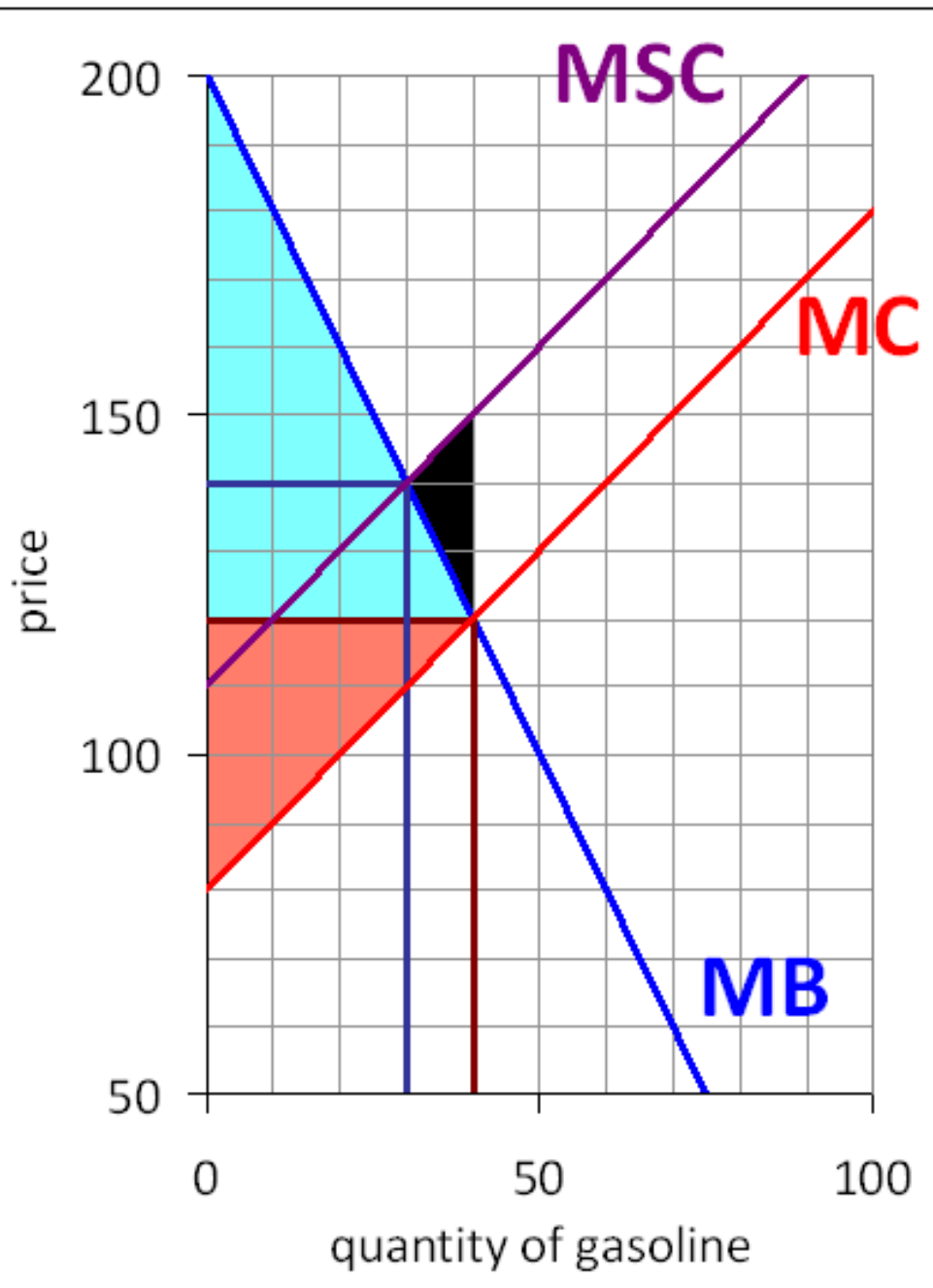


# **Chapter 11: Externalities and Property Rights, part 2**

**Tuesday, July 20**

# NEGATIVE EXTERNALITY: OVERVIEW



$$\text{MB} = 200 - 2Q$$

$$\text{MC} = 80 + Q$$

$$\text{MEC} = 30$$

$$\text{MSC} = 110 + Q$$

**Competitive equilibrium**

$$\text{MB} = \text{MC}$$

$$\rightarrow 200 - 2Q = 80 + Q$$

$$\rightarrow Q^* = 40, P^* = 120$$

**Social optimum**

$$\text{MB} = \text{MSC}$$

$$\rightarrow 200 - 2Q = 110 + Q$$

$$\rightarrow Q^{\circ} = 30, P^{\circ} = 140$$

$$\text{DWL} = .5(30)(10) = 150$$

**QUESTION 1 (negative externality: market equilibrium)**

**marginal private benefit function:  $MB = 210 - 3Q$**

**marginal private cost function:  $MC = 50 + Q$**

**marginal external cost:  $MEC = 80$**

**If the marginal benefit function, marginal private cost function, and marginal external cost of secret green ooze are as given above, what is the market equilibrium quantity, if neither producers nor consumers are required to pay the external cost?**

- A) 60**
- B) 50**
- C) 40**
- D) 30**
- E) 20**

## answer to question 1

**marginal private benefit function:  $MB = 210 - 3Q$**

**marginal private cost function:  $MC = 50 + Q$**

**marginal external cost:  $MEC = 80$**

$$MB = MC$$

$$210 - 3Q = 50 + Q$$

$$4Q = 160$$

$$Q^* = 40$$

A) 60

B) 50

**C) 40**

D) 30

E) 20

**QUESTION 2 (negative externality: market equilibrium)**

**marginal private benefit function:  $MB = 210 - 3Q$**

**marginal private cost function:  $MC = 50 + Q$**

**marginal external cost:  $MEC = 80$**

**When the market equilibrium quantity of 40 is chosen, what is the sum of producer and consumer surplus, minus the total external cost?**

**That is, at  $Q^* = 40$ , find  $CS + PS - EC$**

- A) 2400**
- B) 800**
- C) 200**
- D) 0**
- E) -3200**

## answer to question 2

**marginal private benefit function:  $MB = 210 - 3Q$**

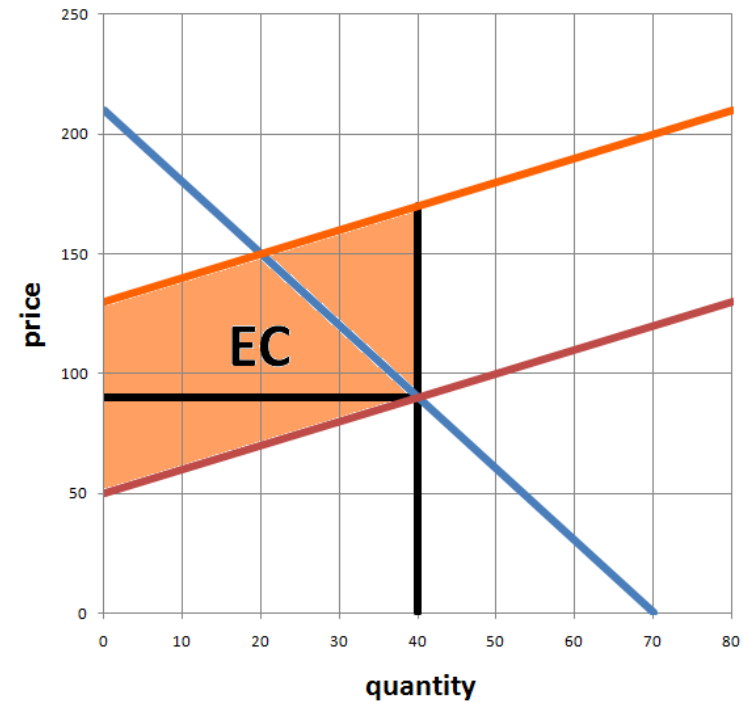
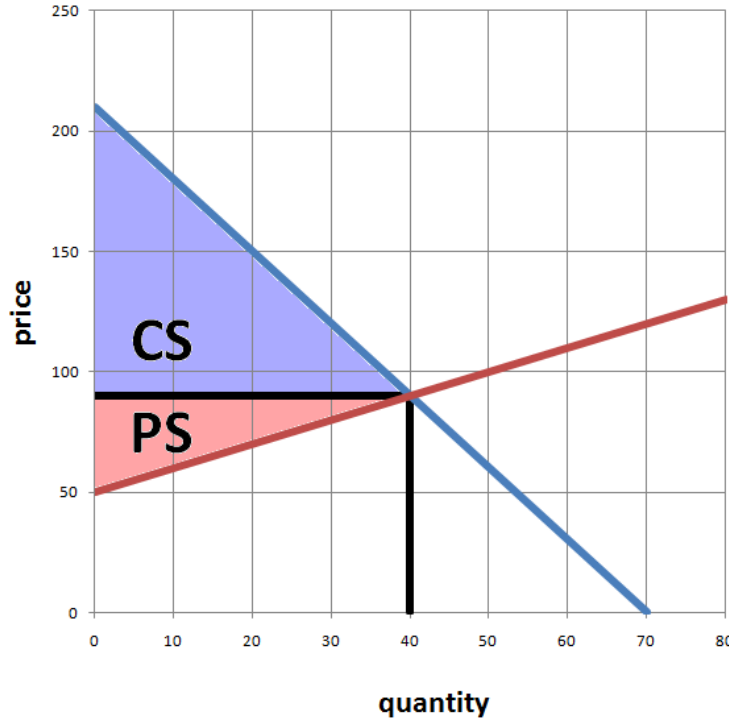
**marginal private cost function:  $MC = 50 + Q$**

**marginal external cost:  $MEC = 80$**

**That is, at  $Q^* = 40$ , find **CS** + **PS** - **EC****

**CS = 2400, PS = 800, EC =  $80 \times 40 = 3200$**

- A) 2400**
- B) 800**
- C) 200**
- D) 0**
- E) -3200**



**QUESTION 3 (negative externality: social optimum)**

**marginal private benefit function:  $MB = 210 - 3Q$**

**marginal private cost function:  $MC = 50 + Q$**

**marginal external cost:  $MEC = 80$**

**What is the socially optimal quantity of secret green ooze?**

- A) 20**
- B) 10**
- C) 5**
- D) 90**
- E) 30**

### answer to question 3

**marginal private benefit function:  $MB = 210 - 3Q$**

**marginal private cost function:  $MC = 50 + Q$**

**marginal external cost:  $MEC = 80$**

$$MSB = MSC$$

$$210 - 3Q = (50 + Q) + 80$$

$$4Q = 80$$

$$Q^{\circ} = 20$$

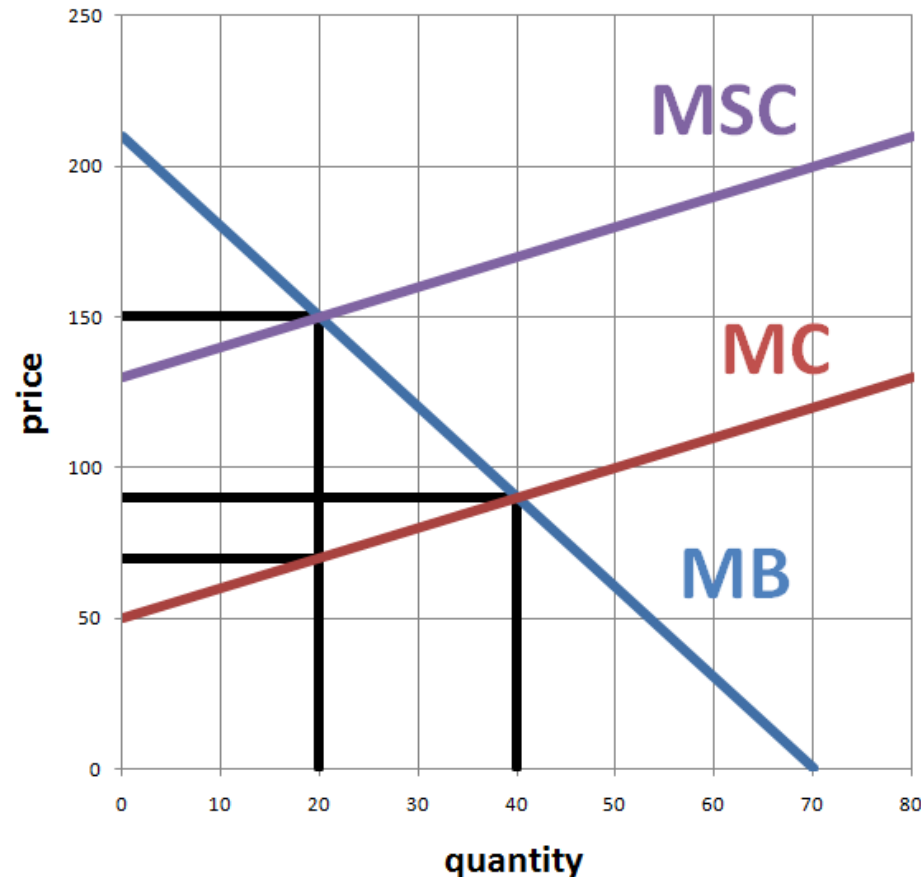
**A) 20**

**B) 10**

**C) 5**

**D) 90**

**E) 30**





**QUESTION 4 (negative externality: market equilibrium)**

**marginal private benefit function:  $MB = 210 - 3Q$**

**marginal private cost function:  $MC = 50 + Q$**

**marginal external cost:  $MEC = 80$**

**When the socially optimal quantity of 20 is chosen, what is the sum of producer and consumer surplus, minus the total external cost?**

**That is, at  $Q^o = 20$ , find  $CS + PS - EC$**

- A) 2400**
- B) 800**
- C) 200**
- D) 0**
- E) -3200**

## answer to question 4

**marginal private benefit function:  $MB = 210 - 3Q$**

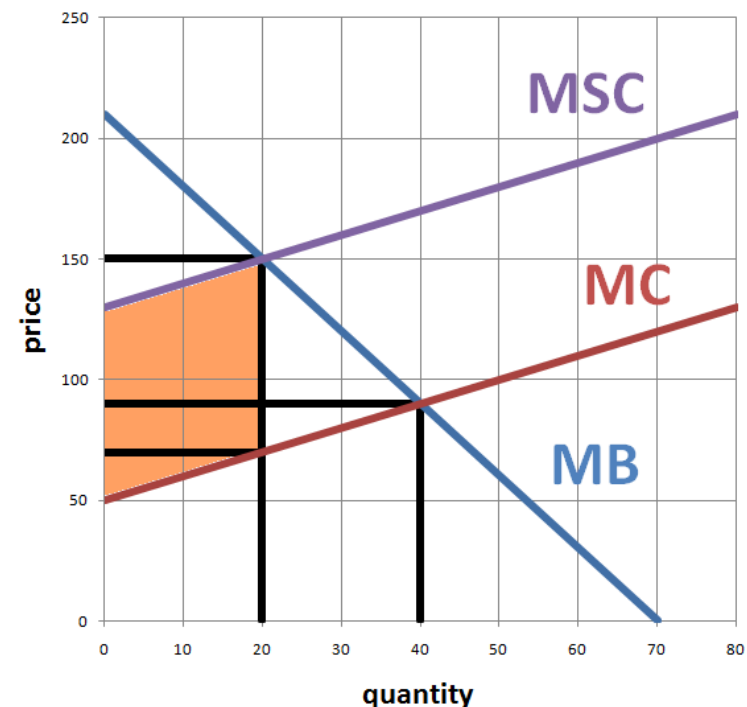
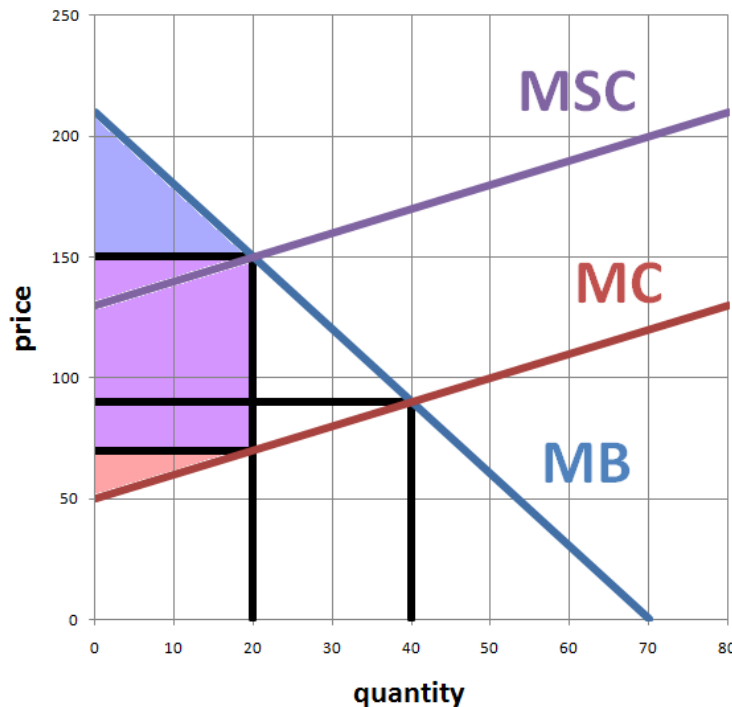
**marginal private cost function:  $MC = 50 + Q$**

**marginal external cost:  $MEC = 80$**

**That is, at  $Q^o = 20$ , find **CS** + **PS** - **EC****

**CS + PS = 2400, EC =  $80 \times 20 = 1600$**

- A) 2400**
- B) 800**
- C) 200**
- D) 0**
- E) -3200**



**QUESTION 5 (negative externality: deadweight loss)**

**marginal private benefit function:  $MB = 210 - 3Q$**

**marginal private cost function:  $MC = 50 + Q$**

**marginal external cost:  $MEC = 80$**

**What is the deadweight loss associated with having the market equilibrium quantity of 40 instead of the socially optimal quantity of 20?**

- A) 800**
- B) 400**
- C) 200**
- D) 600**
- E) 1000**

# answer to question 5

$$MB = 210 - 3Q$$

$$MC = 50 + Q$$

$$MEC = 80$$

**DWL**

$$.5 \times 20 \times 80$$

**800**

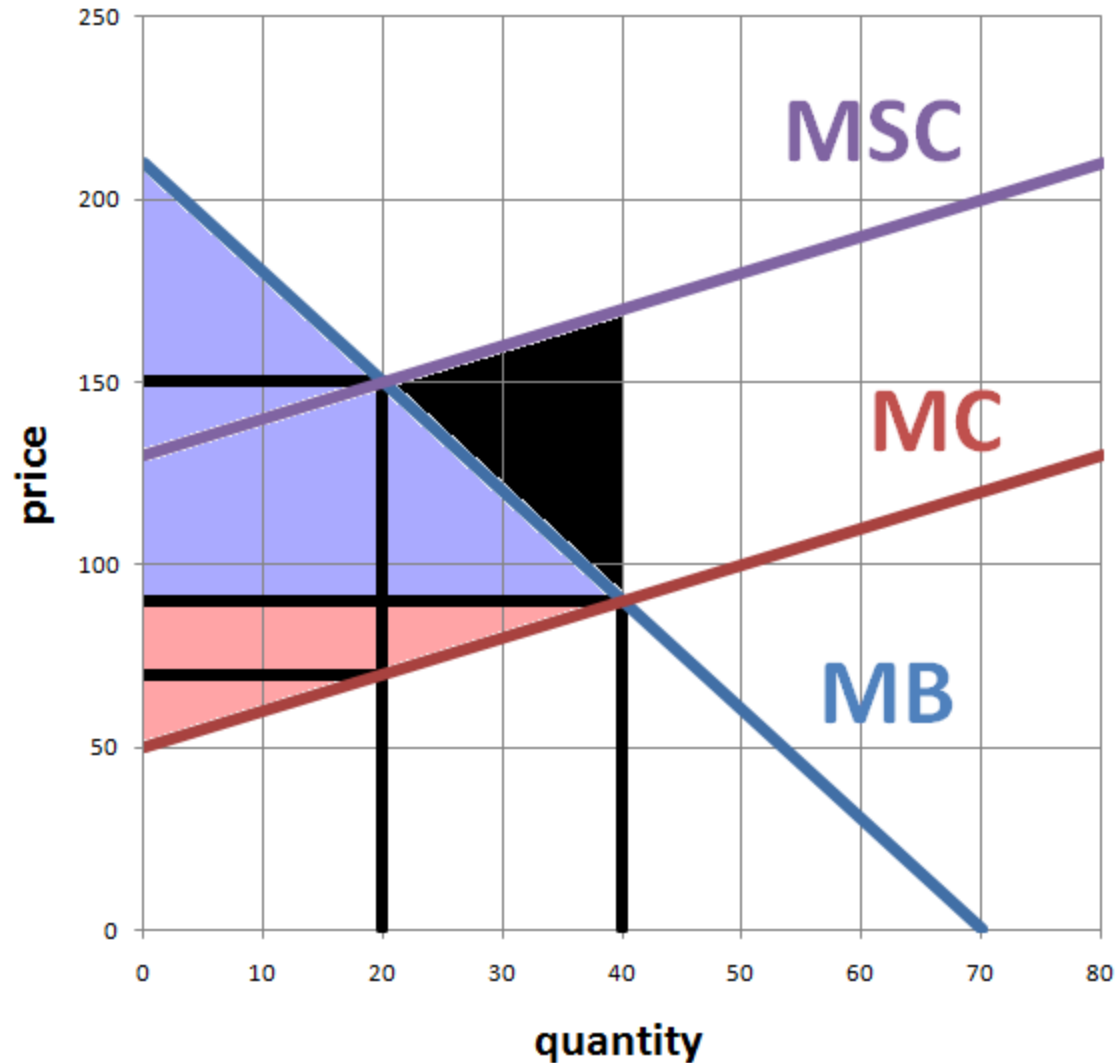
**A) 800**

**B) 400**

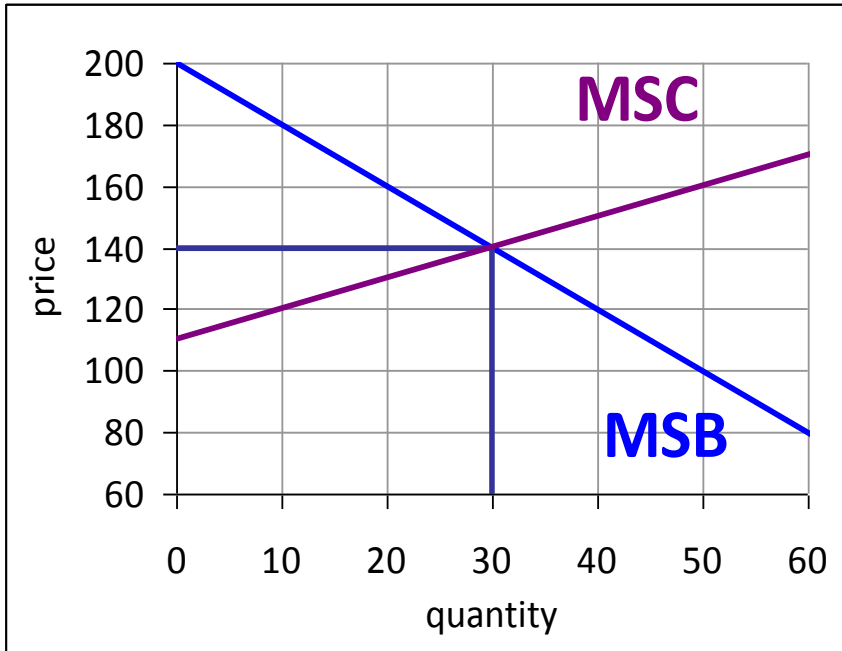
**C) 200**

**D) 600**

**E) 1000**



# CHOOSING QUANTITY TO MAXIMIZE SOCIAL WELFARE

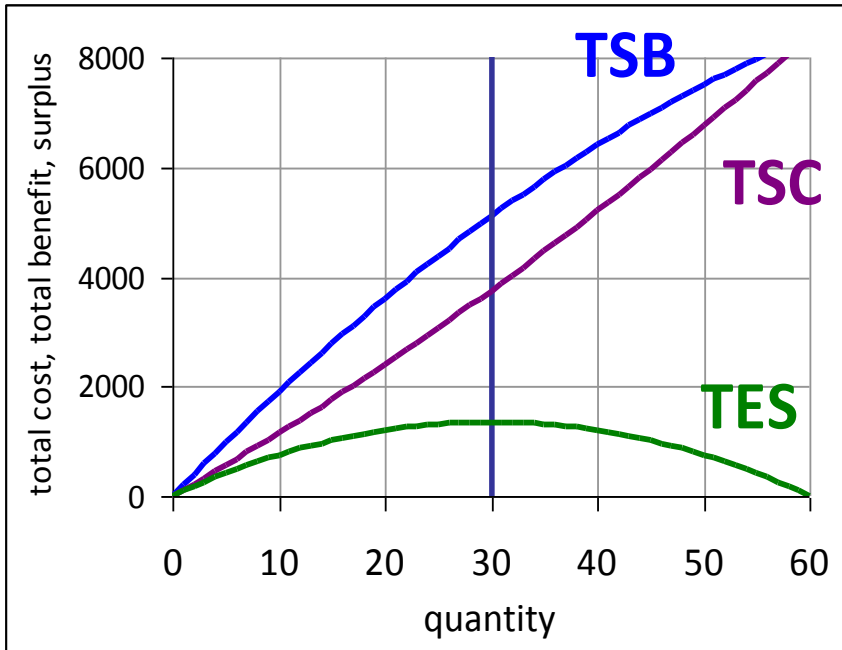


**Marginal social benefit**  
 **$MSB = 200 - 2Q$**

**Total social benefit**  
 **$TSB = 200Q - Q^2$**

**Marginal social cost**  
 **$MSC = 110 + Q$**

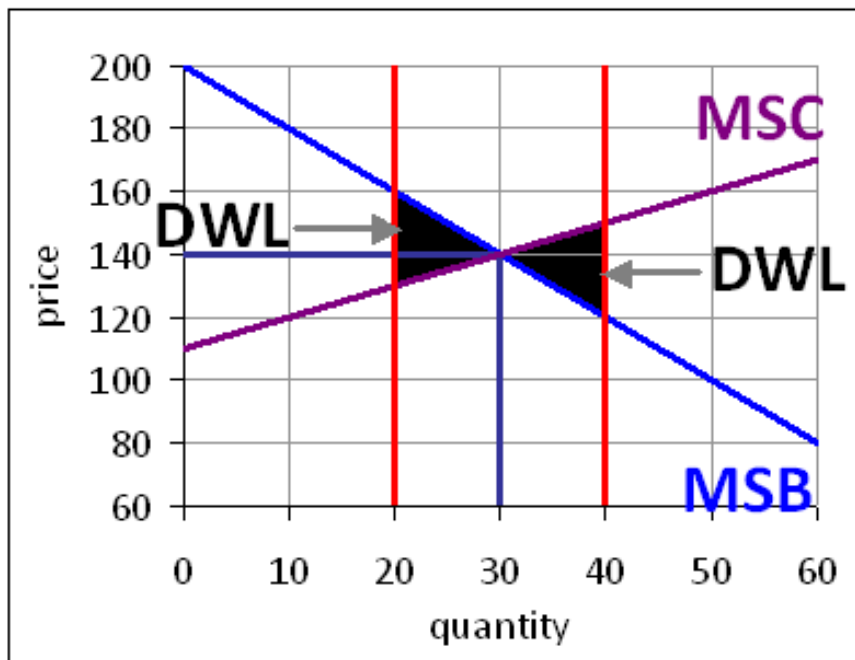
**Total social cost**  
 **$TSC = 110Q + .5Q^2$**



**Total economic surplus**  
 **$TES = TSB - TSC$**   
 **$TES = 90Q - 1.5Q^2$**

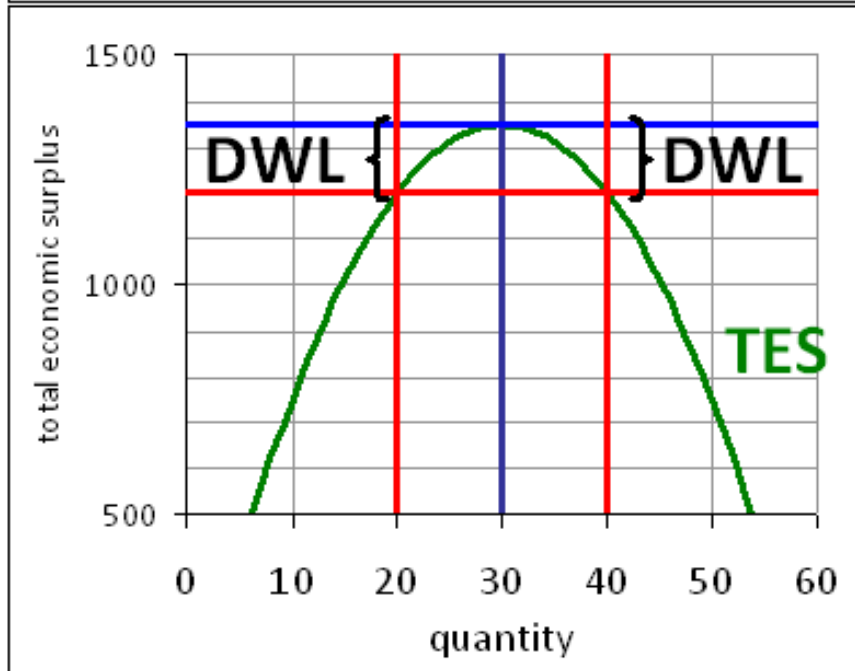
**Total surplus is maximized at  $Q^o = 30$ , where  $MSB = MSC$ .**

# OPTIMAL QUANTITY AND DEADWEIGHT LOSS



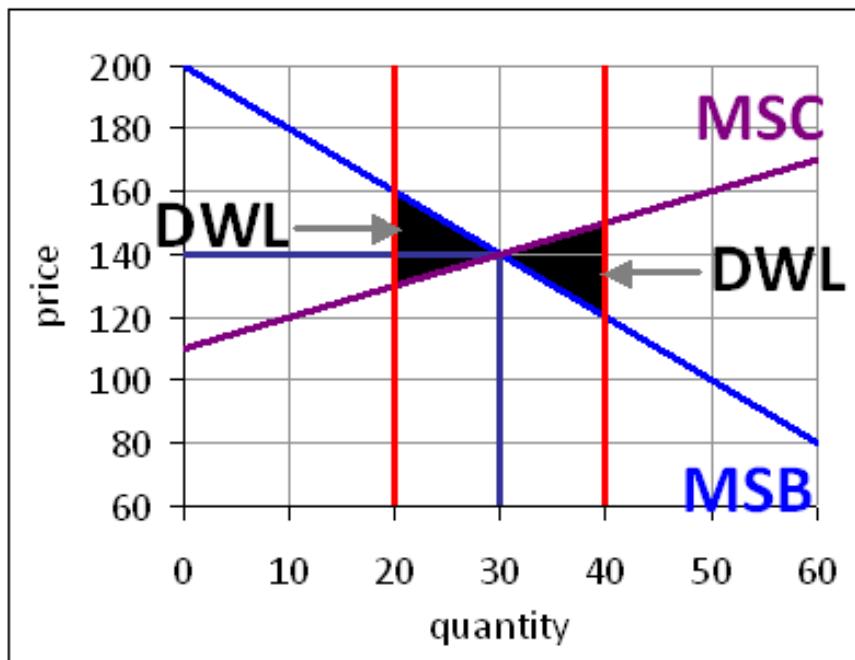
**Total surplus is maximized at  $Q^o = 30$ , where  $MSB = MSC$ .**

**As you get further from the optimal quantity in either direction, deadweight loss increases.**



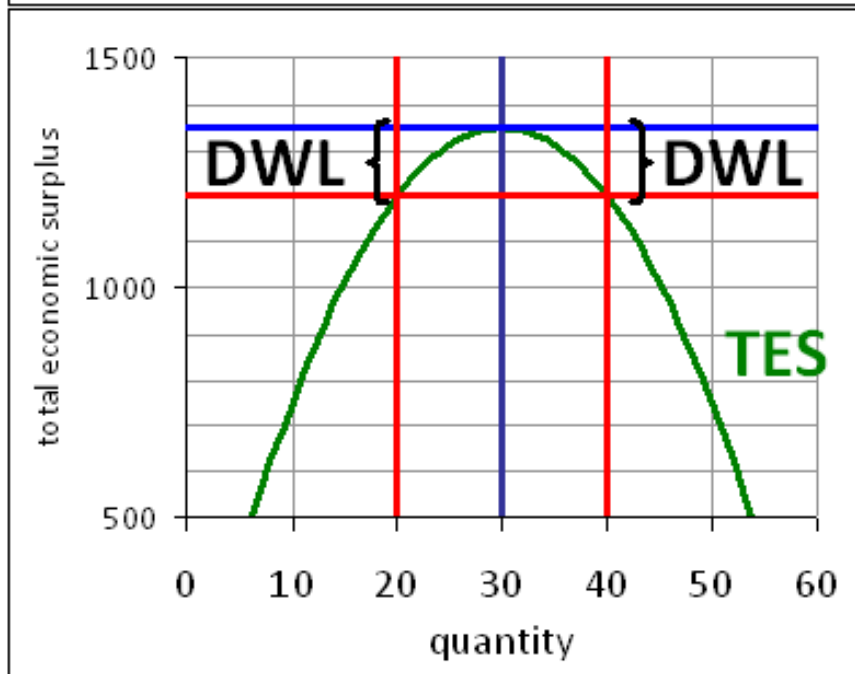
**The deadweight loss at  $Q$  is the distance between  $TES(Q)$  and the maximum value of  $TES$  (shown below), or the area between  $Q$ ,  $Q_o$ , the  $MSC$  curve, and the  $MSB$  curve (shown above).**

# OPTIMAL QUANTITY AND DEADWEIGHT LOSS



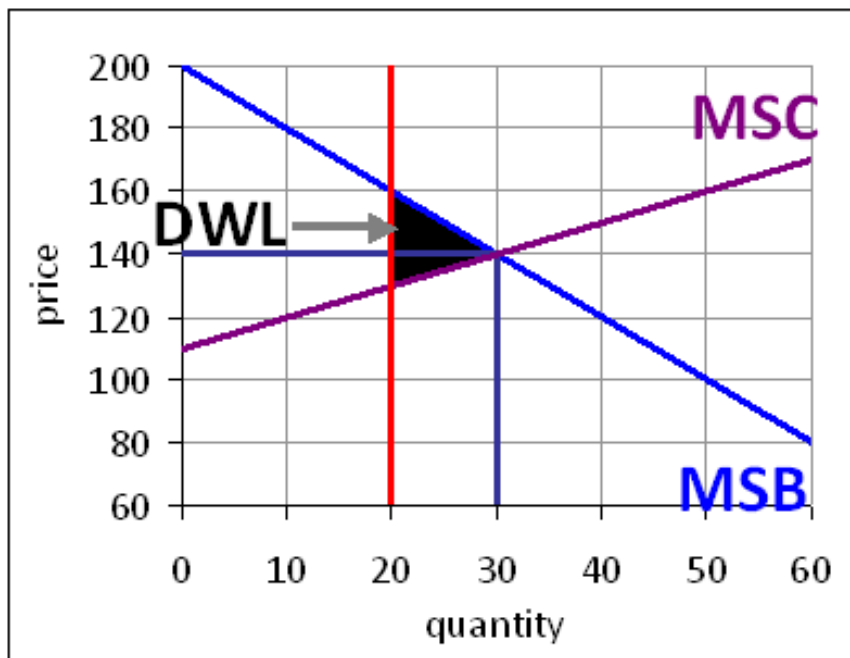
In this case,  $Q^{\circ} = 30$ , so TES is maximized when the quantity is 30. This maximum value of TES is **1350**.

When Q is decreased to **20**, or increased to **40**, then TES is reduced to **1200**, so DWL in both cases is  $1350 - 1200 =$  **150**.



You can find this by way of the shaded triangles above, or using the TES function,  
 **$TES = 90Q - 1.5Q^2$**

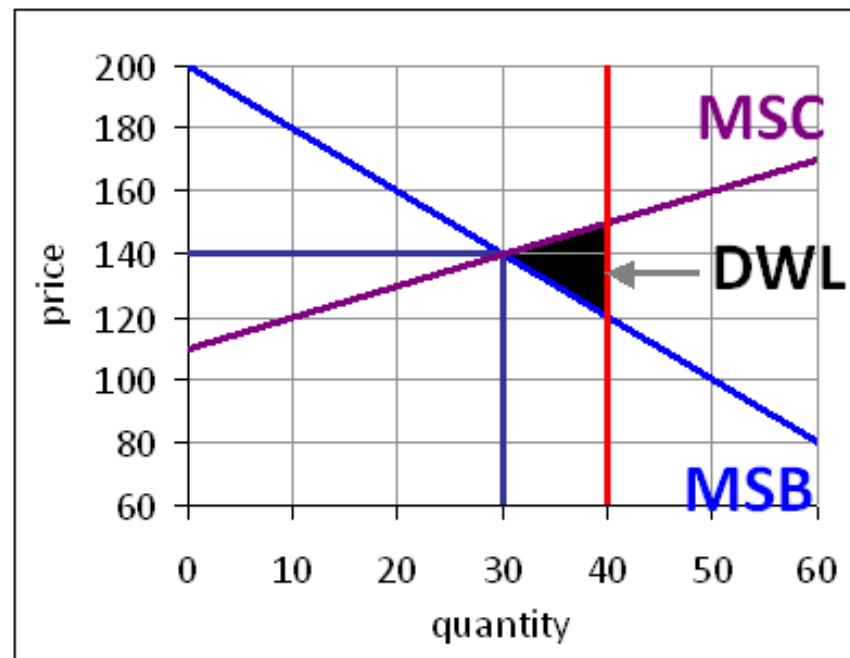
# REASONS WHY OPTIMUM MIGHT NOT BE REACHED



**quantity tends to be below optimum**

**positive externality  
tax**

**monopoly (any market power)  
price control (floor, ceiling)  
public good**

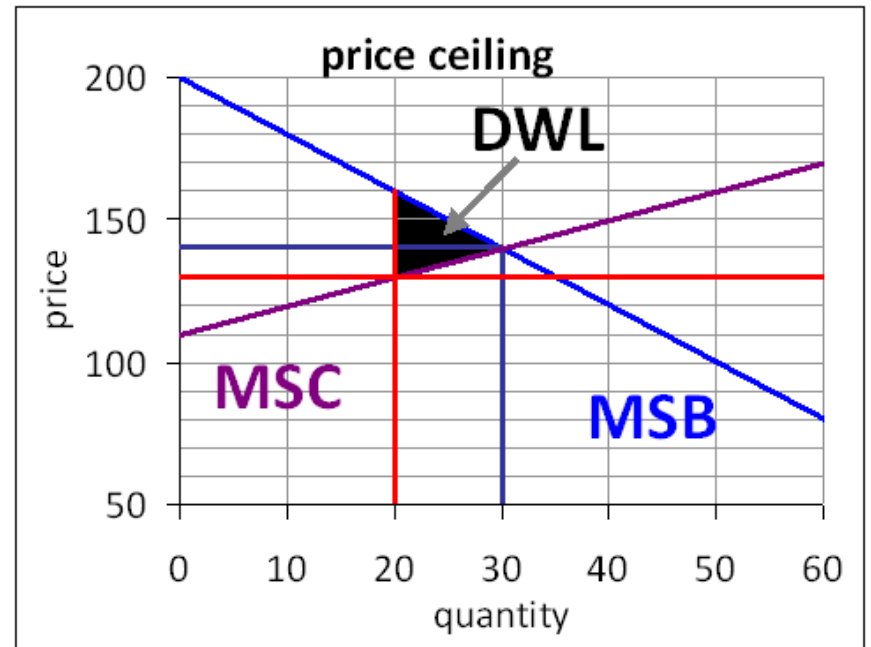
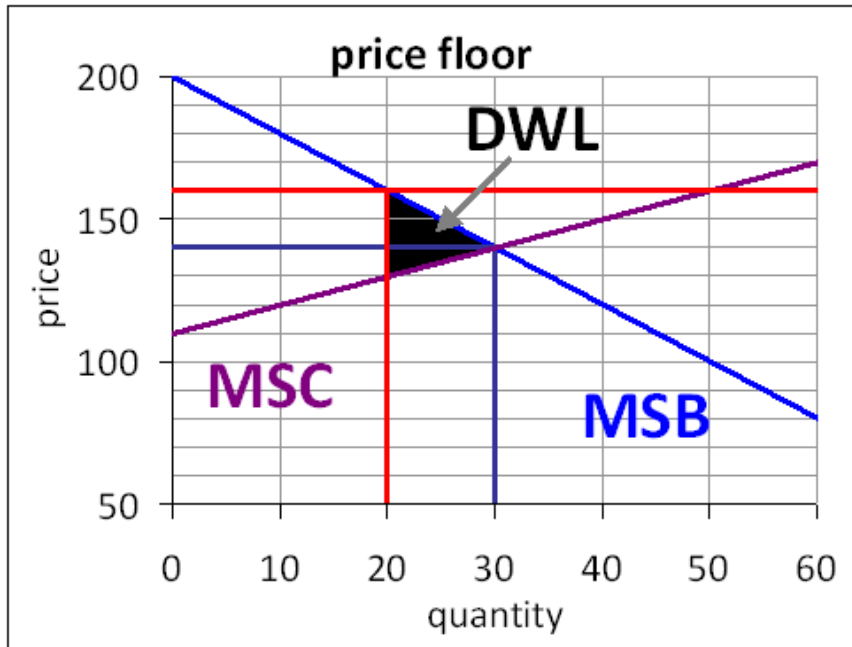
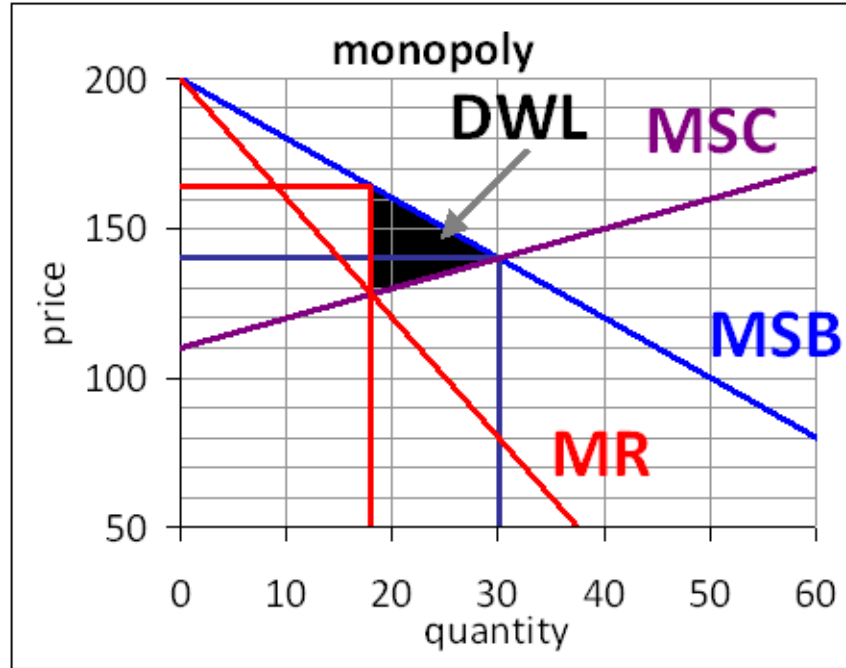


**quantity tends to be above optimum**

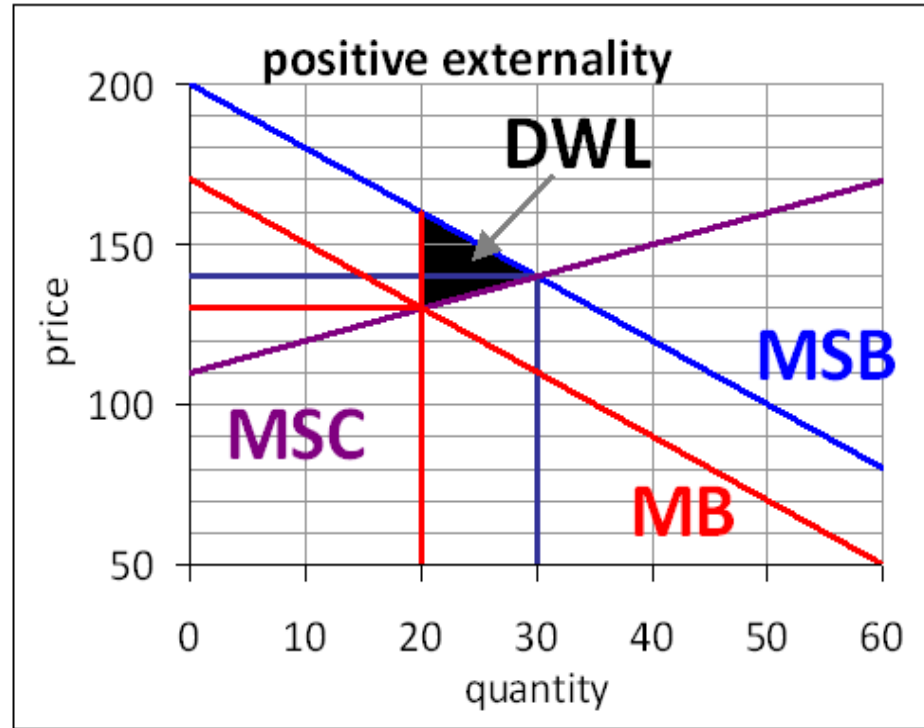
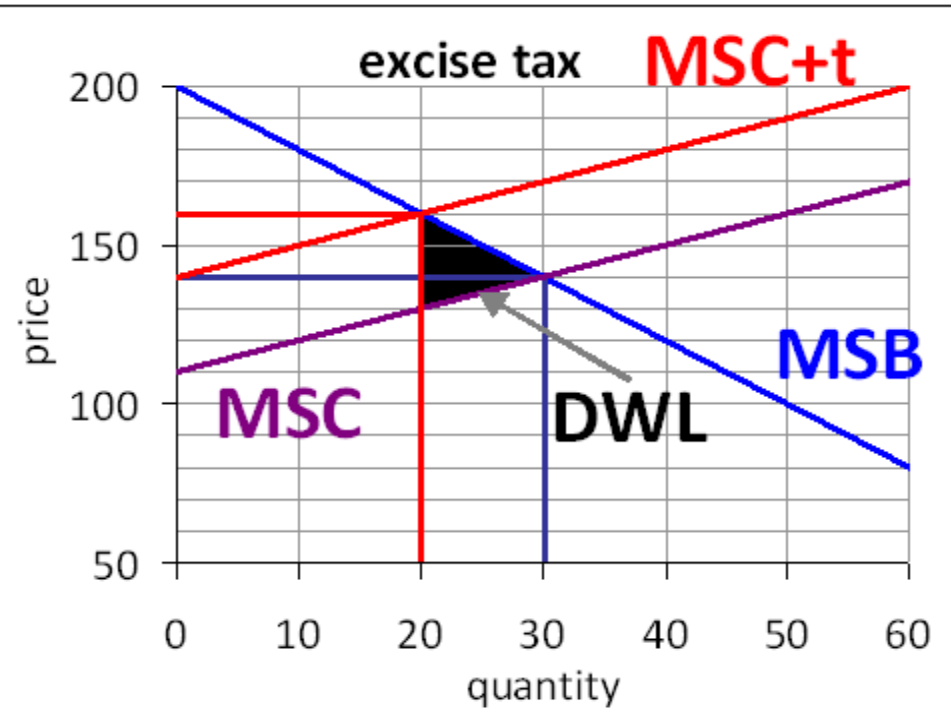
**negative externality  
subsidy**



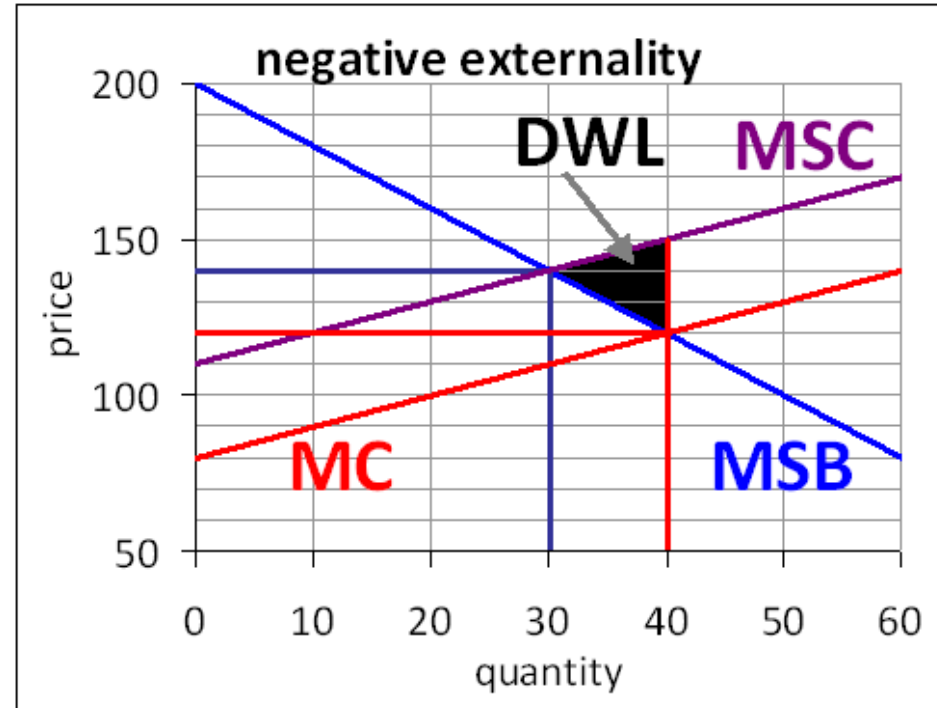
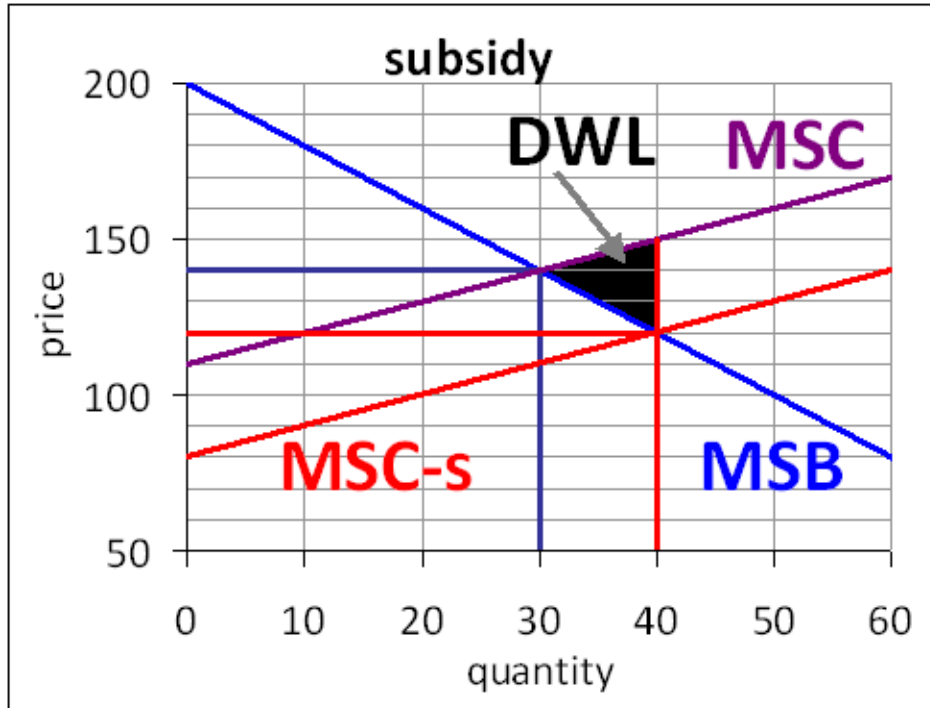
# BELOW-OPTIMUM QUANTITIES



# BELOW-OPTIMUM QUANTITIES



# ABOVE-OPTIMUM QUANTITIES



## QUESTION 6

Fill in the blanks, assuming that the market was efficient to begin with.

When firms exercise monopoly power, then the **equilibrium quantity** tends to be \_\_\_\_\_ the **optimum quantity**;

When there is a negative externality, then the **equilibrium quantity** tends to be \_\_\_\_\_ the **optimum quantity**.

- A) above; above
- B) above; below
- C) below; above
- D) below; below

## answer to question 6

Fill in the blanks, assuming that the market was efficient to begin with.

When firms exercise monopoly power, then the **equilibrium quantity** tends to be \_\_\_\_\_ the **optimum quantity**;

When there is a negative externality, then the **equilibrium quantity** tends to be \_\_\_\_\_ the **optimum quantity**.

- A) above; above
- B) above; below
- C) below; above
- D) below; below

## QUESTION 7

Fill in the blanks, assuming that the market was efficient to begin with.

When a binding price ceiling is imposed, then the **equilibrium quantity** tends to be \_\_\_\_\_ the **optimum quantity**;

When there is a positive externality, then the **equilibrium quantity** tends to be \_\_\_\_\_ the **optimum quantity**.

- A) above; above
- B) above; below
- C) below; above
- D) below; below

## answer to question 7

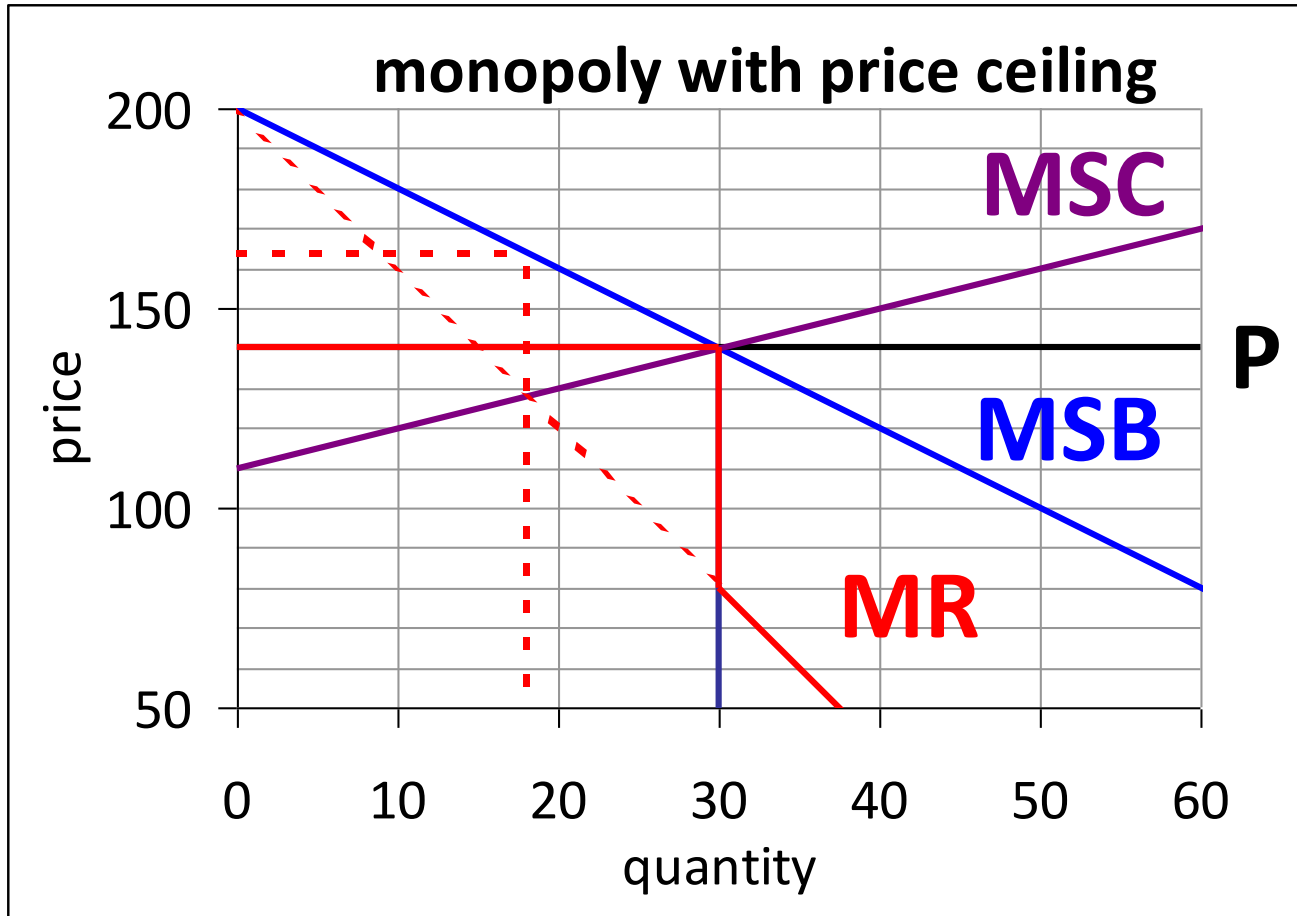
**Fill in the blanks, assuming that the market was efficient to begin with.**

**When a binding price ceiling is imposed, then the **equilibrium quantity** tends to be \_\_\_\_\_ the **optimum quantity**;**

**When there is a positive externality, then the **equilibrium quantity** tends to be \_\_\_\_\_ the **optimum quantity**.**

- A) above; above**
- B) above; below**
- C) below; above**
- D) below; below**

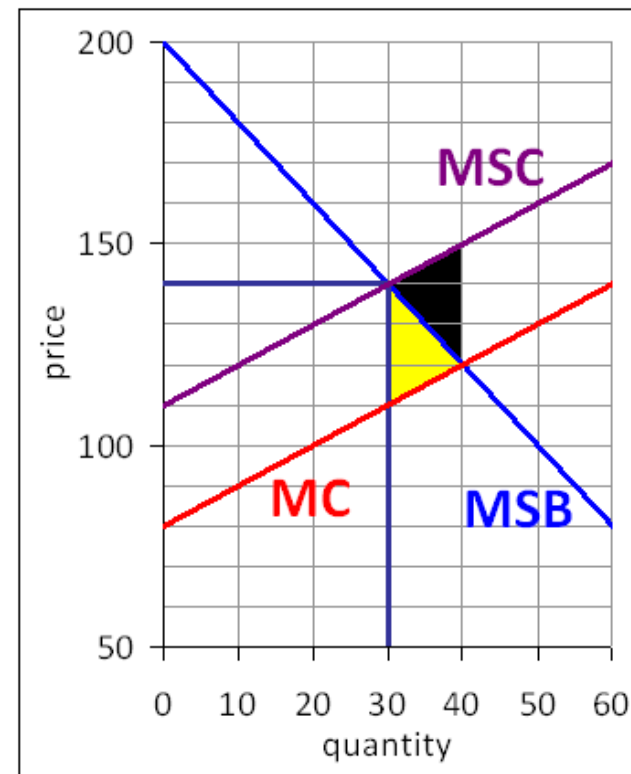
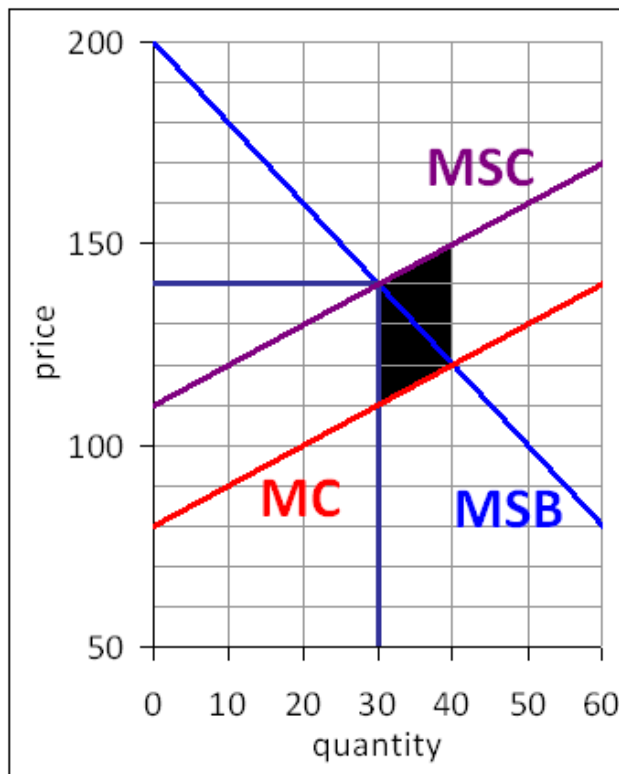
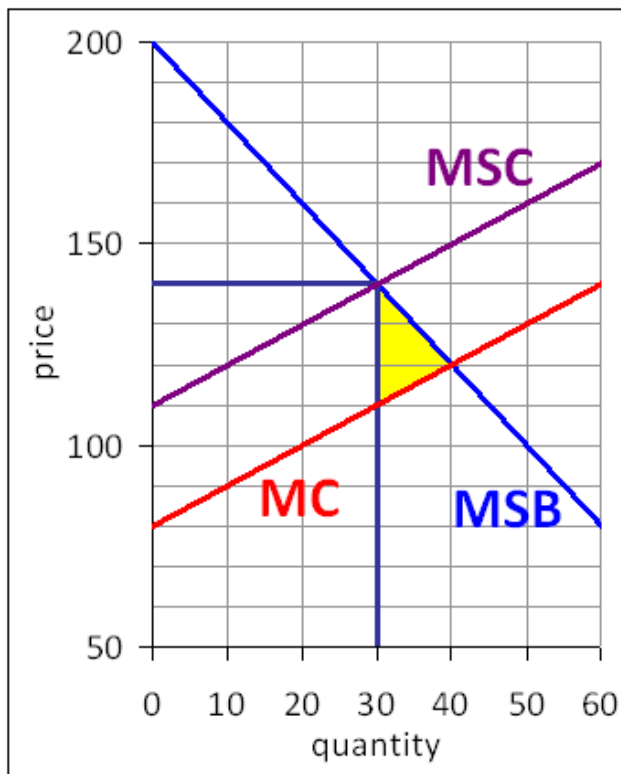
# MONOPOLY WITH PRICE CEILING



**Some of these market disturbances can cancel each other out. For example, if exactly the right price ceiling (maximum price) is chosen, then it can cancel out the effect of monopoly power, and restore efficiency.**

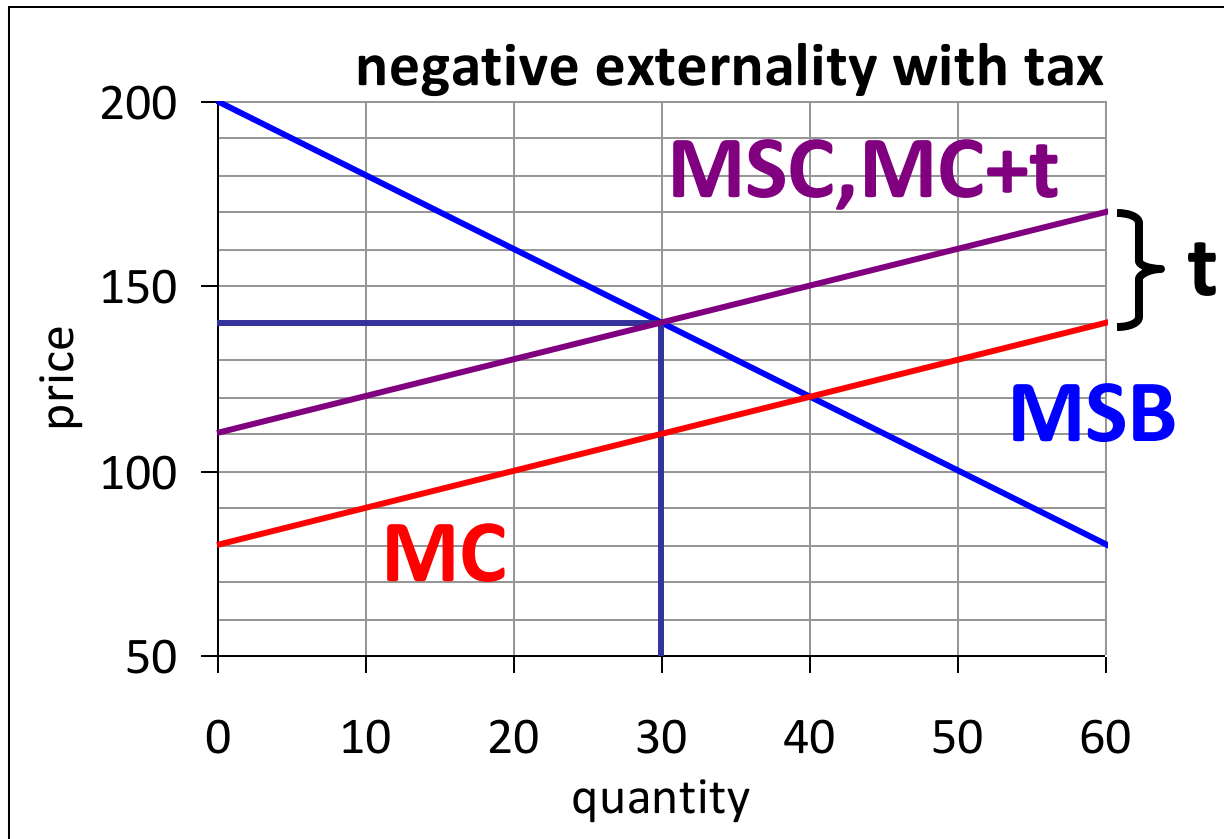


# COST AND BENEFIT OF DEREGULATION



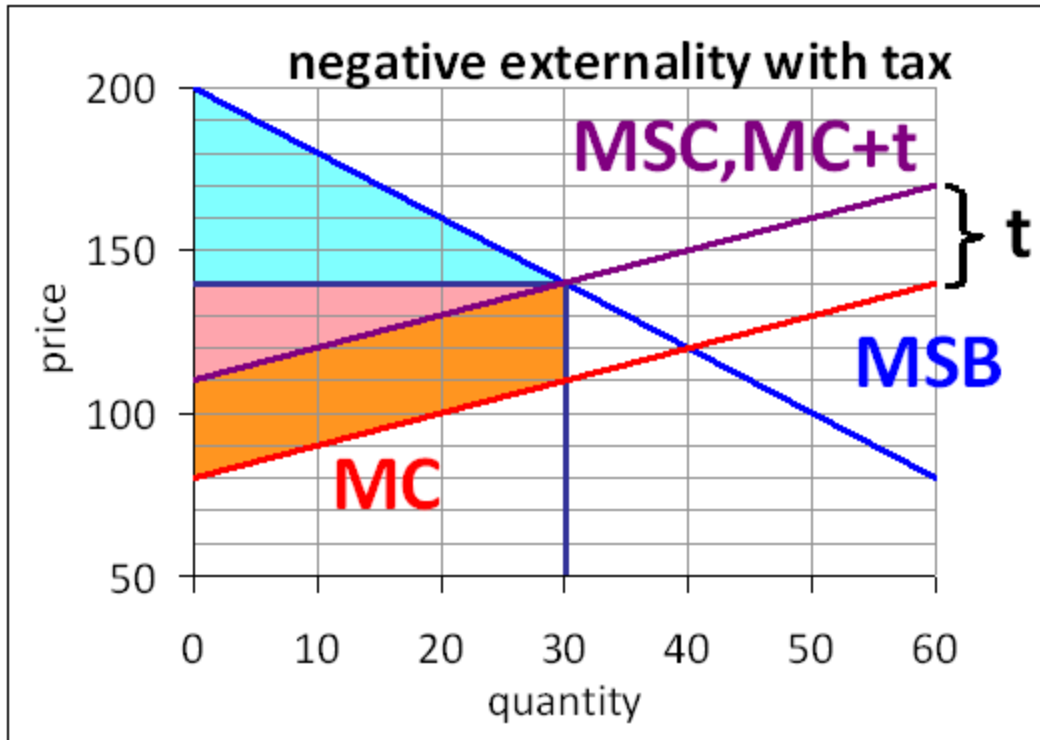
**If we are initially at the social optimum of  $Q = 30$ , and then we deregulate so that  $Q$  changes to 40, then society gains the yellow triangle in extra producer and consumer surplus, but loses the black parallelogram in pollution costs. The difference is the black triangle that represents the DWL of deregulation.**

# NEGATIVE EXTERNALITY WITH TAX



**If part of the cost is external, then the private MC curve will be below the social MC curve, but adding precisely the right tax can shift it back up, and restore efficiency.**

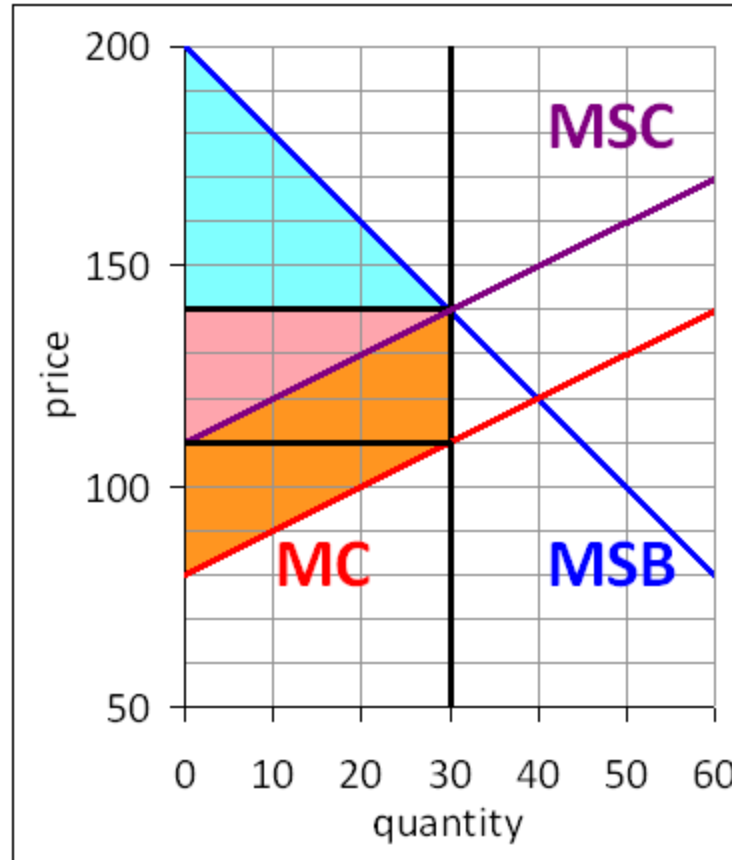
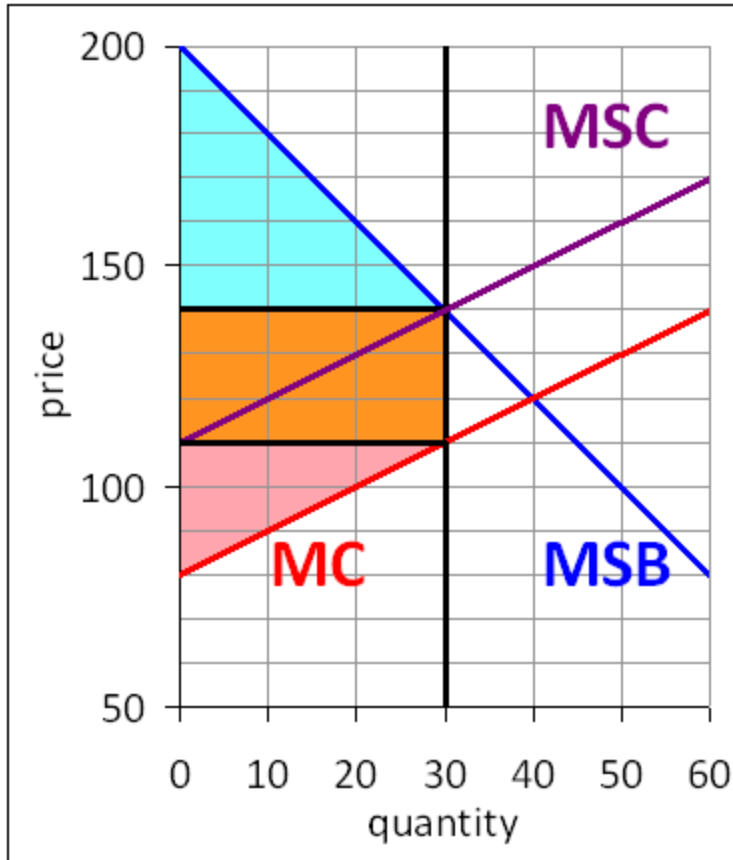
# NEGATIVE EXTERNALITY WITH TAX



**The blue and pink triangles (consumer and producer surplus) together represent the total amount of economic surplus generated by the market.**

**The orange parallelogram represents both the cost of the externality and the revenue received by the government; these approximately cancel out to a zero net welfare effect.**

# CAP AND TRADE



**Instead of imposing a per-unit tax on pollution, the government can limit the total amount of pollution, and then either auction or distribute permits that are required to legally create a certain amount of pollution. If it's an auction, the orange area is government revenue; if the permits are given to firms, it is producer surplus.**

## **QUESTION 8 (negative externality: market equilibrium)**

**marginal private benefit function:  $MB = 400 - 5Q$**

**marginal private cost function:  $MC = 100 + Q$**

**marginal external cost:  $MEC = 60$**

**Once again, we have the market for gasoline, which produces a negative externality of \$60 per unit. If neither buyers nor sellers of gasoline are required to pay for this external cost, then what is the quantity of gasoline produced and consumed in market equilibrium?**

- A) 60**
- B) 55**
- C) 50**
- D) 45**
- E) 40**

## answer to question 8

**marginal private benefit function:  $MB = 400 - 5Q$**

**marginal private cost function:  $MC = 100 + Q$**

**marginal external cost:  $MEC = 60$**

**Once again, we have the market for gasoline, which produces a negative externality of \$60 per unit. If neither buyers nor sellers of gasoline are required to pay for this external cost, then what is the quantity of gasoline produced and consumed in market equilibrium?**

**A) 60**

**B) 55**

**C) 50**

**D) 45**

**E) 40**

$$MB = MC \rightarrow 400 - 5Q = 100 + Q$$

$$\rightarrow 6Q = 300 \rightarrow Q = 50$$

## **QUESTION 9 (optimal pollution cap)**

**marginal private benefit function:  $MB = 400 - 5Q$**

**marginal private cost function:  $MC = 100 + Q$**

**marginal external cost:  $MEC = 60$**

**If you were asked to recommend a pollution cap (maximum quantity) for a cap and trade program to maximize total economic surplus, what cap would you recommend?**

- A) none**
- B)  $Q = 45$**
- C)  $Q = 40$**
- D)  $Q = 35$**
- E)  $Q = 30$**

## answer to question 9

**marginal private benefit function:  $MB = 400 - 5Q$**

**marginal private cost function:  $MC = 100 + Q$**

**marginal external cost:  $MEC = 60$**

**If you were asked to recommend a pollution cap (maximum quantity) for a cap and trade program to maximize total economic surplus, what cap would you recommend?**

**A) none**

**B)  $Q = 45$**

**C)  $Q = 40$**

**D)  $Q = 35$**

**E)  $Q = 30$**

$$MB = MSC \rightarrow 400 - 5Q = 160 + Q$$

$$\rightarrow 6Q = 240 \rightarrow Q = 40$$



## **QUESTION 10 (optimal pollution tax)**

**marginal private benefit function:  $MB = 400 - 5Q$**

**marginal private cost function:  $MC = 100 + Q$**

**marginal external cost:  $MEC = 60$**

**If, instead of a pollution cap, you were asked to recommend a per-unit pollution tax (again, to maximize total economic surplus), what tax would you recommend?**

- A) \$0**
- B) \$50**
- C) \$40**
- D) \$100**
- E) \$60**

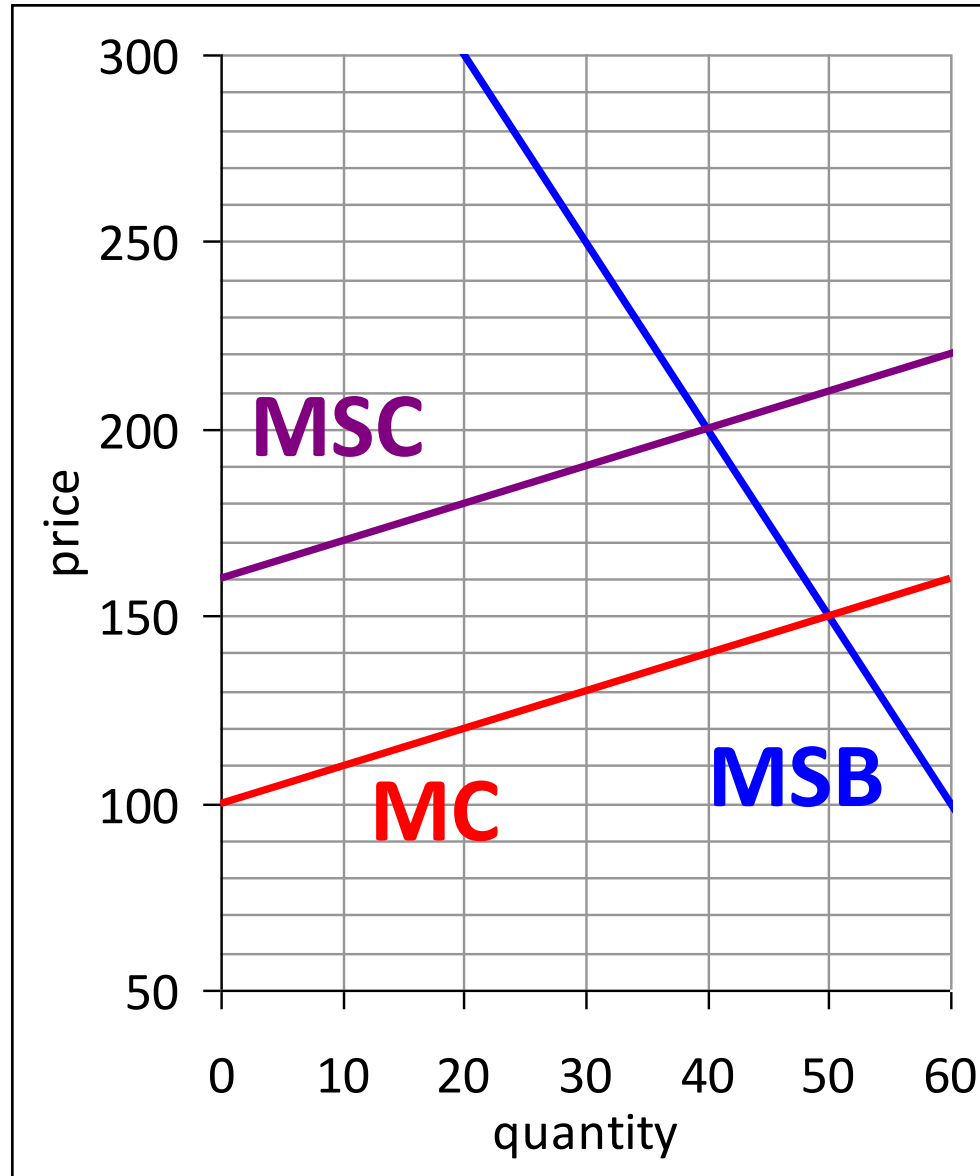
## answer to question 10

$$\text{MB} = 400 - 5Q$$

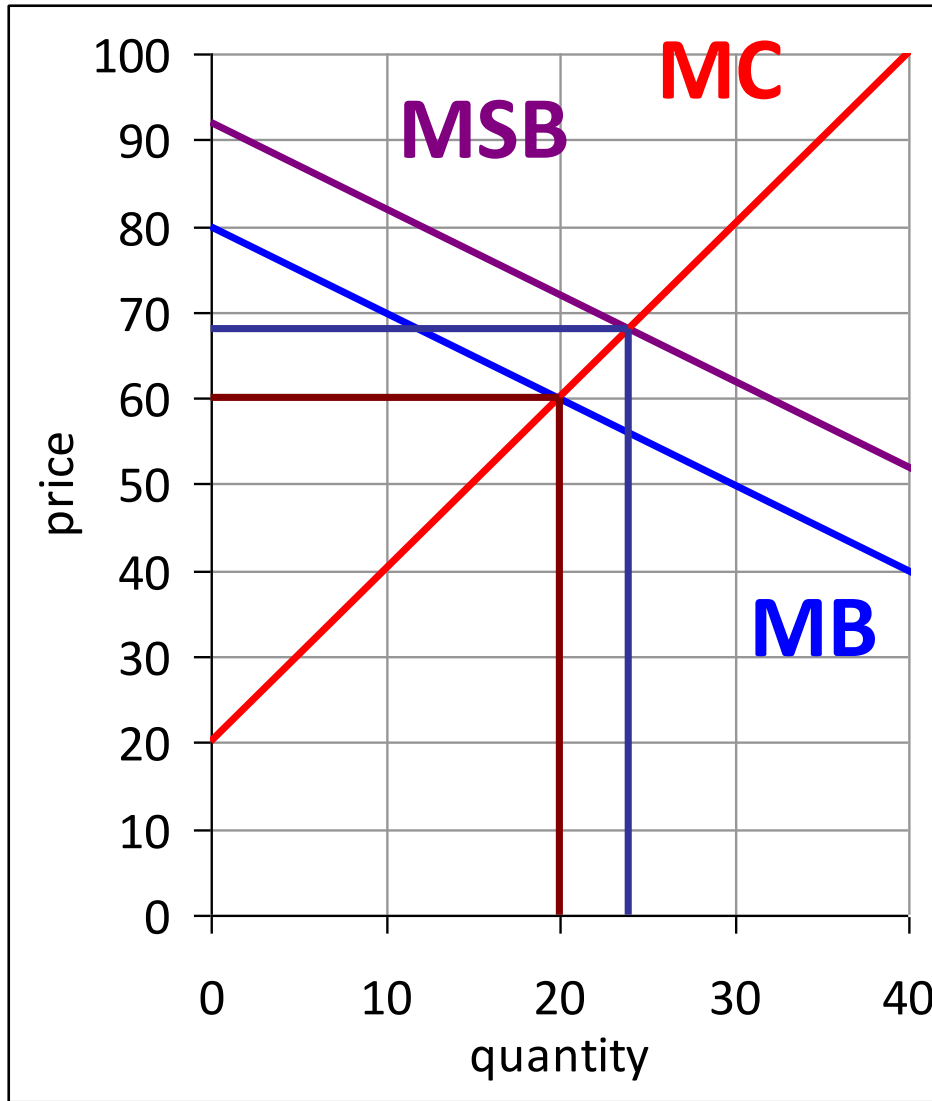
$$\text{MC} = 100 + Q$$

$$\text{MEC} = 60$$

- A) \$0
- B) \$50
- C) \$40
- D) \$100
- E) \$60**



# POSITIVE EXTERNALITY: GRAPH



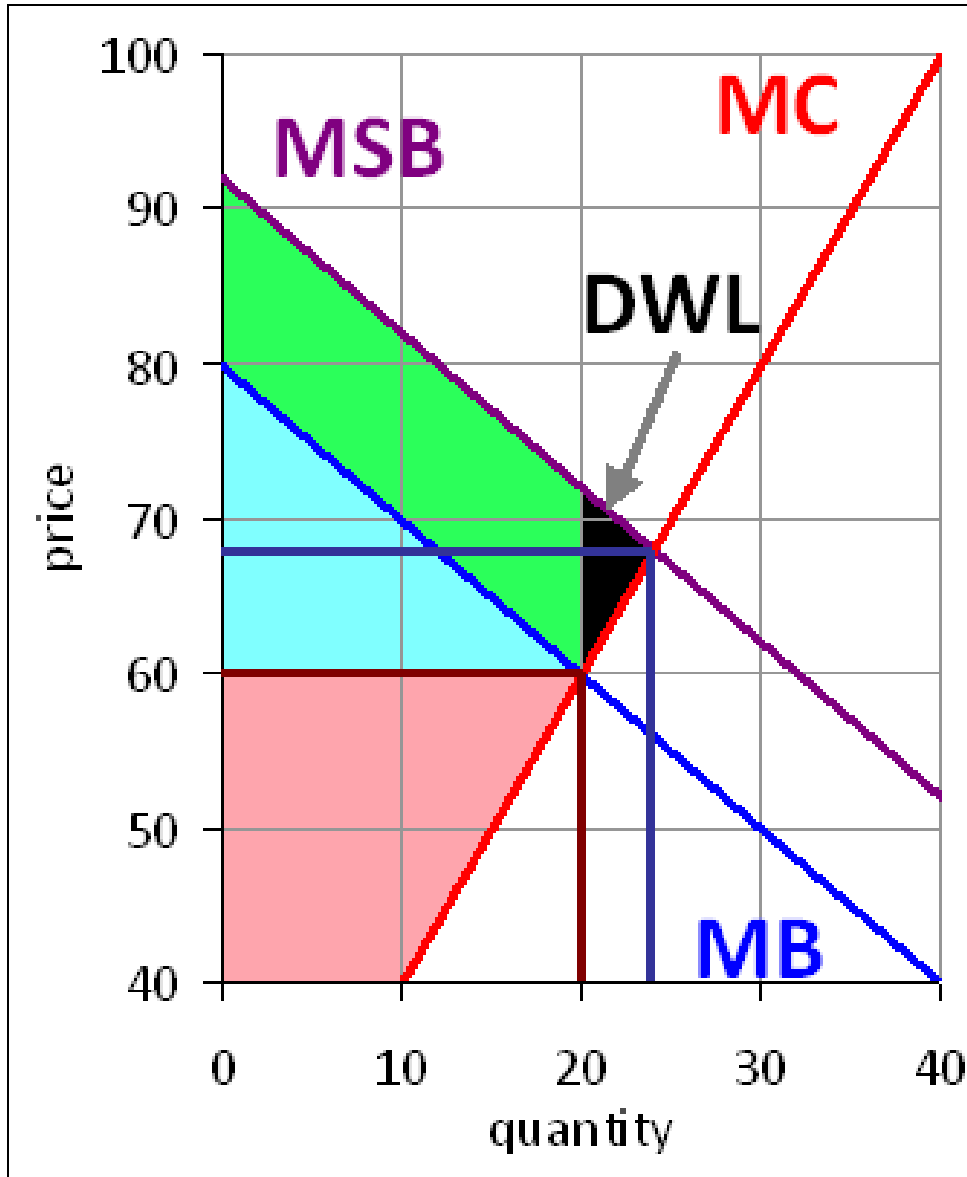
**marginal private benefit**  
 **$MB = 80 - Q$**

**marginal external benefit**  
 **$MEB = 12$**

**marginal social benefit**  
**(private + external)**  
 **$MSB = 92 - Q$**

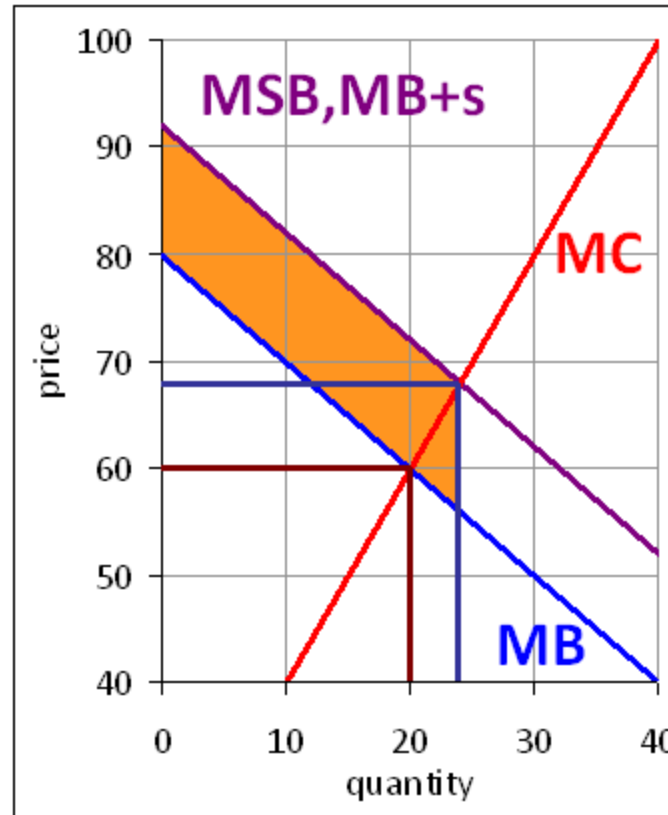
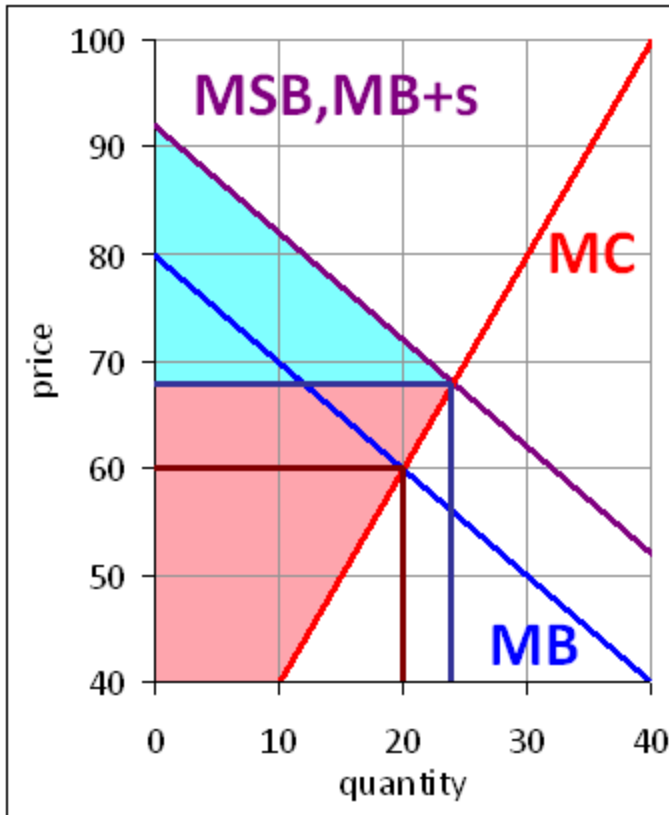
**marginal private cost**  
 **$MC = 20 + 2Q$**

# POSITIVE EXTERNALITY: UNREGULATED



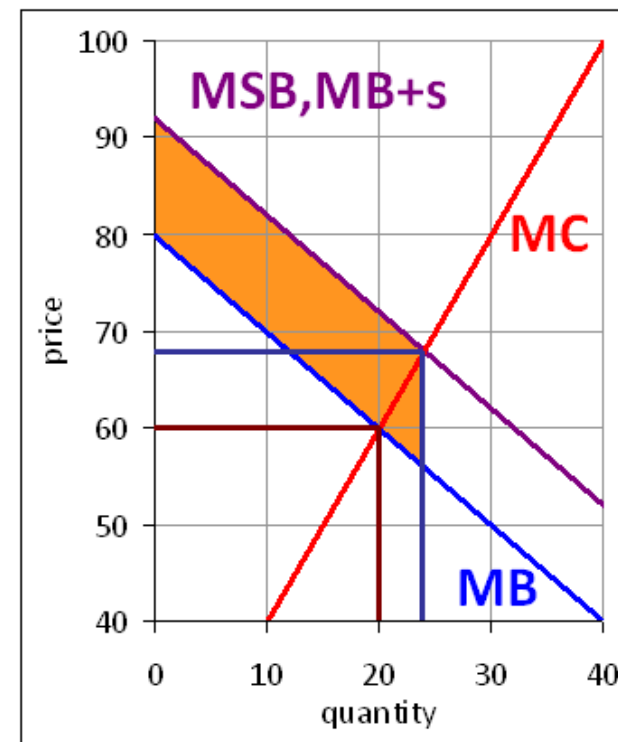
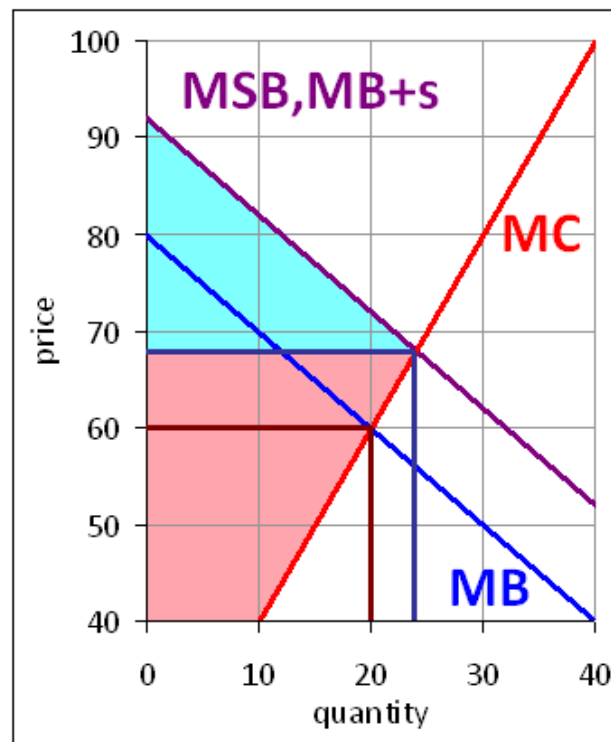
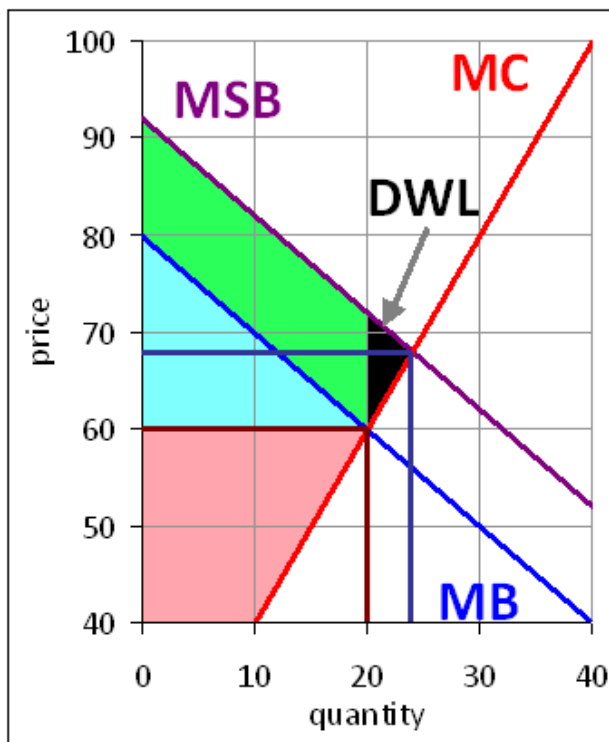
The blue and pink areas are consumer and producer surplus. The green area is external benefit. The black area is deadweight loss from not increasing provision of the good to its socially optimal level.

# POSITIVE EXTERNALITY WITH SUBSIDY



**The blue and pink areas in the graph on the left are consumer and producer surplus. The orange area in the graph on the right is both external benefit, and revenue lost by the government, which balance each other out.**

# POSITIVE EXTERNALITY WITH SUBSIDY



**Notice that the black area in the graph on the left has now been filled in by a combination of consumer and producer surplus. Total economic surplus has been increased to its maximum potential.**

## **QUESTION 11 (market equilibrium quantity)**

**marginal private benefit:  $MB = 100 - Q$**

**marginal external benefit:  $MEB = 20$**

**marginal private cost:  $MC = 20 + Q$**

**If neither buyers nor sellers are compensated directly for the external benefits that they provide to others, then what is the market equilibrium quantity?**

**A) 20**

**B) 25**

**C) 30**

**D) 35**

**E) 40**

## answer to question 11

**marginal private benefit:  $MB = 100 - Q$**

**marginal external benefit:  $MEB = 20$**

**marginal private cost:  $MC = 20 + Q$**

**If neither buyers nor sellers are compensated directly for the external benefits that they provide to others, then what is the market equilibrium quantity?**

**A) 20**

**B) 25**

**C) 30**

**D) 35**

**E) 40**



## QUESTION 12 (socially optimal quantity)

**marginal private benefit:  $MB = 100 - Q$**

**marginal external benefit:  $MEB = 20$**

**marginal private cost:  $MC = 20 + Q$**

**What quantity maximizes total economic surplus?**

**A) 10**

**B) 20**

**C) 30**

**D) 40**

**E) 50**

## answer to question 12

**marginal private benefit:  $MB = 100 - Q$**

**marginal external benefit:  $MEB = 20$**

**marginal private cost:  $MC = 20 + Q$**

**What quantity maximizes total economic surplus?**

**A) 10**

**B) 20**

**C) 30**

**D) 40**

**E) 50**

## QUESTION 13 (optimal subsidy)

**marginal private benefit:  $MB = 100 - Q$**

**marginal external benefit:  $MEB = 20$**

**marginal private cost:  $MC = 20 + Q$**

**Suppose that consumers receive a subsidy of \$s for each unit of the good they buy. What value of s will cause the market to settle on the socially optimal quantity?**

**A) 100**

**B) 20**

**C) 1**

**D) 40**

**E) 0**

## answer to question 13

**marginal private benefit:  $MB = 100 - Q$**

**marginal external benefit:  $MEB = 20$**

**marginal private cost:  $MC = 20 + Q$**

**Suppose that consumers receive a subsidy of \$s for each unit of the good they buy. What value of s will cause the market to settle on the socially optimal quantity of?**

**A) 100**

**B) 20**

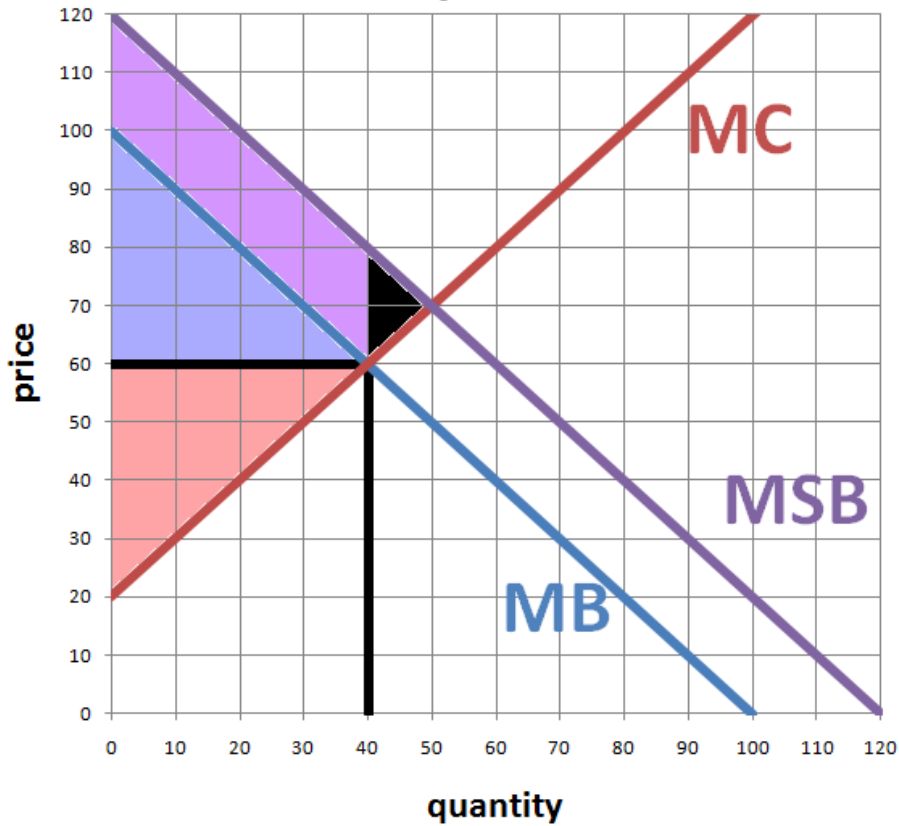
**C) 1**

**D) 40**

**E) 0**

# graphs for questions 11-13

## market equilibrium



## social optimum

