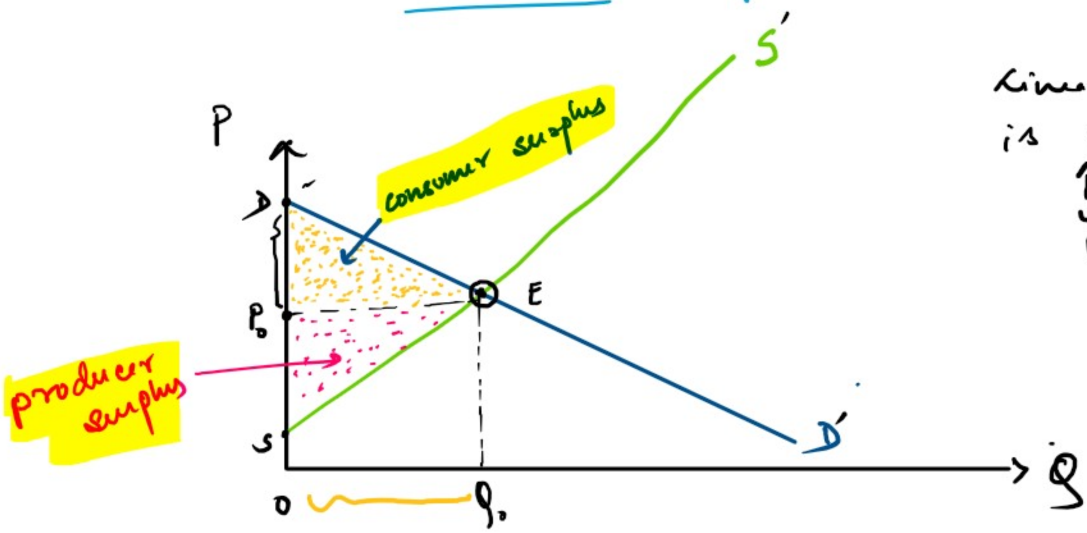
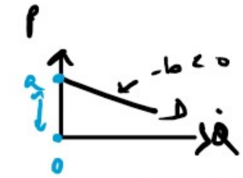
06 December 2023 07:11 PM

Consumers' Surplus and Producers' Surplus



Linear demand function is $P = a - bQ$

$P \to y$; a: Max willingness to pay $(P = a \Rightarrow Q = 0)$; slope $= \frac{\partial P}{\partial Q} = -b < 0$



Linear supply curve.

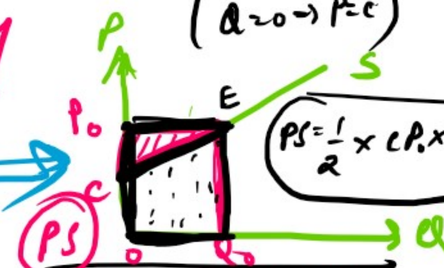
$P = c + dQ$

c: min acceptance price $(Q = 0 \Rightarrow P = c)$

Def: The consumer surplus can be defined as the difference between the maximum willingness to pay and the actual/market/equilibrium price paid by a consumer for any unit of a commodity bought.

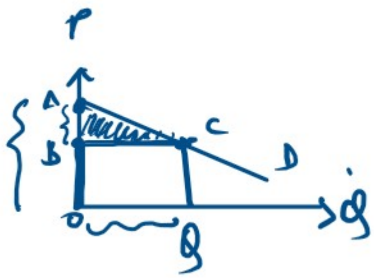
Formula:

$$\boxed{PS = P \times Q - \int_0^Q S(Q)\,dQ}$$



$\boxed{PS = \frac{1}{2} \times CP_0 \times EP_0}$

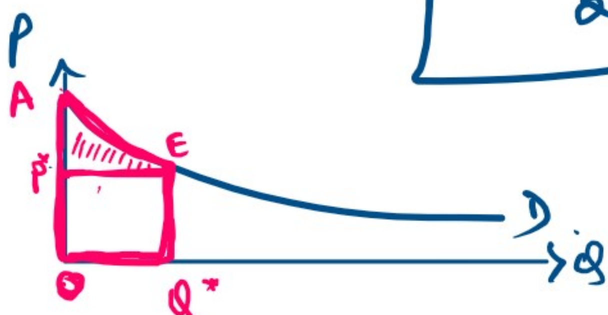
Def: diff b/w min acceptance price of seller and actual/market/equil price the seller received



CS = area of Δ ABC

$= \frac{1}{2} \times BC \times AB$

$$\boxed{CS = \frac{1}{2} \times OQ \times (OA - OB)}$$



$$CS = \int_0^{Q^*} D(Q)\,dQ - (OQ^* \times OP^*)$$

$= \text{area } AP^*E$

Q Suppose the demand and supply function of a product is given by $P_d = 20 - 3Q$ ✓

and $P_s = 5 + 2Q$ ✓

Find out the equilibrium price and quantity in the market. Calculate total consumer surplus. Represent it diagramatically. Also calculate producer's surplus.

Given a linear demand fn : $P^d = 20 - 3Q$

and a linear supply fn : $P^s = 5 + 2Q$

We know in market equilibrium.

$$P^d = P^s$$

$$\text{or } 20 - 3Q = 5 + 2Q$$

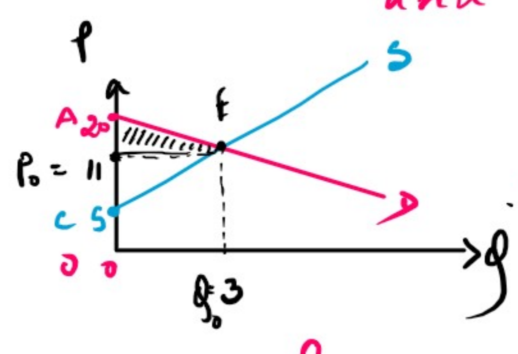
$$\text{or, } \boxed{Q = 3 \text{ units}}$$ ✓

∴ equilibrium Quantity is 3 units

and equil price is $P = 5 + 2 \times 3$

$$= 5 + 6$$

$$\boxed{P = 11}$$



∴ consumer surplus = area △ P_0AE

$= \frac{1}{2} \times P_0A \times P_0E$

$= \frac{1}{2} \times (20 - 11) \times 3$

$= \frac{1}{2} \times 9 \times 3$

$$\boxed{CS = \frac{27}{2} = 13\frac{1}{2}}$$ (ans)

OR $CS = \int_0^Q D(Q)\,dQ - P \times Q$

$= \int_0^3 (20 - 3Q)\,dQ - (11 \times 3)$

$$= \int_0 (20-3Q)\,dQ - (11\times 3)$$

(ans)

$$= 20[Q]_0^3 - 3\left[\frac{Q^2}{2}\right]_0^3 - 33$$

$$= 20(3-0) - \frac{3}{2}[3^2-0^2] - 33$$

$$= 60 - \frac{27}{2} - 33$$

$$\boxed{CS = 13.5 \text{ (ans)}}$$

same answer.

And Producer's surplus = area ΔCP_0E

$$= \frac{1}{2} \times CP_0 \times P_0E$$

$$= \frac{1}{2} \times (11-5) \times 3$$

$$= \frac{1}{\cancel{2}} \times \cancel{6}^{\,3} \times 3$$

$$= \underline{9 \text{ units (Ans)}}$$

OR $PS = P\times Q - \int_0^Q S(Q)\,dQ$

$$= (11\times 3) - \int_0^3 (5+2Q)\,dQ$$

$$= 33 - 5(Q)_0^3 - 2\left(\frac{Q^2}{2}\right)_0^3$$

$$= 33 - 5\times 3 - \frac{2}{2}(3^2-0^2)$$

$$= 33 - 15 - 9$$

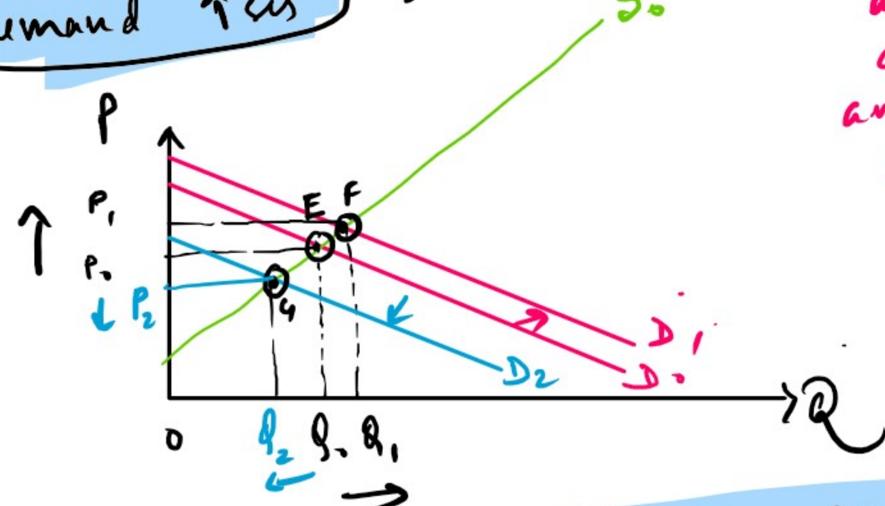
$$= \underline{9 \text{ (ans)}}$$

— * —

changes in Market Equilibrium

Case 1: When supply remain same and only demand will change

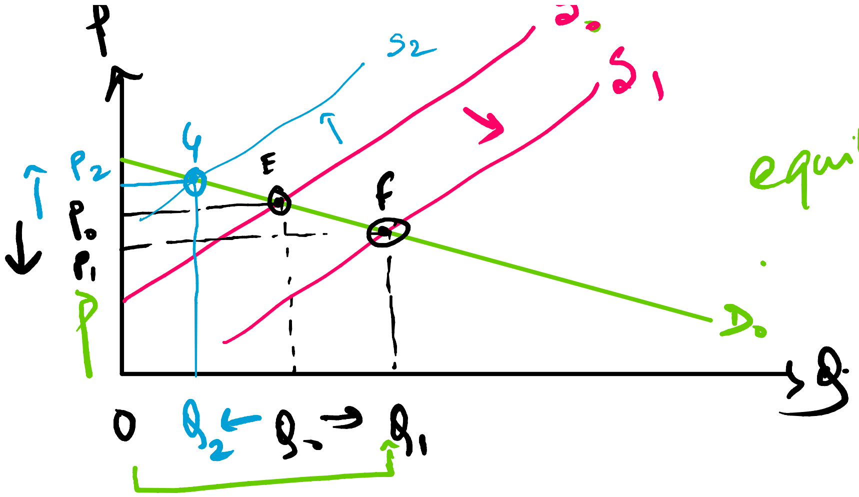
A. demand ↑ses → demand curve shifts to right (D_1)
↓
and both equilibrium price and equilibrium quantity increases to maintain the market equil.



B. Demand ↓ses → demand curve shifts to left (D_2)
↓
both the equilibrium price and equilibrium quantity will decrease to maintain market equilibrium.

Case 2: If demand remains same while the supply changes.

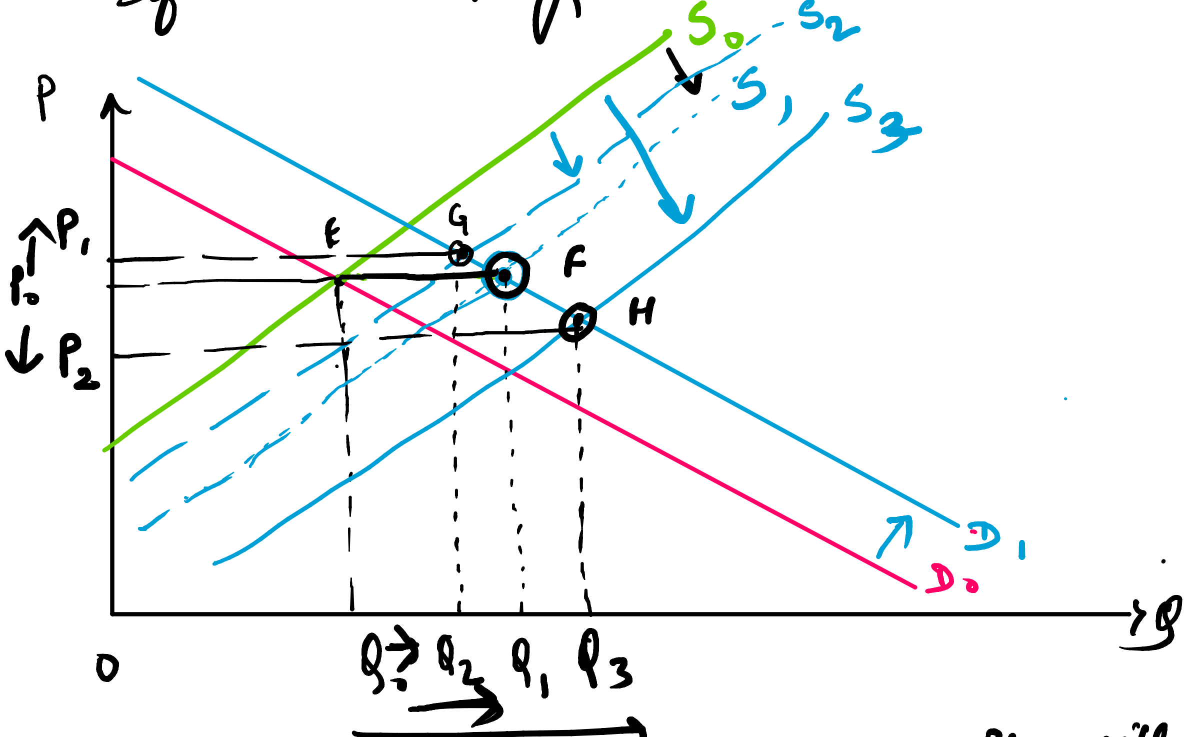
A. Let supply increase → supply shifts to the right (S_0)
↓
to maintain market equilibrium,



to maintain market equilibrium, equil quantity increases to OQ_1

but equilibrium price decreases to OP_1.

Case 3: If both supply and demand increases.



equilibrium Quantity is determined - it will increase
equilibrium Price is undetermined - it will remain same, increase or decrease.

HW: $\boxed{\text{Both supply and demand shift to left}}$

Conclusion: If both demand and supply ... in same direction

Conclusion: If both demand … changes in same direction the ~~Q~~ equilibrium quantity is determined but equilibrium price is undetermined.