Midterm #2 : May 18 (Supply Side focus)

Perfect competition
- many firms - open entry + exist
- Same goods
- Price takers

· Firms review :

* firms in input + output market *

cost ← input ; output → revenue ($q \times p$) — p = selling price

↳ Constraints :

(1) technology - what + how much can be produced - feasibility constraint

(2) Market - demand quantity + prices (how is this set?!)

· Perfect competition :

* agents take market $\boxed{\text{price as given}}$ - Price takers! *

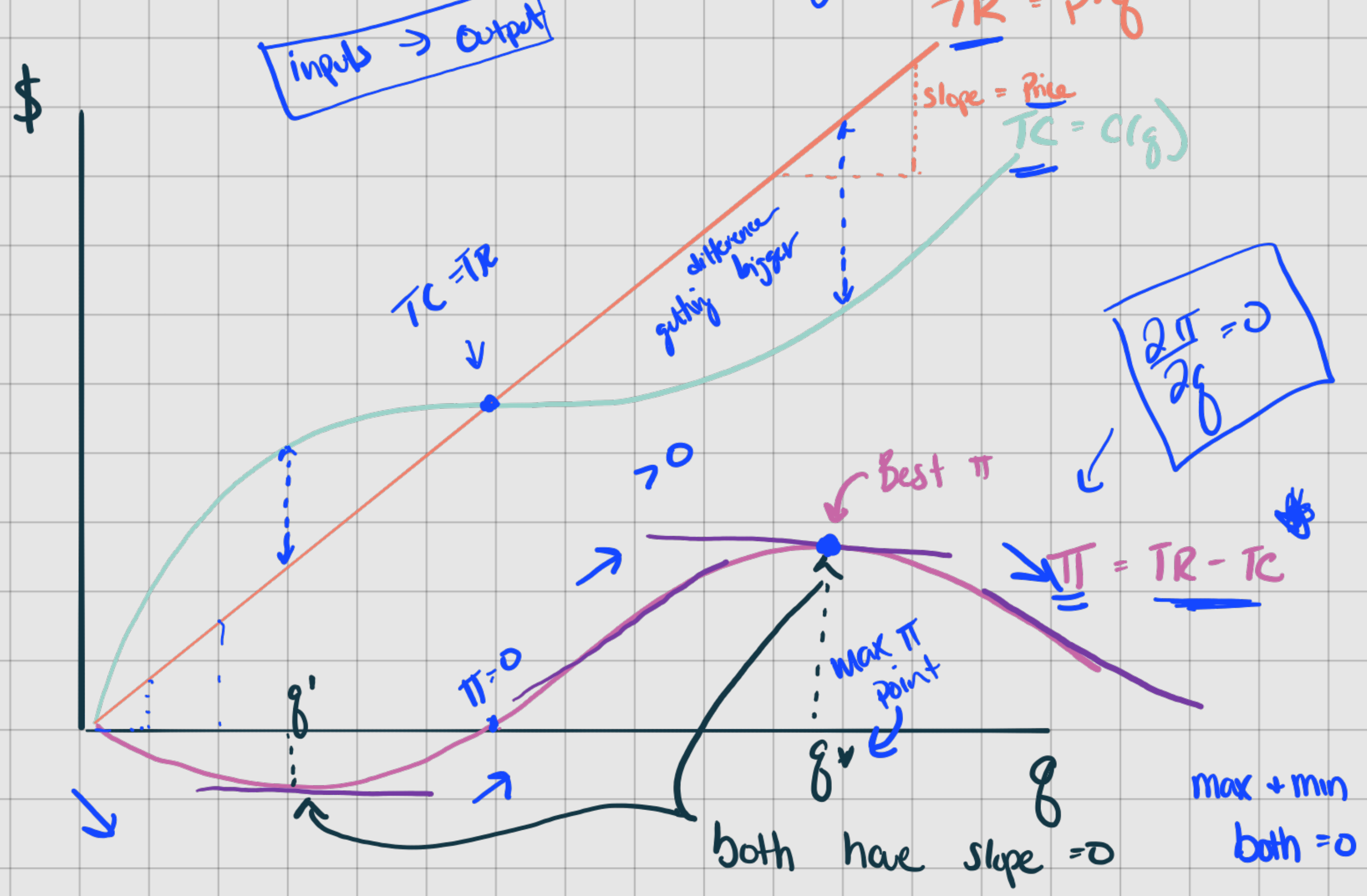
$9 ~~$16~~ ~~$100~~

· what happens if firms set a higher price?

↳ ∴ they know how much to charge but not how much to produce!

(charge ↑ given)

$\boxed{\text{inputs} \rightarrow \text{output}}$



Profit Maximization Problem - finding q^*

$$\frac{\partial(\overset{TR}{P\cdot q} - \overset{TC}{c(q)})}{\partial q} = 0$$

· how to find q^* only + not q'

$P - mc = 0$

$\boxed{P = mc}$

(1) first order condition $\frac{\partial \pi}{\partial q} = 0$ (π = TR - TC)

first derivative

· min + max

$$\frac{\partial(P - mc)}{\partial q} < 0$$

(2) second order condition $\frac{\partial^2 \pi}{\partial q^2}$ $\boxed{< 0}$ ($\frac{\partial^2 \pi}{\partial q^2} = \partial(\frac{\partial \pi}{\partial q})$)

(diminishing)

second derivative

getting larger

switch sign

$$- \frac{\partial mc}{\partial q} < 0$$

larger than 0

$$\boxed{\frac{\partial mc}{\partial q} > 0}$$

Δ in π for each incremental increase in q is getting bigger

↳ Now that we have introduced π need to consider WHEN TO OPERATE (operate / shut down condition)

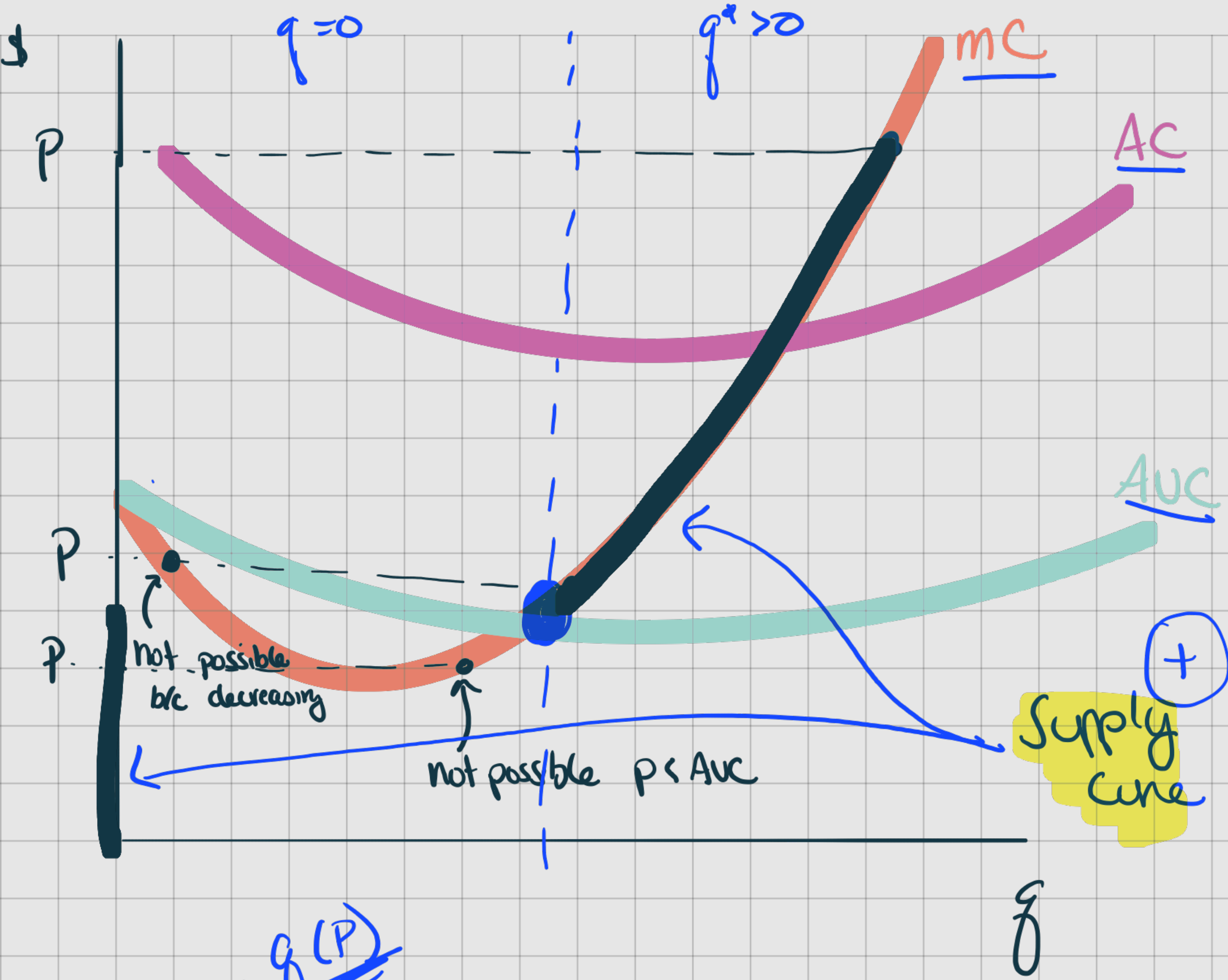
	(Operate) $q^* > 0$	(Shut down) $q = 0$
π	$\underbrace{P\cdot q}_{TR} - \underbrace{c(q)}_{TC}$ $= P\cdot q - (VC + \cancel{F})$	$-F$ $\cancel{-F}$

$\boxed{P\cdot q - VC}$	$\boxed{0}$
Pq	VC
P	$VC/q = AVC$

Comparisons

→ if $\boxed{P \geq AVC}$ OPERATE $q^* > 0$

operating condition



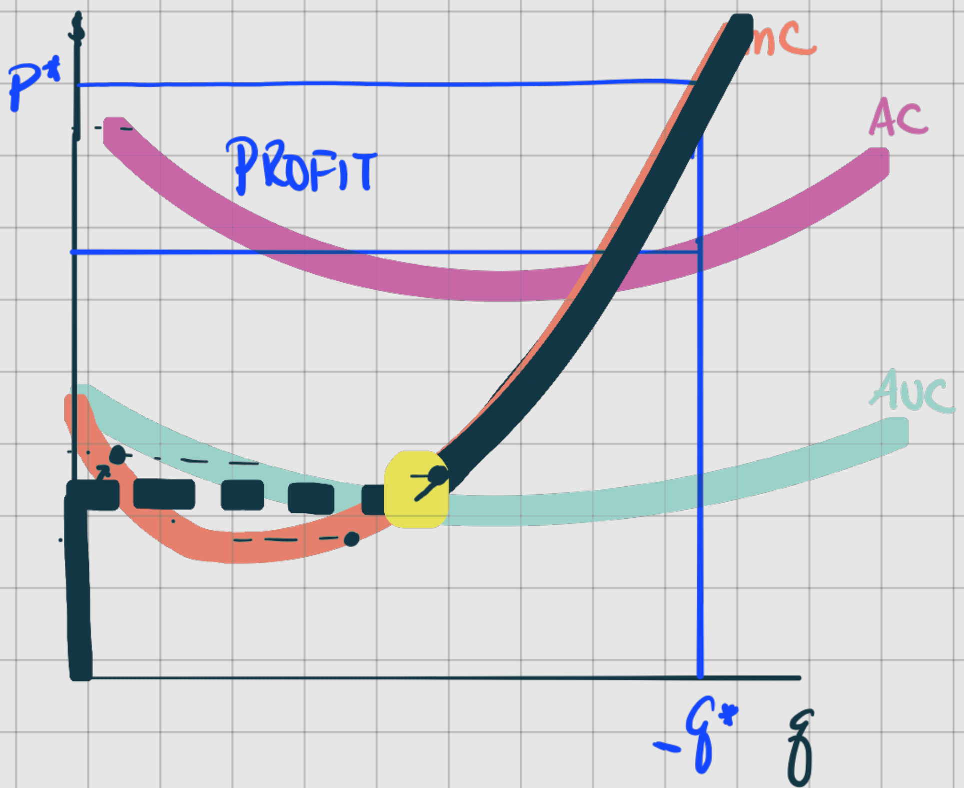
$q(P)$

⇒ Supply curve : $\begin{bmatrix} p = mc & \text{if} & P \geq \min AVC \\ q = 0 & \text{if} & P < \min AVC \end{bmatrix}$

* inverse supply curve * solves for P

$q^{-1}(P)$

$p(q)$



Steps to find supply curve:

1) find MC
2) set MC = P
3) compare MC vs AVC
4) Supply curves

ex: $\boxed{C(q) = q^2+1}$

$MC = 2q$ ← $P(q)$ ← inverse supply curve

market price $P = 2q$

$2q > q$ $\therefore$ $\boxed{MC > AVC}$

rearrange

$q = \frac{P}{2}$ ← supply curve $q(P)$

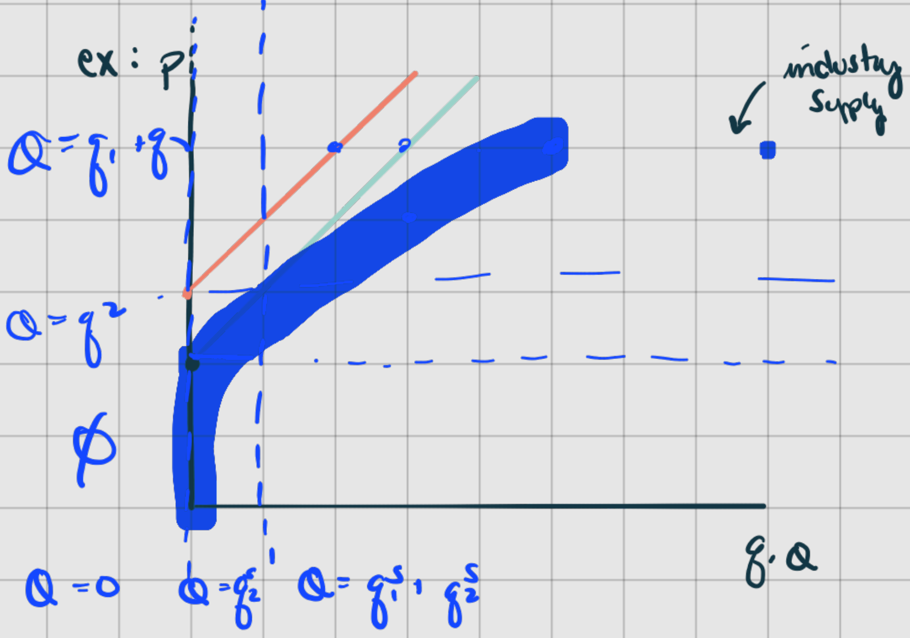
Short Run - $\boxed{\text{Industry supply}}$ in PC

↳ number of firms is fixed!

summing across

$$Q = \underline{q_1^s(p)} + \underline{q_2^2(p)} + \dots + \underline{q_n^2(p)} \; \boxed{= \sum_{i=1}^{i=n} q_i^s(P)}$$

* different to firm * SR where $k = \bar{k}$

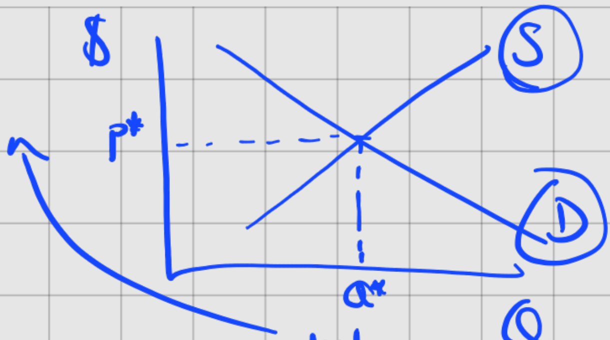


$q_1^s = P - 3$ $\quad$ $P = q + 3$

$q_2^s = P - 2$ $\quad$ $P = q + 2$

$Q = q_1^s + q_2^s$ ⇒ horizontal summation

Market Equilibrium



not a single firm for all the industry what firms will take

$$\boxed{P^* \text{ s.t. } Q^d = Q^s}$$

ex: SR w linear + fixed n

$Q^d = a - bp$ $\qquad$ $Q^s = c + dp$

Steps

1) $\boxed{Q^d = Q^s}$

$Q^d \qquad Q^s$

$$a - bp = c + dp$$

$$P^* = \frac{a-c}{d+b}$$

point where $Q^s = Q^d$

2) find q^*

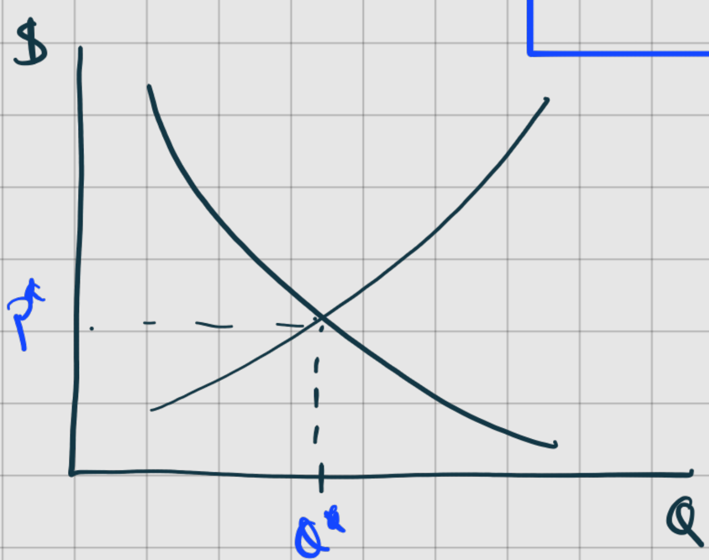
$$Q^d = a - b\left(\frac{a-c}{d+b}\right)$$

Plug into either Q^d or Q^s

$$= a\left(\frac{d+b}{d+b}\right) - b\left(\frac{a-c}{d+b}\right)$$

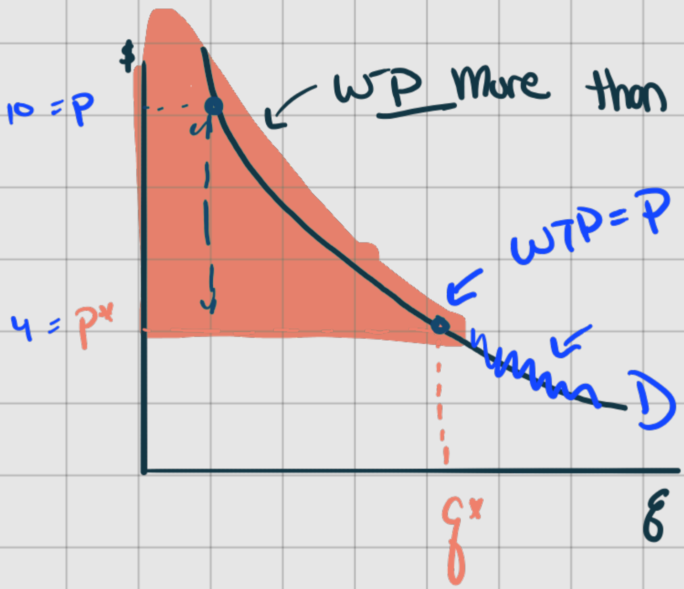
$$= \frac{ad + \cancel{ba} - \cancel{ba} - bc}{d+b}$$

$$\boxed{Q^* = \frac{ad - bc}{d+b}}$$

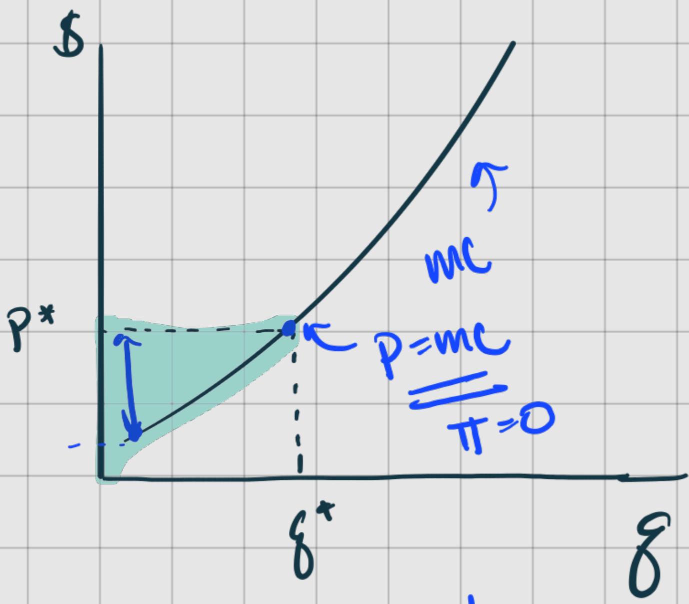


Economic Surplus

Consumer Surplus



Producer Surplus



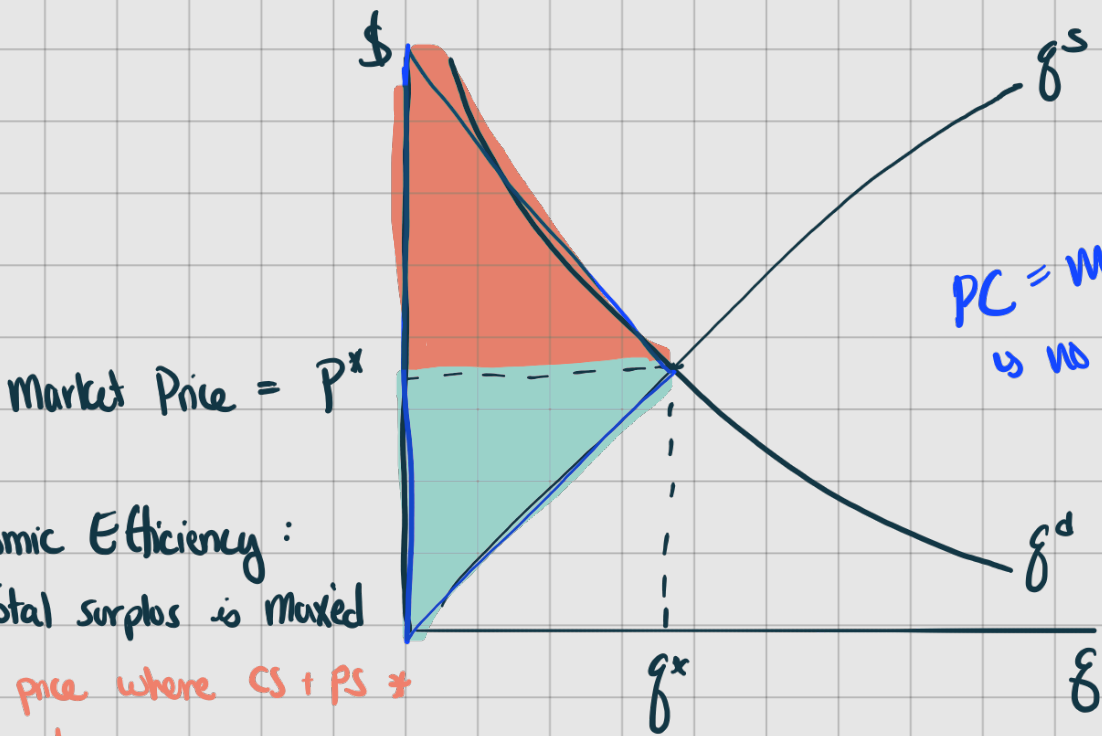
↳ difference b/w consumer WTP & P they actually pay

⇒ Consumer welfare

↳ difference b/w WTA & Price they charge

⇒ producer benefit

total Surplus



PC = max TS

↳ no inefficiency in market

Economic Efficiency:

⇒ Total surplus is maxed

* no price where CS + PS is higher *

↳ Taxes in SR

w/o taxes p^* $p^d = p^s$

w taxes $p^*(t)$ ∴ $p^d > p^s$

1) Quantity tax

$ tax / unit

$\$t$ tax ∴ $\boxed{p^d = p^s + t}$

2) Value tax

% of value of good

$t\%$ ∴ $P_d = (1+t) P_s$

⇒ Equilibrium w taxes:

p^* + Q^* same for Both

(i) $Q^d(P_d) = Q^s(P_s)$

(ii) $P_d = P_s + t$ if quantity

$P_d = (1+t) P_s$ if value

* who pays the tax? *

↳ doesn't matter if seller or buyer

Burden will be distributed b/w seller + buyer

ex: $Q^d(P_d) = a - bP_d$

$Q_s(P_s) = c + dP_s$

Q tax: $P_d = P_s + t$

find p^* w tax, Q^* w tax

$Q_d = Q_s$

$a - b\boxed{P_d} = c + d\boxed{P_s}$

sub tax Price

1 eq 1 unknown → $a - b(P_s + t) = c + dP_s$

$a - c - bt = P_s(d+b)$

$p^* <$ $P_s^* = \dfrac{a - c - bt}{d+b}$

$P_d^* = P_s + t$ $> p^s$

$= \dfrac{a - c - bt}{d+b} + t$

↓

Q^d

$Q_s^* = c + d\left(\dfrac{a - c - bt}{d+b}\right)$

$\cancel{c}d + cb$

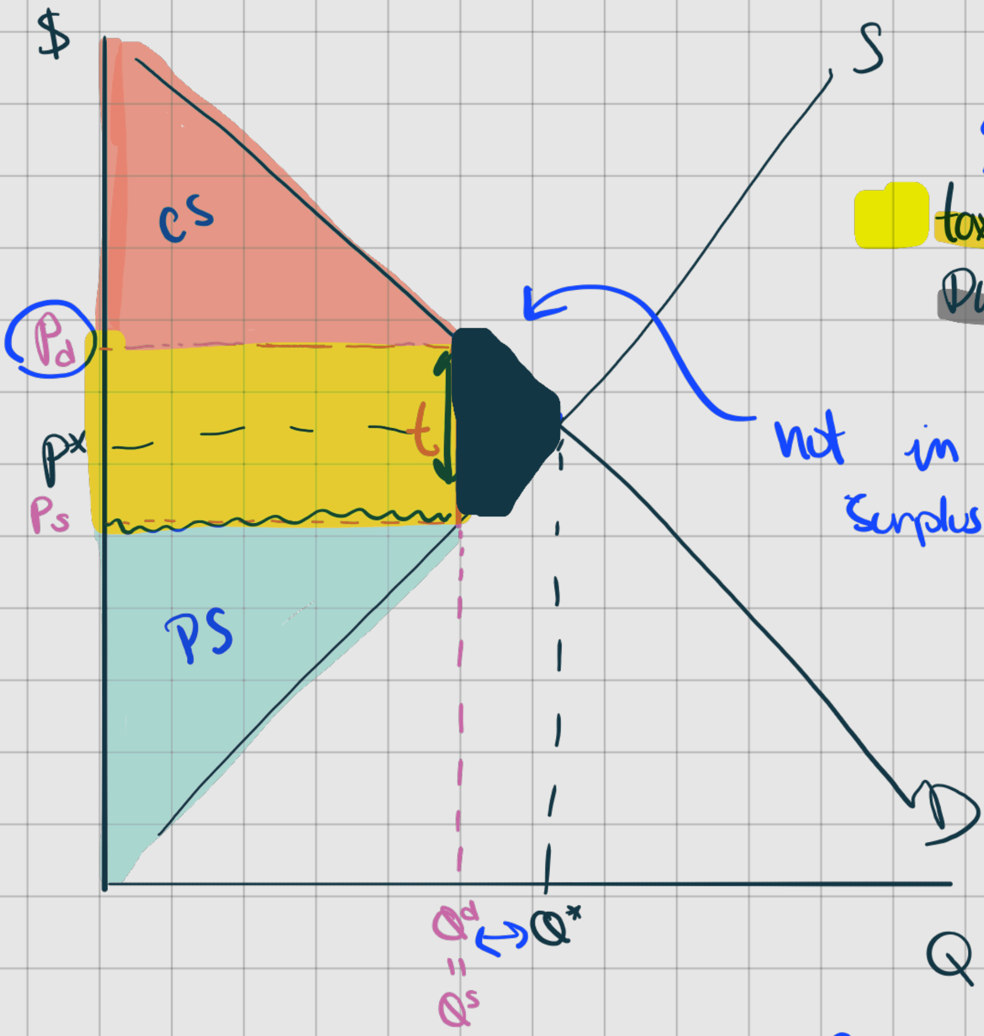
$= c + \dfrac{da - \cancel{dc} - dbt}{d+b}$

$= \dfrac{cb + da - dbt}{d+b} < Q^*$

difference from above

* w taxes Q^* w tax $< Q^*$

$P_d \geq P^* > P_s$



inefficiency

tax Revenue $(Q \times t)$

DWL (lost!)

not in economic surplus any more

$(P^d - P^s)$

$$= (Q^* - Q^d) \cdot T \cdot \frac{1}{2}$$

area of DWL

$Q^{*\,tax} < Q^*$

(Q2) SR $TC = 400 + Q + 4Q^2$ 2,4,6

$\uparrow$ FC $\quad$ VC $\Rightarrow$ depends on Q

1) AVC?

$$AVC = \frac{VC}{Q} = \frac{Q + 4Q^2}{Q} = 1 + 4Q$$

compare MC & AVC

2) Operating condition : $MC \geq AVC$

$$MC = 1 + 8Q \quad \left(\frac{\partial AVC}{\partial q}\right) \quad \therefore \text{ if } \cancel{1} + 8Q \geq \cancel{1} + 4Q \quad \boxed{q^* > 0}$$

when does this hold?

3) Supply function

SR Supply curve $\Rightarrow$ $\boxed{P = MC}$

$$\boxed{MC \text{ rising} : \frac{\partial MC}{\partial q} = 8 > 0}$$

inverse supply $P = Q$

$$P^* = 1 + 8Q$$

$$\boxed{Q^s = \frac{P-1}{8}} \quad Q(P)$$

4) Min operating Price

$\Rightarrow$ firm operates if $Q > 0$ $\therefore$ $0 = \frac{P-1}{8}$

$P = 1$ - if the market price is greater than 1, they they can operate

(Q4) LR MC $= 30 - 12Q + 3Q^2$

LR AC $= 30 - 6Q + Q^2$

$Q^d = 300 - 10P$

> DNK TC AFC

1) inverse $\boxed{\text{LR Supply curve}}$ & min $\boxed{\text{operate Price}}$

$P = MC = 30 - 12Q + 3Q^2$

↳ operate if $\boxed{MC \geq AC}$

$$30 - 12Q + 3Q^2 \geq 30 - 6Q + Q^2$$

$$-6Q + 2Q^2 \geq 0$$

$$Q^2 - 3Q \geq 0$$

$$Q(Q-3) \geq 0$$

$Q = 0$ $\quad$ $\boxed{Q = 3}$

$P^* = 30 - 12(3) + 3(3)^2 = \$21$

∴ for all $P^* \geq 21$ the LR Supply inverse curve $P^S = 30 - 12Q + 3Q^2$

($Q(P)$

2) Q^*

$\boxed{AC = MC}$ ⇒ in Perfect Comp no π

$\boxed{Q^* = 3}$

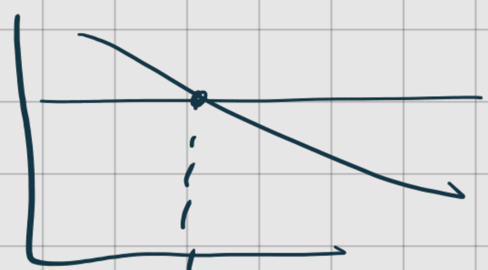
3) P^* $\quad P = 21$

4) LR Supply curve is flat at a price that min cost ($MC = AC$)

$P^S_{industry} = 21$

* Price takers

P^{21}



5) Q^d

how many produces.

$$\boxed{\begin{aligned} Q^d &= 300 - 10(21) \\ &= 90 \end{aligned}}$$

↳ each firm has $q^* = 3$ ∴ $\frac{90}{3}$ $\boxed{30 \text{ firms}}$

need 30 firms to reach industry demand

(Q6) $Q^S = P^S$

$Q^D = 60 - P^d$

1) P^* Q^* ?

$$Q^S = Q^D$$

$$P = 60 - P$$

$$\boxed{\begin{aligned} P^* &= 30 \\ Q^* &= 30 \end{aligned}}$$

2) tax on consumers (per unit) — Quantity tax

$Q^{*\,tax}$, P^d, P^s

$$\boxed{P^d = P_s + t}$$

$$Q^s = Q^d$$

$$P_s = 60 - (P_s + t)$$

$$\boxed{P_s = 30 - \frac{t}{2}} < P^*$$

$$P_d = 30 - \frac{T}{2} + t$$

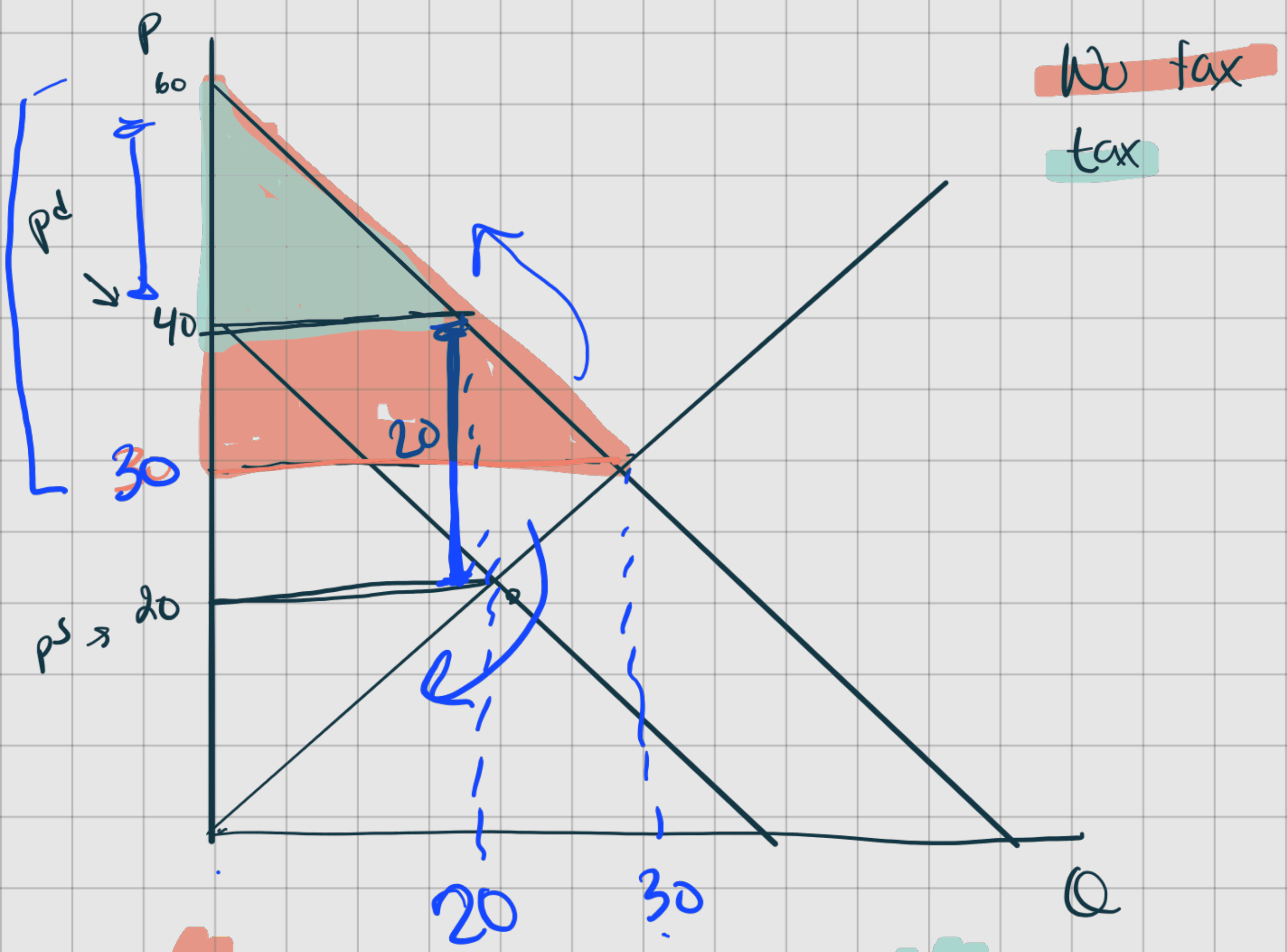
$$= 30 + \frac{t}{2} > P^*$$

$$\boxed{Q^* = 30 - \frac{t}{2}} < Q^*$$

3) $\boxed{T=20}$ ∴ P^d, P^s, Q^* tax ?

$P^s = \underline{20}$ $P^d = \underline{40}$ $Q^* = \underline{20}$

4) CS, PS



CS =

$30 \cdot 30 \cdot \frac{1}{2}$

$= 450$

CS =

$20 \cdot 20 \cdot \frac{1}{2}$

200

loss in CS 200

5) if $\boxed{Q^* = 5}$ what tax ?

$Q^* = 30 - \frac{T}{2} \Rightarrow \underline{5 = 30 - \frac{T}{2}}$ $\boxed{T = 50}$

$Q^{*} = 0$