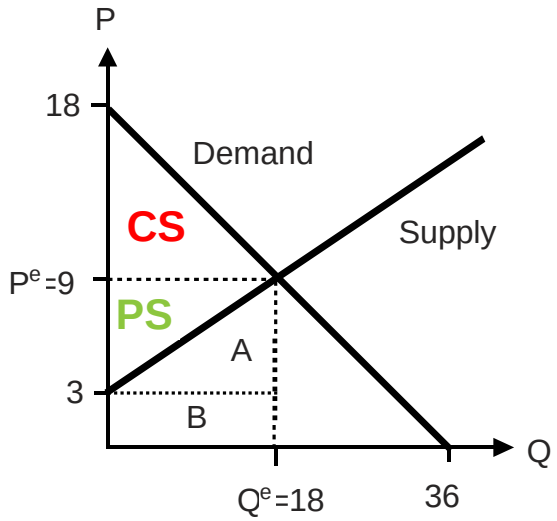
Microeconomics and mathematics (with answers)

7 Consumer surplus and producer surplus

Consumer surplus (CS)

CS is the difference between the price consumers are willing to pay and the price actually paid.



Demand: $P = f(Q) = 18 - \frac{1}{2}Q$

CS $= \frac{(18 - 9) * 18}{2} =$ **81**

Formula **CS** $= \int_0^{Q^e} f(Q)dQ - P^e*Q^e$

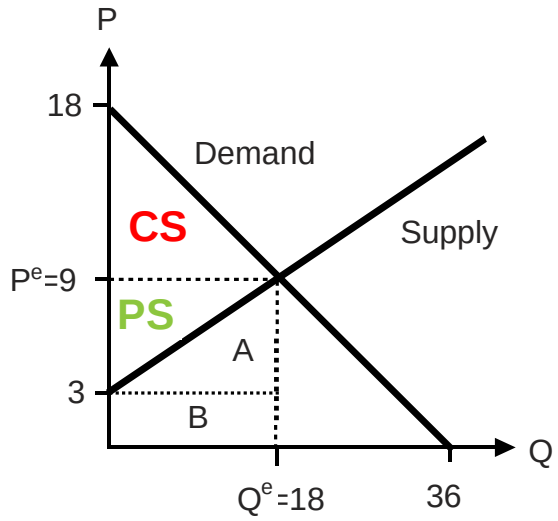
CS again $= \int_0^{18} (18 - \frac{1}{2}Q)dQ - P^e*Q^e$

$= 18Q - \frac{1}{4}Q^2 - P^e*Q^e$

$= 18*18 - \frac{1}{4}*18^2 - 9*18$ **= 81**

Producer surplus (PS)

PS ist difference between the price actually paid and the price producers are willing to get paid.



Supply: $P = g(Q) = 3 + \frac{1}{3}Q$

PS $= P^e*Q^e - A - B$

$= 9*18 - \frac{(9 - 3) * 18}{2} - 3*18$ **= 54**

or PS $= \frac{(9 - 3) * 18}{2}$ **= 54**

Formula **PS** $= P^e*Q^e - \int_0^{Q^e} g(Q)dQ$

PS again $= P^e*Q^e - \int_0^{Q^{18}} (3 + \frac{1}{3}Q)dQ$

$= P^e*Q^e - 3Q - \frac{1}{6}Q^2$

$= 9*18 - 3*18 - \frac{1}{6}18^2$ **= 54**

7.1 **Consumer surplus (CS)**

Demand: $P = 15 - Q$ ($P^e = 9$)

Calculate consumer surplus (diagram and formula).

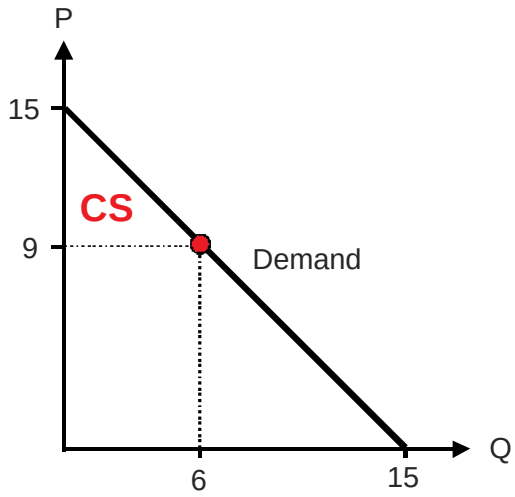
7.2	**Consumer surplus (CS)** Demand: $P = 32 - Q - \frac{1}{10}Q^2$ $(Q^e = 10)$ Calculate consumer surplus (formula).
7.3	**Producer surplus (PS)** Supply: $P = 5 + 2Q$ $(Q^e = 4)$ Calculate producer surplus (diagram and formula).
7.4	**Producer surplus (PS)** Supply: $P = \frac{1}{2}Q^2 + Q + 2$ $(P^e = 26)$ First calculate Q^e (quadratic equation), then calculate producer surplus (formula).
7.5	**Consumer surplus (CS) and producer surplus (PS)** Demand: $P = 32 - 8Q_d$ Supply: $P = 12 + 2Q_s$ Calculate consumer surplus and producer surplus at the market equilibrium.
7.6	**Consumer surplus (CS) (Monopoly vs competition)** Demand (monopoly): $P = AR = 30 - 2Q$ Marginal cost (MC) of the monopolist = 12 7.61 Calculate Q and P if the monopolist targets a maximum profit. 7.62 Calculate consumer surplus: Monopoly vs competition Monopoly: $P > MC$ Competition: $P = MC$ [We assume that in the case of competition demand and marginal cost are the same as in the case of monopoly.] 7.63 Graph 7.61 and 7.62 in the same diagram and verify both CS.
7.7	**Consumer surplus (CS), producer surplus (PS) and the effects of a per unit tax** Demand: $P = 240 - 6Q_d$ Supply: $P = 120 + 4Q_s$ Answering 7.71 and 7.72 graph two different diagrams. 7.71 Calculate consumer surplus and producer surplus at the market equilibrium. 7.72 Now a new per unit tax of 20 is introduced. Calculate the tax receipts and the new CS, the new PS as well as the deadweight loss.

→ Answers. Click here!

Answers *Microeconomics* and mathematics

7 Consumer surplus and producer surplus

7.1 Consumer surplus (CS)



Q^e: → $9 = 15 - Q^e$ → $Q^e = 6$

CS = $\frac{(15 - 9) * 6}{2}$ = **18**

CS = $\int_0^6 (15 - Q)\,dQ$ - $P^e*Q^e = 15Q - \frac{1}{2}Q^2 - P^e*Q^e = 15*6 - \frac{1}{2}6^2 - 6*9 = 90 - 18 - 54$ **= 18**

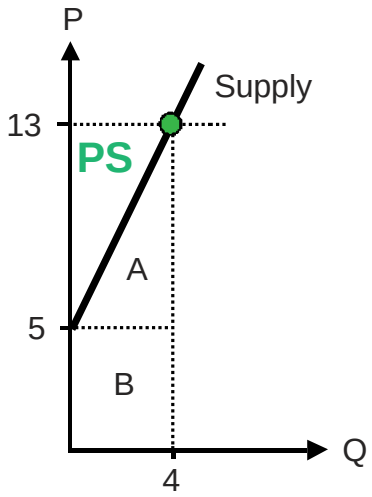
7.2 Consumer surplus (CS)

$P^e = 32 - 10 - \frac{1}{10}10^2 = 12$

CS = $\int_0^{10} (32 - Q - \frac{1}{10}Q^2)\,dQ$ - $P^e*Q^e = 32Q - \frac{1}{2}Q^2 - \frac{1}{30}Q^3 - P^e*Q^e$

= $32*10 - \frac{1}{2}10^2 - \frac{1}{30}10^3 - 12*10 = 320 - 50 - 33\frac{1}{3} - 120$ **= $116\frac{2}{3}$**

7.3 Producer surplus (PS)



$P^e = 5 + 2*4 = 13$

7.3 cont.

PS = P^e*Q^e - A - B = 13*4 - $\frac{4*8}{2}$ - 4*5 = 52 - 16 - 20 **= 16**

PS = P^e*Q^e - $\int_0^4 (5+2Q)dQ$ = 13*4 - 5Q - Q^2 = 52 - 5*4 - 4^2 = 52 - 20 - 16 **= 16**

7.4

Producer surplus (PS)

Q^e

- 26 = $0.5Q^2$ + Q + 2
  - $0.5Q^2$ - Q + 24 = 0
  Q^2 + 2Q - 48 = 0
- Factorization:
  (Q + 8)*(Q - 6) = 0
  (Q_1 = - 8 < 0) → (Q must be positive.))
  Q_2 = 6
  Q^e = 6
- Formula:
  $\frac{-b \pm \sqrt{b^2-4ac}}{2a}$ = $\frac{-2 \pm \sqrt{2^2+4*48}}{2}$ = $\frac{-2+14}{2}$ = 6 and ($\frac{-2-14}{2}$ = -8)
  Q^e = 6

PS = P^e*Q^e - $\int_0^6 (\frac{1}{2}Q^2+Q+2)dQ$ = 26*6 - $\frac{1}{6}Q^3$ - $\frac{1}{2}Q^2$ - 2Q = 156 - $\frac{1}{6}6^3$ - $\frac{1}{2}6^2$ - 2*6
= 156 - 36 - 18 - 12 **= 90**

7.5

Consumer surplus (CS) and producer surplus (PS)

- Market equilibrium:
  Q^e: 32 - $8Q^e$ = 12 + $2Q^e$
  $10Q^e$ = 20
  Q^e = 2
  P^e = 32 - 8*2 = 16
- **CS** = $\int_0^2 (32-8Q)dQ$ - P^e*Q^e = 32Q - $4Q^2$ - 16*2 = 32*2 - $4*2^2$ - 32
  = 64 - 16 - 32 **= 16**
- **PS** = P^e*Q^e - $\int_0^2 (12+2Q)dQ$ = 16*2 - 12Q - Q^2 = 32 - 12*2 - 2^2 **= 4**

7.6

Consumer surplus (CS) (Monopoly vs competition)

7.61 Q and P if maximum profit as target

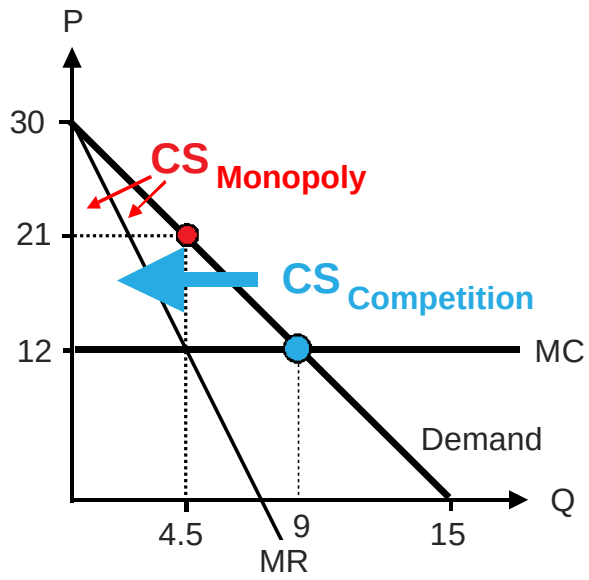
- AR = 30 - 2Q
  TR = 30Q - $2Q^2$
  MR = 30 - 4Q
- MC = MR
  12 = 30 - 4Q
  4Q = 18
  Q = 4.5
  P = 30 - 2*4.5 **= 21**

7.6 cont.

7.62

- Prices Monopoly: 21 Competition: 12
  Quantities Monopoly: 4.5 Competition: 12 = 30 - 2Q = 9
- **CS Monopoly** = $\int_0^{4.5} (30 - 2Q)\,dQ$ - P^e*Q^e = 30Q - Q^2 - 21*4.5
  = 30*4.5 - 4.5^2 - 94.5 = 135 - 20.25 - 94.5 **= 20.25**
- **CS Competition** = $\int_0^{9} (30 - 2Q)\,dQ$ - P^e*Q^e = 30Q - Q^2 - 12*9
  = 30*9 - 9^2 - 108 = 270 - 81 - 108 = **81**

7.63



CS Monopoly:

$\frac{(30 - 21) * 4.5}{2}$ **= 20.25**

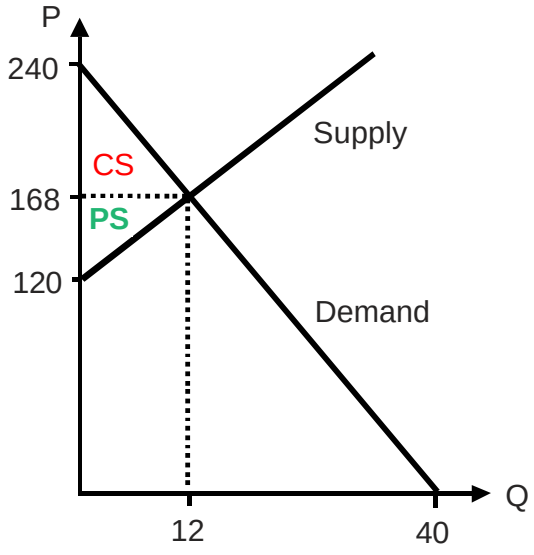
CS Competition:

$\frac{(30 - 12) * 9}{2}$ **= 81**

7.7

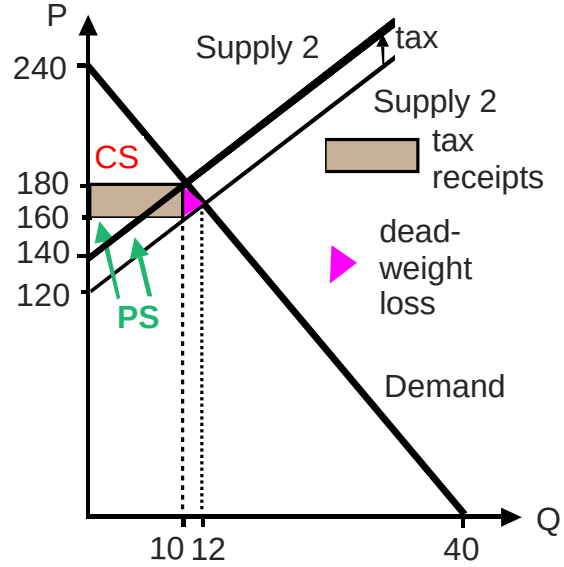
CS, PS and the effects of a per unit tax

7.71



CS = 0.5*(240 - 168)*12 **= 432**
PS = 0.5*(168 - 120)*12 **= 288**
CS + PS = 432 + 288 = 720

7.72



CS = 0.5*(240 - 180)*10 **= 300**
PS = 0.5*(160 -120)*10 **= 200**
Tax receipts = 10*20 **= 200**
Deadweight loss = 720-300-200-200 **= 20**

→ Back to questions. Click here!