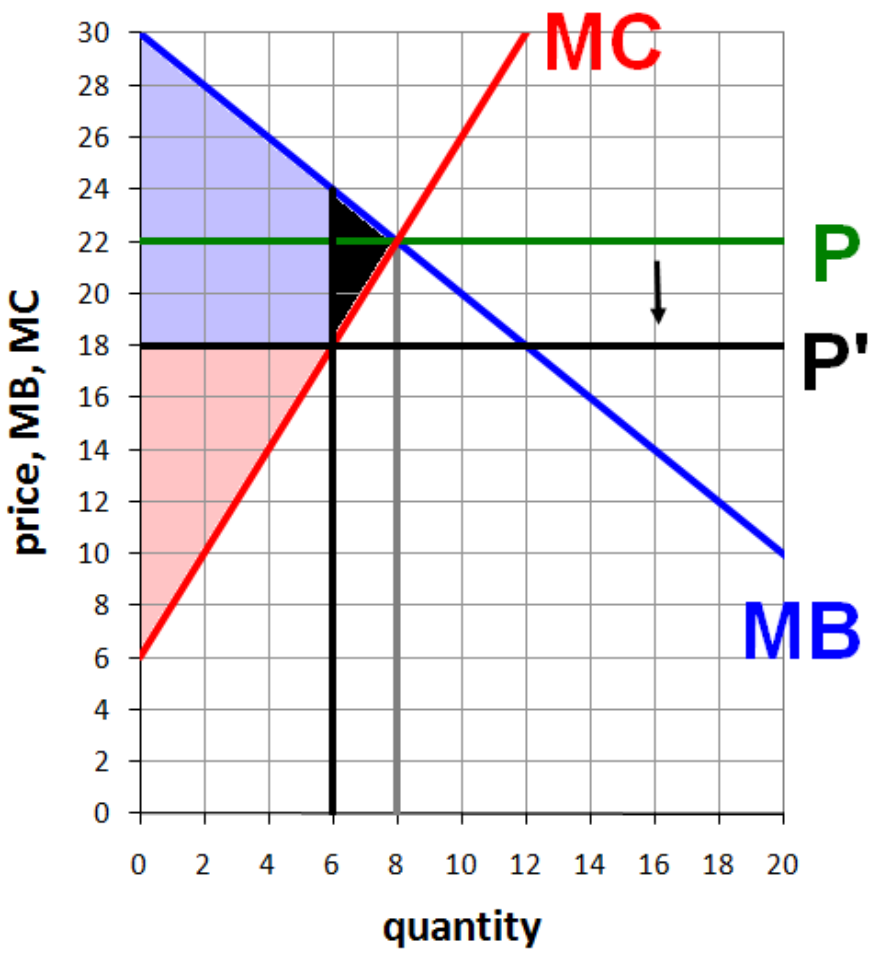
$TB = 30(6) - .5(6)^2 = 162$

$CS = TB - P \times Q$

$= 162 - 18 \times 6$

$= 162 - 108$

$CS = 54$



# PRICE CEILING: FINDING PS

$MB = 30 - Q \rightarrow Q_d = 30 - P$

$TB = 30Q - .5Q^2$

$MC = 6 + 2Q \rightarrow Q_s = -3 + .5P$

$VC = 6Q + Q^2$

$P = 18$ (price ceiling)

$Q_d = 12, Q_s = 6 \rightarrow Q = 6$

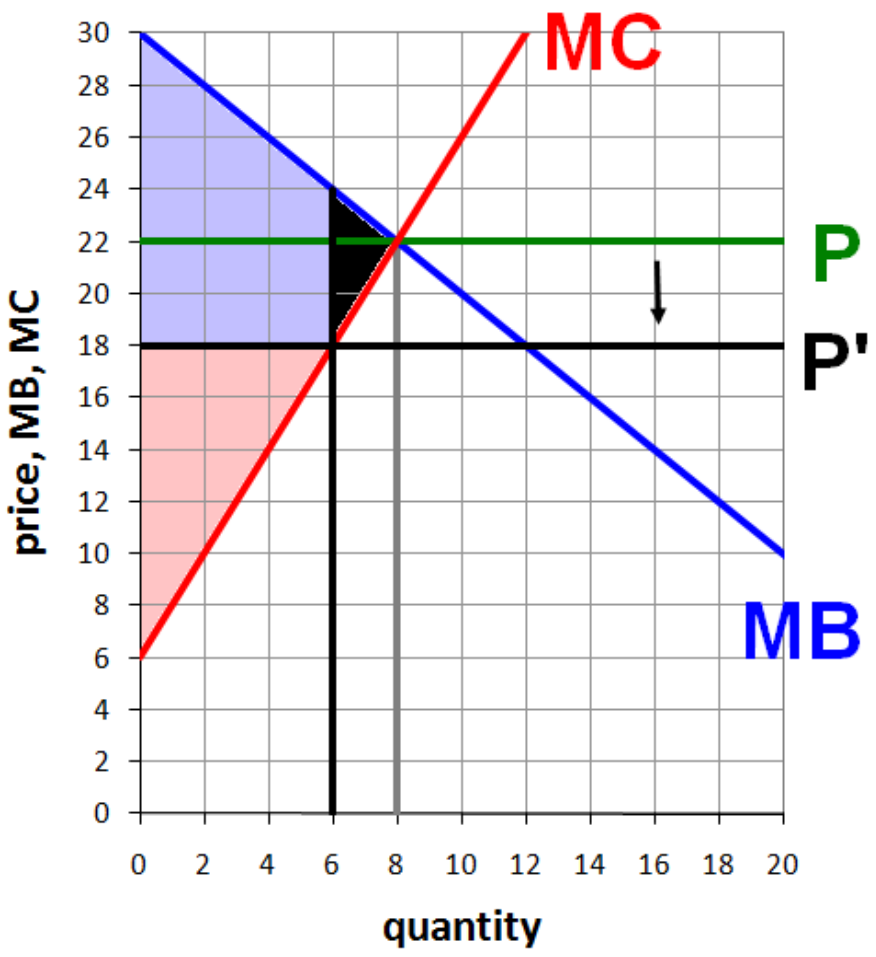
$VC = 6(6) + (6)^2 = 72$

$PS = P \times Q - VC$

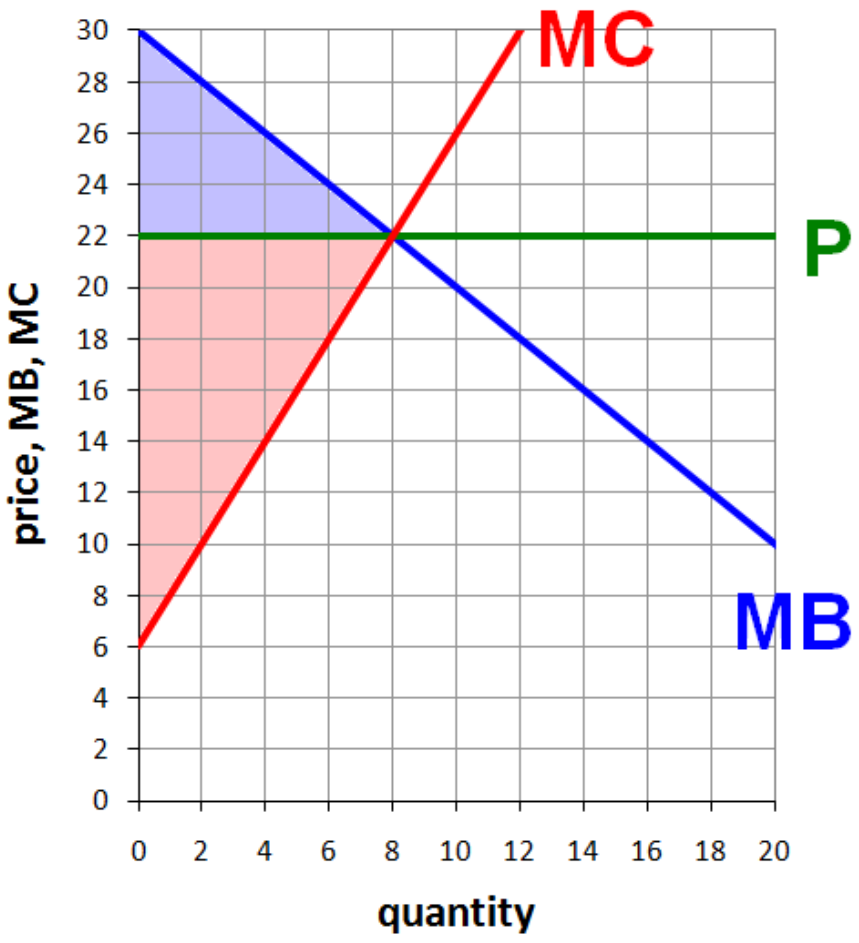
$= 18 \times 6 - 72$

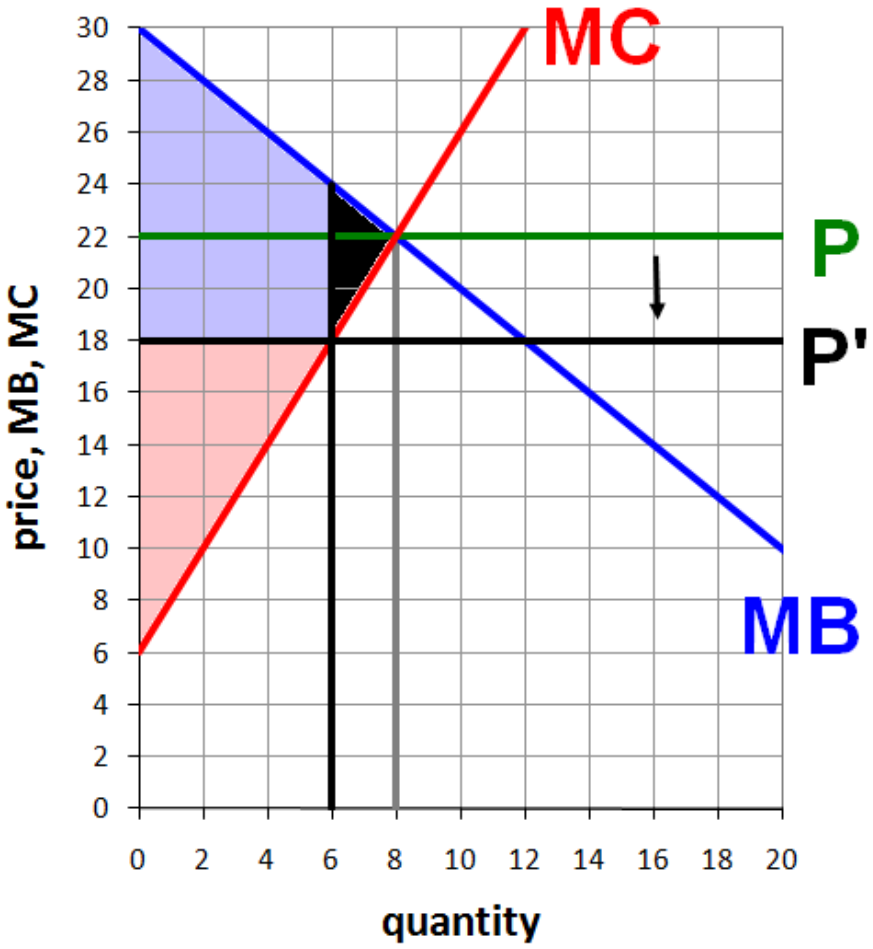
$= 108 - 72$

$PS = 36$



# PRICE CEILING: EFFECT ON TES




**CS = 32, PS = 64**

**TES = 96**

**CS = 54, PS = 36**

**TES = 90**

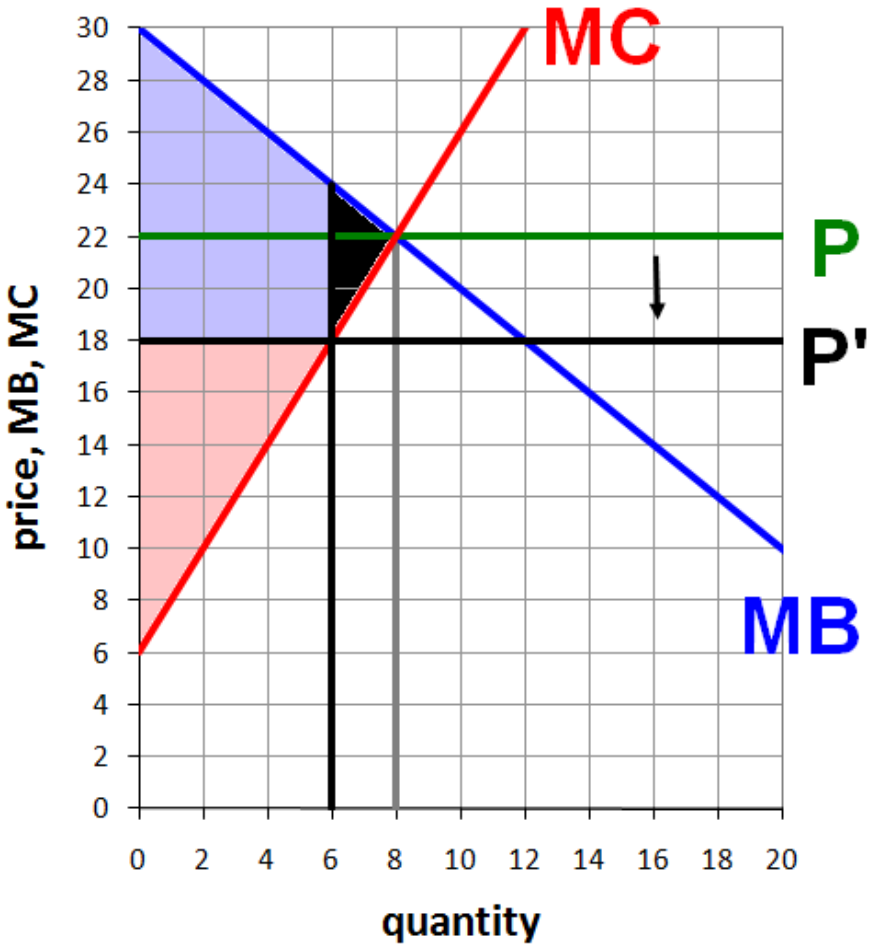
# PRICE CEILING: DEADWEIGHT LOSS

**Without the price ceiling, CS = 32, PS = 64, and TES = 96.**

**With the price ceiling, CS = 54, PS = 36, and TES = 90.**

**Thus, the producers lose more than the consumers gain. This surplus that is lost and not regained by anyone is known as a "deadweight loss".**

**As the name might suggest, deadweight loss is something that we should avoid when possible.**



# PRICE CEILING: CALCULATING DEADWEIGHT LOSS

**Again, find the area of the triangle.**

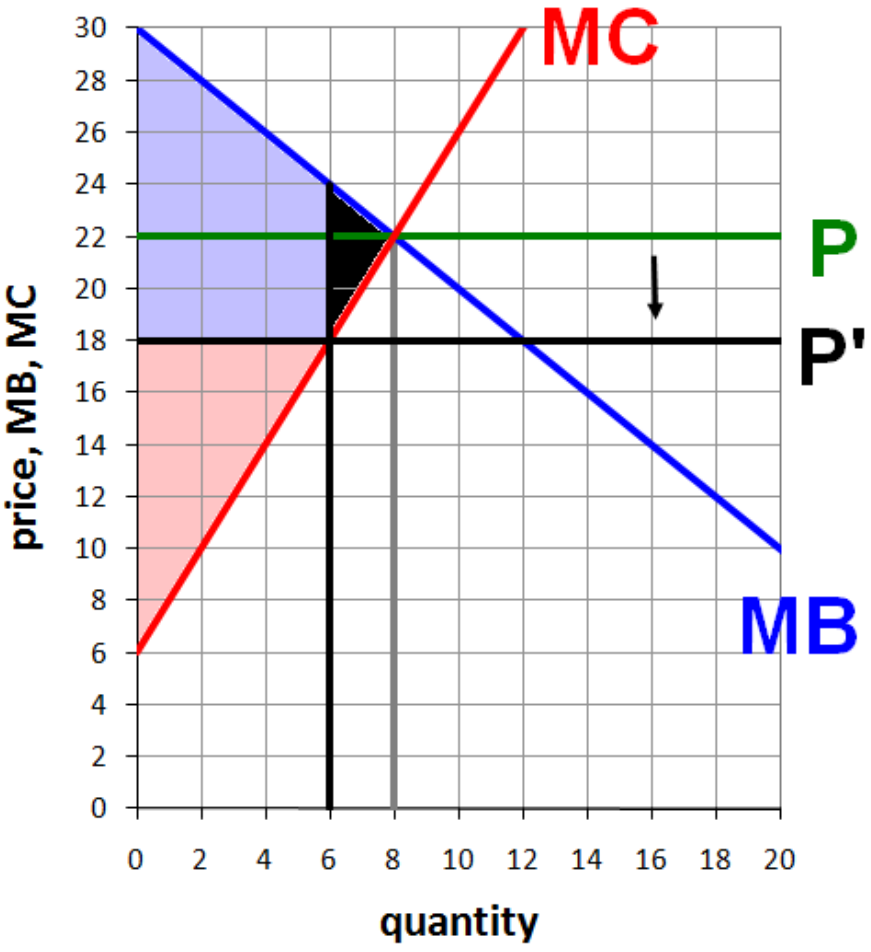
$$DWL = .5 \times 6 \times 2 = 6$$

**(This is the difference between the TES with and without the price ceiling.)**

**Generally, with linear demand and supply curves,**

$$DWL = .5 \times (MB - MC) \times \Delta Q$$

**where MB and MC stand for the marginal benefit and marginal cost at the quantity *with* the price ceiling.**



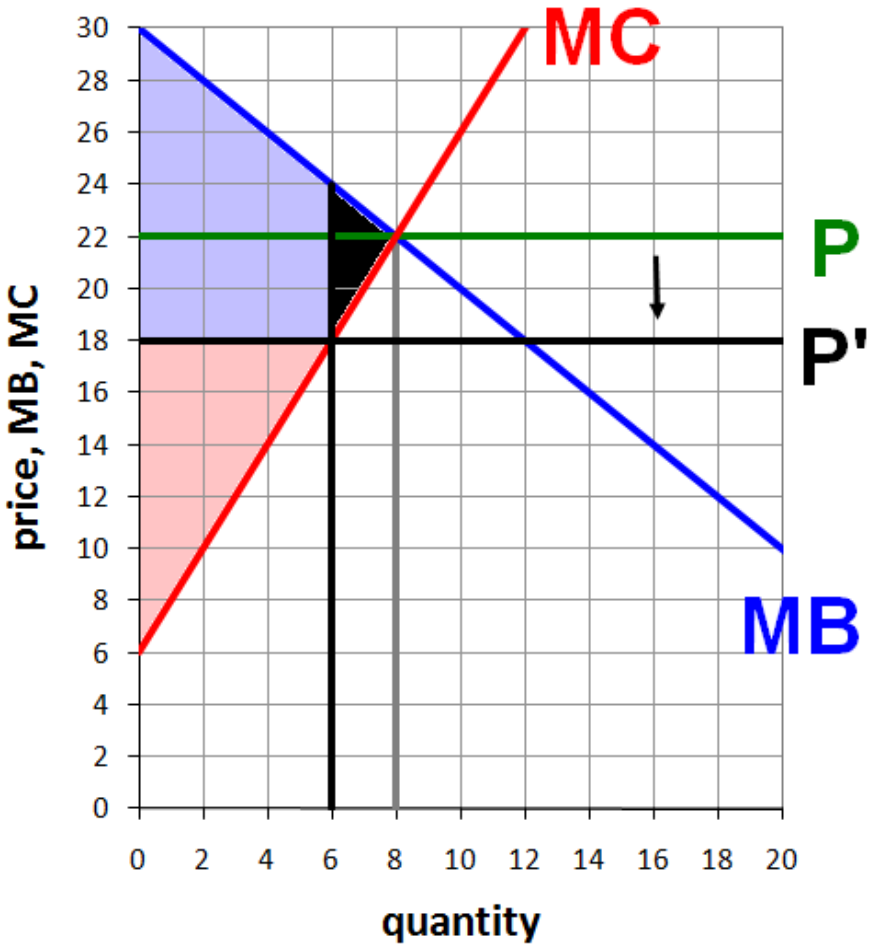
# PRICE CEILING AND PARETO IMPROVEMENT

**Without the price ceiling, CS = 32, PS = 64, and TES = 96.**

**With the price ceiling, CS = 54, PS = 36, and TES = 90.**

**The consumers gain 22 from the price ceiling, but the producers lose 28.**

**If the producers could agree to give the consumers any amount of money between 22 and 28 in exchange for getting rid of the price ceiling, this would be a Pareto improvement.**



# QUESTION 7 (price ceiling and quantity)

**MB = 24 – Q**

**MC = Q**

**What is the quantity produced and consumed when there is a price ceiling of 10?**

**A) 0**
**B) 10**
**C) 12**
**D) 14**
**E) 24**

# answer to question 7

**MB = 24 – Q**

**MC = Q**

**What is the quantity produced and consumed when there is a price ceiling of 10?**

A) 0
**B) 10**
C) 12
D) 14
E) 24

$$MB = 24 - Q \rightarrow Q_d = 24 - P$$

$$\rightarrow Q_d(10) = 14$$

$$MC = Q \rightarrow Qs = P$$

$$\rightarrow Q_s(10) = 10$$

$$Q = 10$$

# QUESTION 8 (price ceiling and deadweight loss)

**MB = 24 – Q**

**MC = Q**

**What is the deadweight loss associated with imposing a price ceiling of 10?**

**A) 4**
**B) 8**
**C) 10**
**D) 12**
**E) 16**

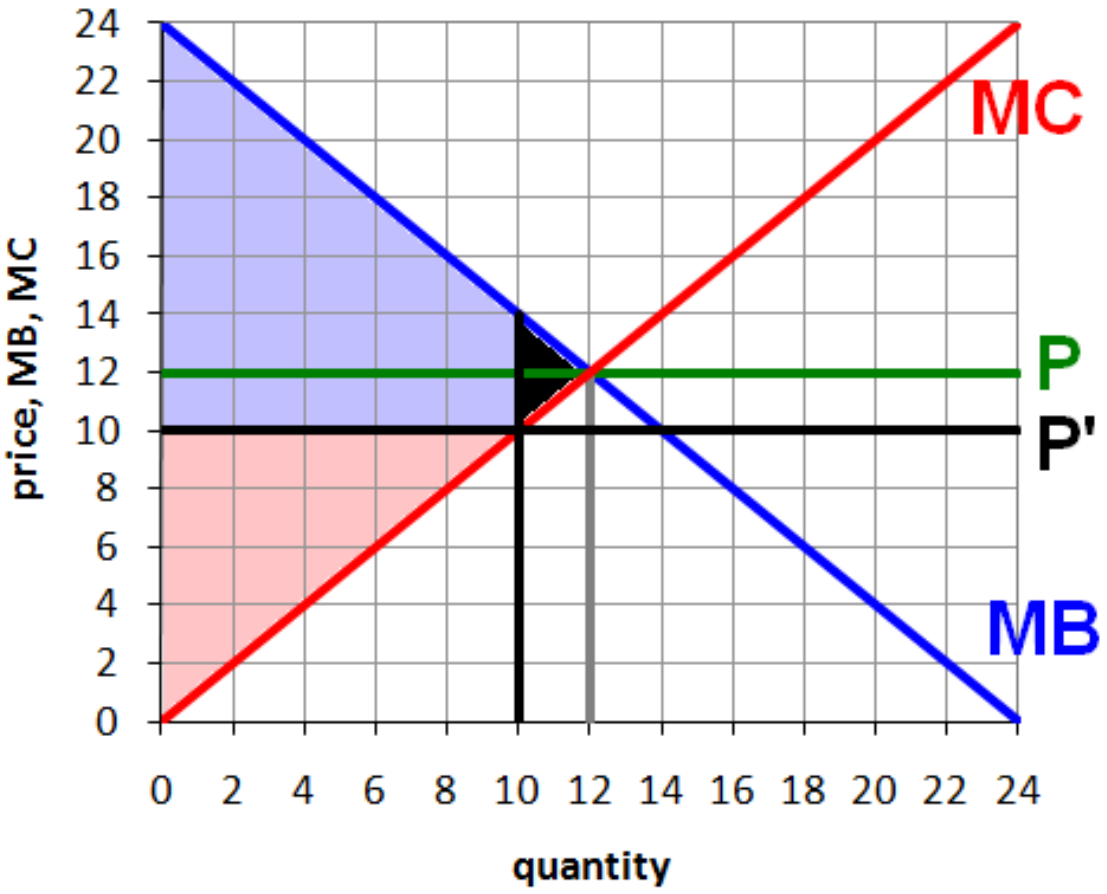
# answer to question 8

**MB = 24 – Q**

**MC = Q**

**DWL = .5(4)(2) = 4**

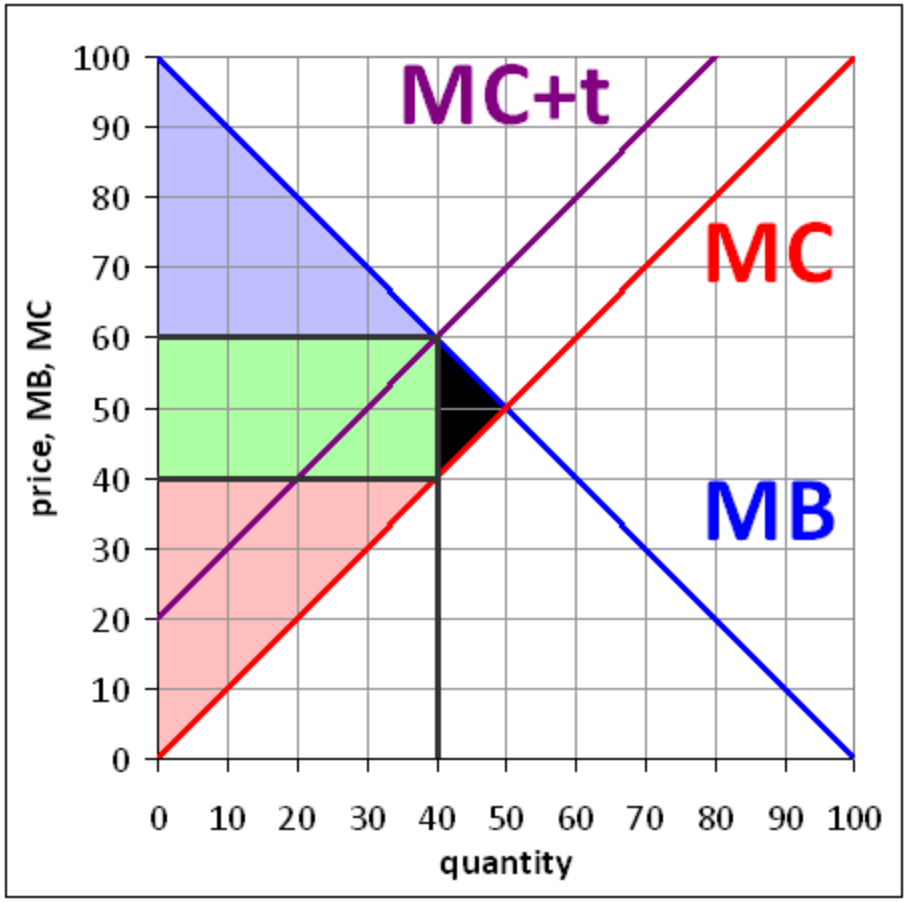
**A) 4**
B) 8
C) 10
D) 12
E) 16



# TAXES ON EFFICIENT MARKETS

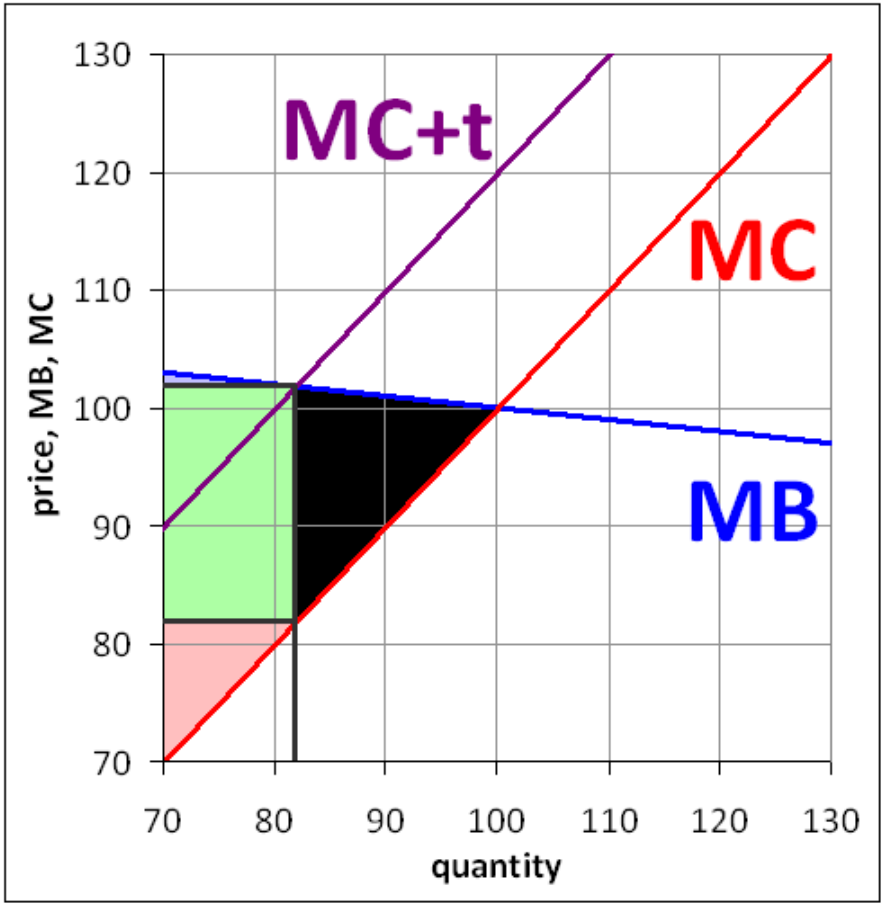
**Suppose that we have an initially efficient market (perfectly competitive, with no externalities), and we apply an excise (per unit) tax.**

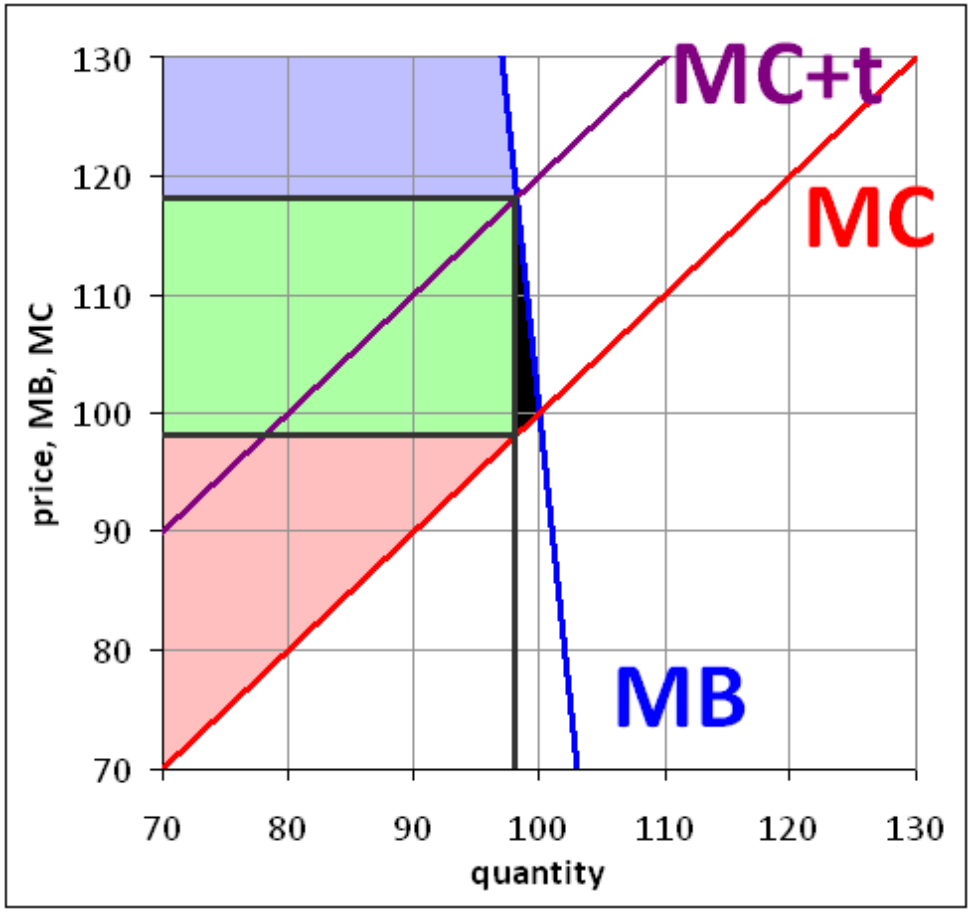
**The blue area shows consumer surplus, the red area shows producer surplus, and the green area shows government revenue, G.**




**If t is the tax per unit, and Q is the quantity of the good sold, then G = tQ.**

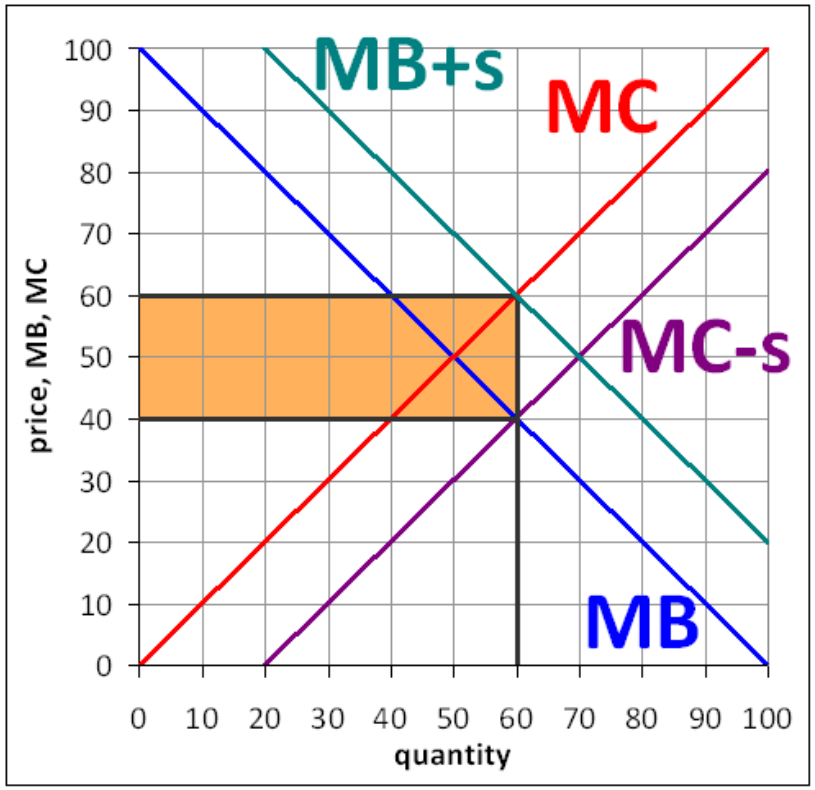
# ELASTICITY AND DEADWEIGHT LOSS

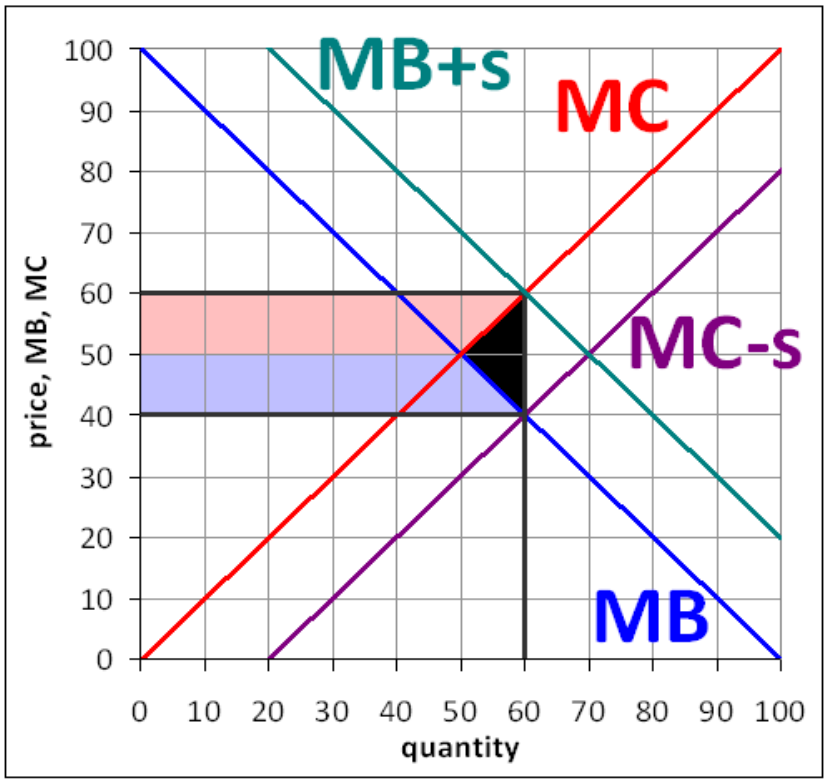



**When either the supply or demand is highly elastic (sensitive to price changes), then the deadweight loss of taxation tends to be higher, as shown on the left above. If either is perfectly inelastic, then taxation has no deadweight loss.**

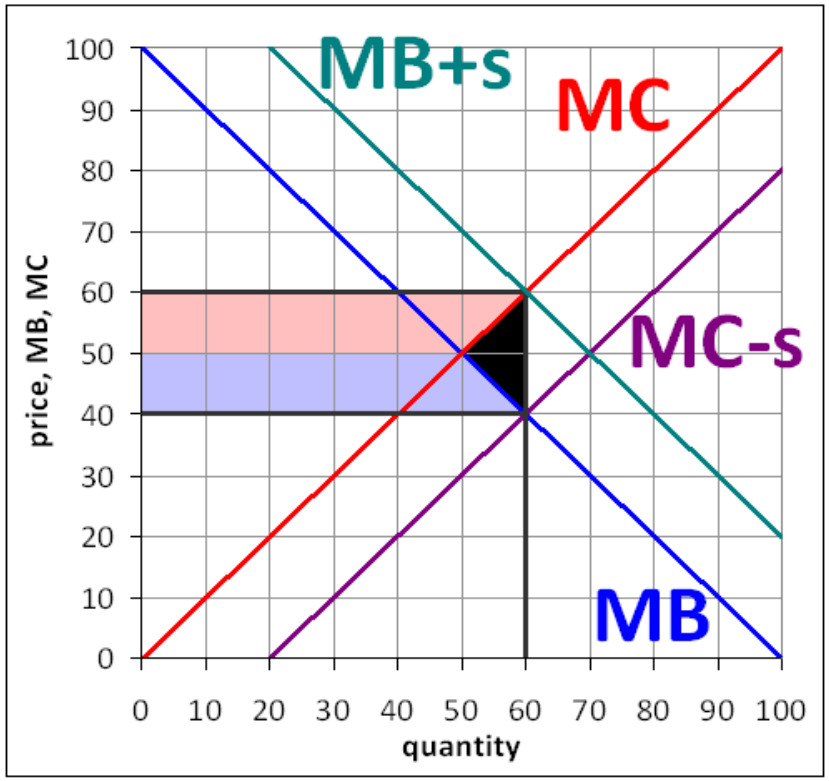
# ADDING SUBSIDIES TO EFFICIENT MARKETS

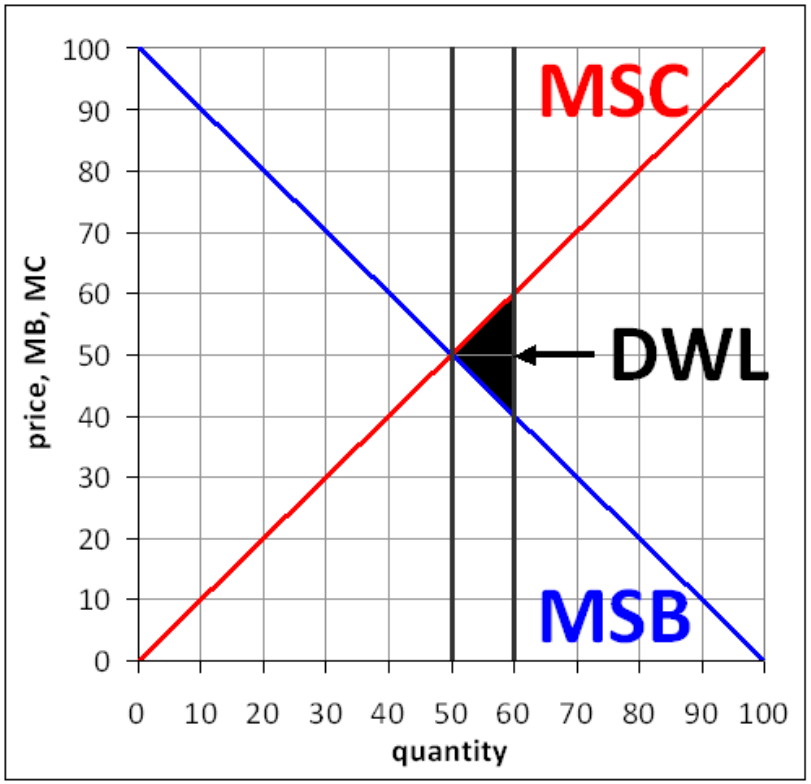



**Adding a subsidy to an already-efficient market can also cause a loss in total economic surplus. Here, the orange area represents the money that the government must pay to support the subsidy, the blue area represents the gain in consumer surplus, the red area represents the gain in producer surplus, and the black area is a deadweight loss, i.e. lost government revenue that doesn't become either consumer or producer surplus.**

# ADDING SUBSIDIES TO EFFICIENT MARKETS




**Adding a subsidy to an already-efficient market decreases surplus because you are causing the market to produce when the marginal social cost is greater than the marginal social benefit. The distance between these two defines the deadweight loss.**

# TAXES: ALGEBRA

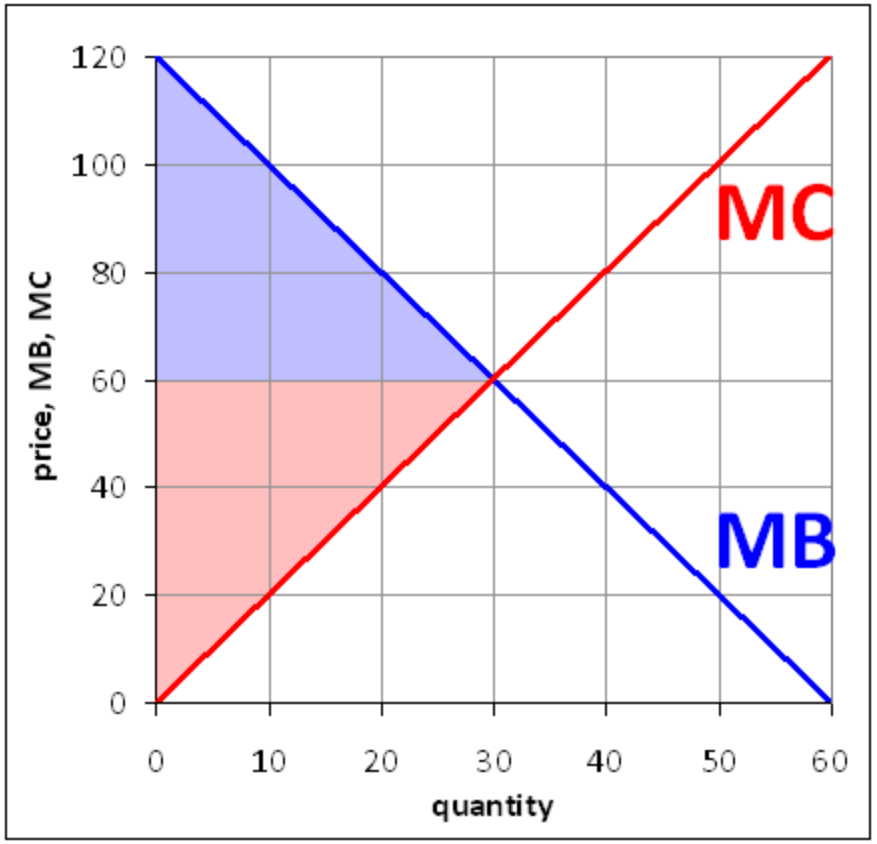
**First, with no tax…**

**MB = 120 – 2Q**
**MC = 2Q**

**MB = MC → 120 – 2Q = 2Q**
**→ 4Q = 120 → Q = 30**

**CS = (.5)(30)(60) = 900**
**PS = (.5)(30)(60) = 900**

**TES = CS + PS = 1800**

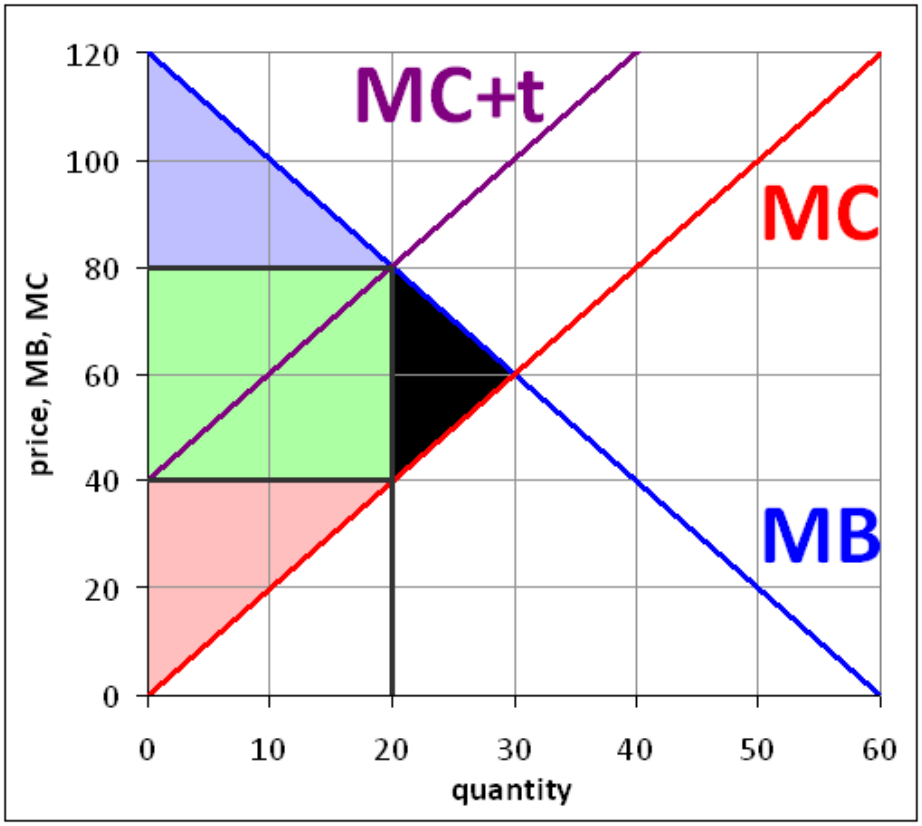


# TAXES: ALGEBRA

**MB = 120 – 2Q**
**MC = 2Q**
**t = 40**

**MB = MC+t**
**→ 120 – 2Q = 2Q + 40**
**→ 4Q = 80 → Q = 20**

**CS = (.5)(20)(40) = 400**
**PS = (.5)(20)(40) = 400**
**G = tQ = (40)(20) = 800**




**With the tax of 40, TES = CS + PS + G = 1600.**

***Without the tax*, TES was 1800, so DWL = 200.**

**You can also find that using DWL = (.5)(10)(40), calculating the area on the graph above.**