06/12/16

DEMAND

Demand means desire for commodity or service backed by sufficient purchasing power and willingness to pay. There involves an element of time with the demand.

Factors affecting demand =)

Q) Write any 4 imp. factors determining the demand for a comodity. (2 m)

1) Price of the comodity (Price $\propto \frac{1}{\text{Demand}}$)
2) Prices of the related goods → (substitutes and complimentary goods)
   (competitive goods) ↓ either ↓ consumed together
3) Income of the consumer
   ↳ (income rises demand rises)
4) Taste, choice and preference of the consumer
5) Size of population (Population $\propto$ Demand)
6) Composition of population
7) Advertisements
8) Weather and climatic conditions
9) Price Expectation of the consumer

LAW OF DEMAND ⇒

Other things remaining constant, with the rise in the price quantity demanded goes down and vice versa

(Other things - Except the price of the commodity, all the other factors are other things)

07/11/16

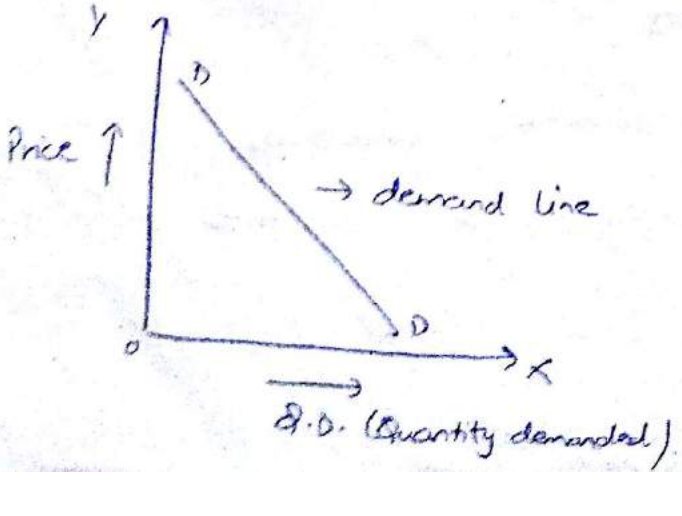
DEMAND SCHEDULE ⇒

Demand schedule is a list or a table showing different quantity demanded volumes corresponding to different/various prices.

Price	10	11	15	18	19	20
Quantity (kg) Demanded	100	90	67	50	43	34

DEMAND CURVE ⇒

$D = f(p)$ ceteris paribus ⇒ other things remaining constant.



The demand curve shows that the relationship between price and demand to be inversely proportional i.e. when the price rises demand goes down and vice versa.

- Movement along the Demand Curve
- Shifting of the demand curve

<u>Demand equation</u>:

$$Q_x = a - bP_x$$

Q - demand of 'x' commodity

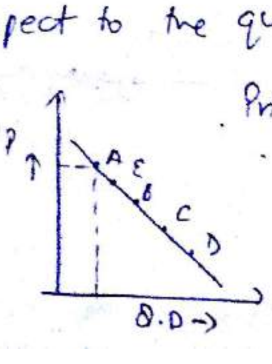
a - quantity intercept (when price is zero, what will be the quantity)

P_x - price of 'x'

b - slope

'–' → minus sign indicates that slope is negative i.e. the demand line/curve is downwards sloping in nature.

<u>Movement along the demand line</u> - At different points on the line, we get different price with respect to the quantity demanded.



Price changes leads to the movement along the demand line

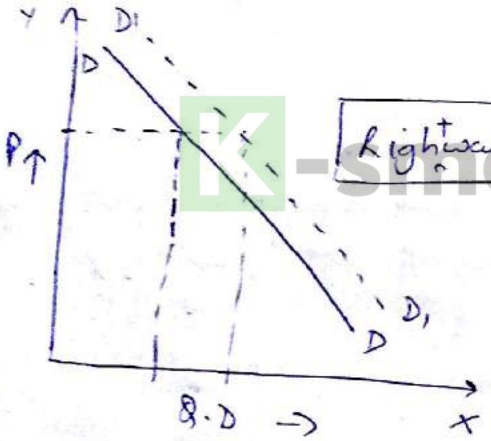
Movement along the demand curve is possible because of a change in the price only, other factors remaining constant.

<u>Shifting of the Demand line :</u>

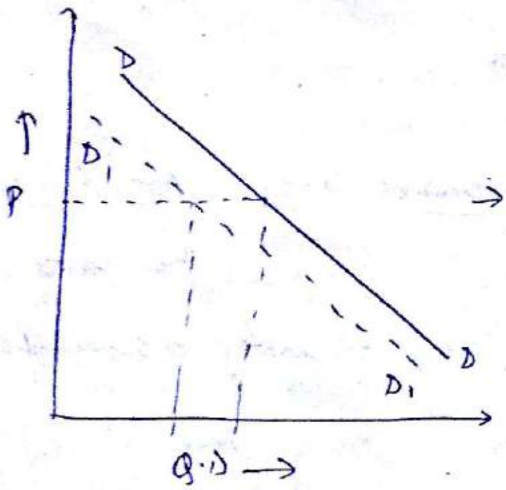
It maybe of two types -

a) Leftward shifting

b) Rightward shifting



Rightward shifting



Leftward shifting

Shifting of the demand curve is possible because of the change in the other factors, price remaining constant.

SUPPLY

Quantity of commodity offered for sale in the market at a given point of time given the prices is understood as supply.

Stock is the potential supply.

$$S = f(P) \rightarrow \text{ceteris paribus (other things remaining constant)}$$

The relationship between price and supply is positive and direct i.e. when the price increases supply increases.

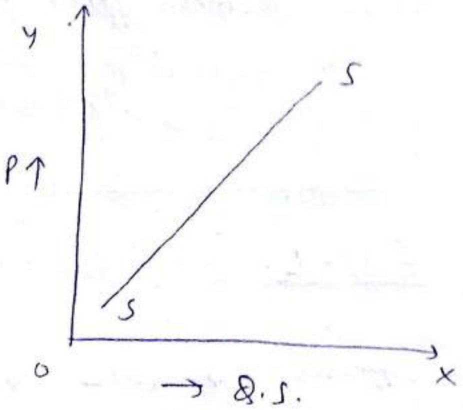
$$Q_s = c + dP$$

$c \rightarrow$ intercept

$d \rightarrow$ slope (positive)

$P \rightarrow$ price

Supply Line:



Supply schedule :-

Price	50	52	55	60	61	62
Q.S(kg)	100	120	135	155	180	200

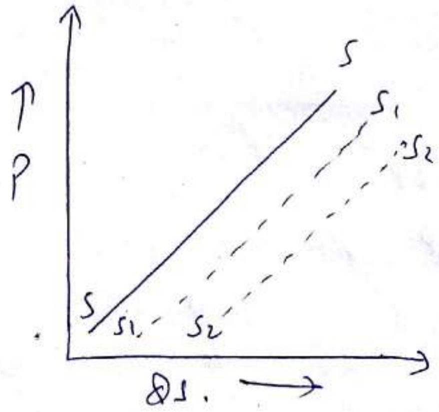
09/12/16

Factors affecting supply ⇒

1) Price of the comodity
2) Prices of the related goods
3) Cost of production
4) State of technology
5) Goal of the producer→(monopoly or competitive)
6) Means of transportation, communication, banking and insurance facilities

7) Natural factors

Supply curve may shift to the left or to the right.



→ right shifting

left shifting

Shifting of the supply curve is possible because of a change in the other factors; price remaining constant.

Movement along the supply curve is possible because of a change in the price only; other factors remaining constant.

Demand-Supply Equilibrium ⇒

Equilibrium in the market is attained, there where demand and supply are equal.

$$D = S$$

$$D = 100 - 2P$$

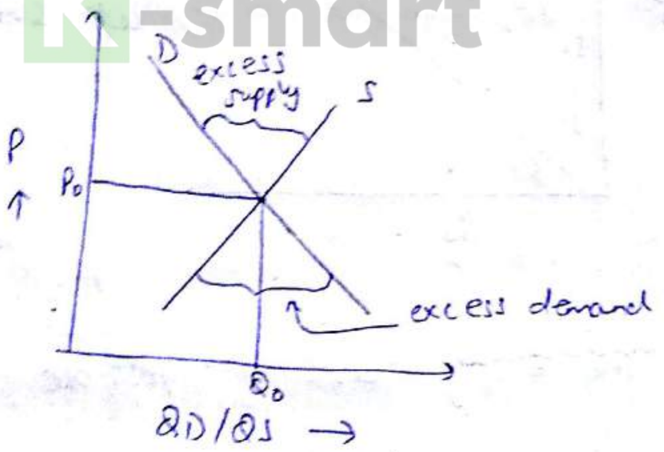
$$S = 28 + 3P$$

$$D = S$$

$$\Rightarrow 100 - 2P = 28 + 3P$$

$$\Rightarrow 5P = 72 \quad \Rightarrow P = 14.4$$

Now, $D = 71.2 = S$



$$D = a - bp$$

$$S = c + dp$$

$$D = S$$

$$a - bp = c + dp$$

$$p = \frac{a-c}{d+b}$$

~~Now putting P~~

Substituting P in D;

$$D = a - b\left[\frac{a-c}{b+d}\right]$$

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

$$D = \frac{ad + bc}{b+d}$$

P in S;

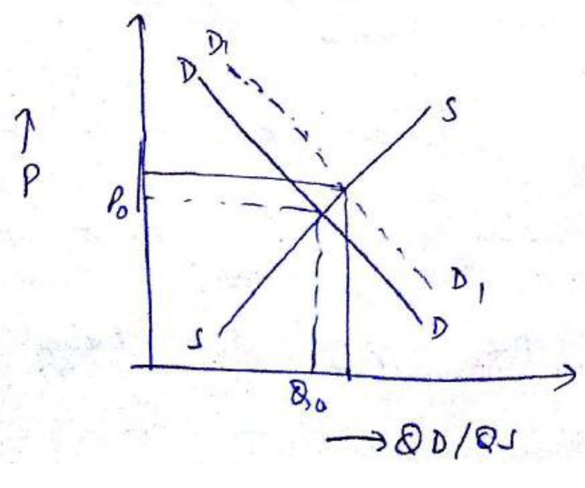
$$S = c + d\left[\frac{a-c}{b+d}\right]$$

$$= \frac{cb + \cancel{cd} + ad - \cancel{cd}}{b+d}$$

$$S = \frac{bc + ad}{b+d}$$

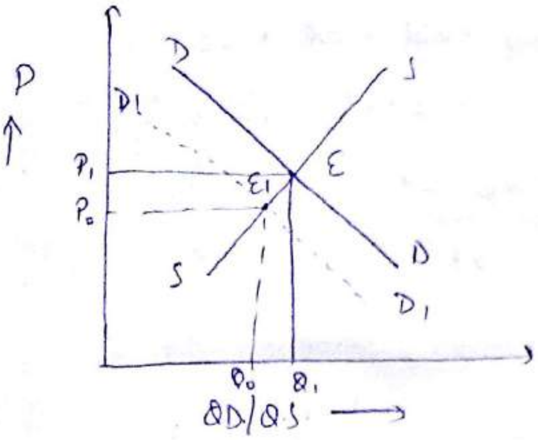
In the market, equilibrium condition is automatically restored because of either excess supply or excess demand.

If the supply condition remaining constant, there is a rightward shift in the demand condition

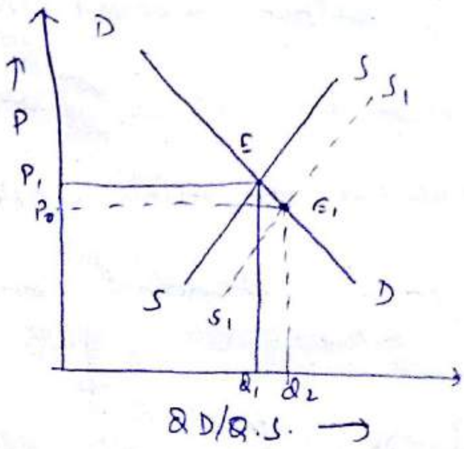


Supply will be adjusted to demand, this will result in an increase in the price.

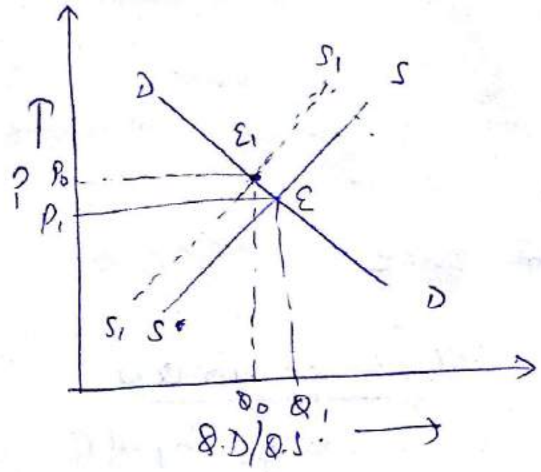
14/12/16



When the supply condition remaining constant, the demand condition shifts to the left, equillibrium will be to the left side and as a result, there will be a decrease in the price



When the demand condition remaining unchanged, the supply condition shifts to the right, demand will be adjusted to the supply but there will be a fall in the price.



When the supply condition shifts to the left the demand condition remaining constant, this will result in an increase in the price

Elasticity of Demand =>

Elasticity means degree of responsiveness.

Mainly speaking, there are 3 factors, determing the demand for a comodity. They are:-

1) Price of the comodity
2) Income of the consumer
3) Prices of the related goods.

Accordingly, we get 3 elasticity concept;

i) Price elasticity of demand ~~(ep)~~ (ep)
ii) Income elasticity of demand (ey)
iii) Cross elasticity of demand (ec)

PRICE ELASTICITY OF DEMAND :→

In this case, we measure the percentage change in the demand because of a certain change in the price.

$$e_p = \frac{\text{\% change in QD}}{\text{\% change in price}}$$

$$= \frac{\% \Delta Q}{\% \Delta P}$$

$P = 10 \quad Q = 80$

$P_1 = 12 \quad Q_1 = 61$

$$\% \Delta Q = \frac{Q - Q_1}{Q} = \frac{\Delta Q}{Q}$$

$$\% \Delta P = \frac{P - P_1}{P} = \frac{\Delta P}{P}$$

$$e_p = \frac{\Delta Q}{Q} \Big/ \frac{\Delta P}{P}$$

$$= \frac{\Delta Q}{Q} \times \frac{P}{\Delta P}$$

$$= \boxed{-\frac{\Delta Q}{\Delta P} \times \frac{P}{Q}}$$

More elastic (ex- chocolates) - more response

Less elastic - less response to change in price or any other necessary goods

(ex - salt consumption remains unchanged)

Govt. will keep control over utility services.

* If we want to calculate e_p at a particular price,

$$\lim_{\Delta p \to 0} \left\{ \frac{-\Delta Q}{\Delta P} \times \frac{P}{Q} \right\} \Rightarrow e_p = \frac{dQ}{dP} \times \frac{P}{Q}$$

Q) Studies in USA indicates that the price elasticity for cigarettes is 0.4. If a pack of cigarette currently costs 2 dollar and the govt. wants to reduce smoking by 20%. By how much should the govt. increase the price and what is the new price?

Ans

$e_p = 0.4$ $\quad P = 2$ dollars

$$e_p = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

$$e_p = \frac{\% \Delta Q}{\% \Delta P}$$

$$\Rightarrow 0.4 = \frac{20}{\% \Delta P}$$

$$\Rightarrow \% \Delta P = \frac{20}{0.4}$$

$$\Rightarrow \% \Delta P = 50$$

New price $= \frac{50}{100} \times 2 + 2$

$= 3$ dollars

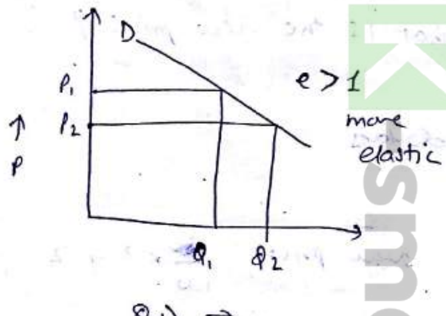
Increase $= 1$ dollar

Q) Anna owns a ~~secret~~ sweet ~~choclac~~ chocolate store. Anna charges 10 dollar each for his hand-made sweet chocolates. You being an engineering economist have calculated the elasticity of demand for the chocolate in that town to be 2.3. If Anna wants to increase the total revenue what advice will you give him and why?

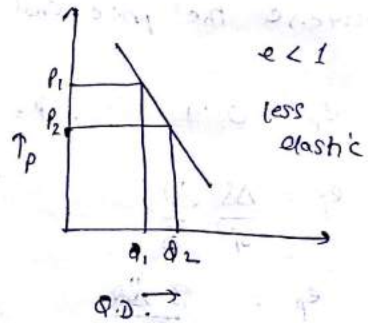
Ans ep is less then even with the increase in price people will buy.

ep is more so with decrease in price people will buy.

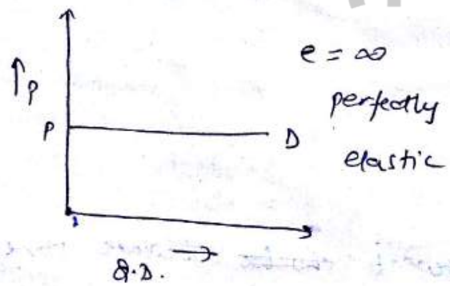
<u>Types of demand curves and the degree of elasticity</u> ⇒

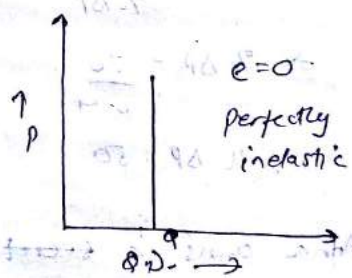


(Flatter)

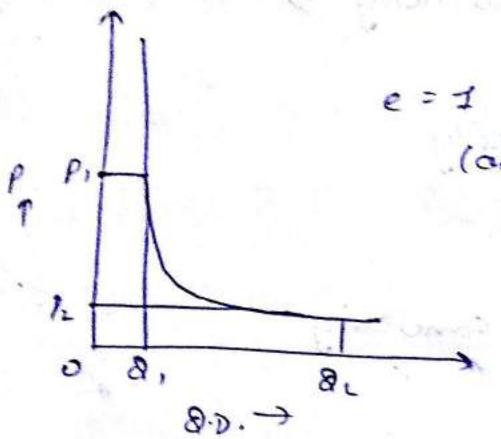


(Stepper)





(no response)



(unitary elastic)

10/01/17

Q) Sona sells cookies for 4\$ a dozen and she sells 50 dozens. Sona decides to charge more and increases the price to 6\$ a dozen. Now she sells 40 dozens. (i) What is the elasticity of demand (ii) Assuming that the elasticity of demand remains constant, how many would she sell if price were 10\$ a dozen.

(i) $e_p = \frac{-\Delta Q}{\Delta P} \times \frac{P}{Q}$

$= \frac{50-40}{4-6} \times \frac{4}{50}$

$= -\frac{10}{2} \times \frac{4}{50} = 0.4$

ii) $0.4 = \frac{\Delta Q}{-6} \times \frac{4}{50} \Rightarrow 30 = \Delta Q$

Ans: $50-30 = 20$ dozens

Factors affecting Price Elasticity ⇒

1) Nature of the comodity

2) No. of substitutes

3) No. of uses of the comodity

4) Price level of the comodity

5) Possibility of postponement of consumption

6) Joint demand

7) Consumer behaviour

INCOME ELASTICITY OF DEMAND ⇒

In case of income elasticity of demand we measure the percentage change in demand because of a certain change in the income

- For inferior goods, income elasticity, e_Y is negative

- Income elasticity of demand for normal goods is positive but greater than 1. The goods are normal superiors.

If income elasticity is in between 0 & 1, the goods are normal necessary.

11/01/17

(1) $e_Y = \frac{\% \Delta Q}{\% \Delta Y}$

2) $e_Y = \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q}$

(3) $e_Y = \frac{dQ}{dY} \times \frac{Y}{Q}$

CROSS ELASTICITY OF DEMAND ⇒

In case of cross elasticity we measure % change in quantity of comodity x with respect to a certain change in the price of comodity Y.

→ Cross elasticity between the substitutes is +ve.

→ Cross elasticity between the complimentaries is -ve.

Higher the value of cross elasticity, stronger the degree of substitutability and complimentarity

* In case the goods are perfect substitutes the cross elasticity between them will be +ve infinity.

* In case the goods are perfect compliments the cross elasticity between them will be tending towards -ve infinity.

1) $e_c = \frac{\% \Delta Q_x}{\% \Delta P_Y}$

2) $e_c = \frac{\Delta Q_x}{\Delta P_Y} \times \frac{P_Y}{Q_x}$

(3) $e_c = \frac{dQ_x}{dP_Y} \times \frac{P_Y}{Q_x}$

(Q) In a year no. of cars sold decreased by 20%. During that year the price of car increased by 5%, per capita income declined by 2% and prices of petrol increased by 10%. Income elasticity (e_y) for cars is estimated to be +1.5 and cross price elasticity (e_c) of petrol and ~~cross~~ cars is estimated to be −0.30.

i) What is the impact of decline in per capita income on the demand for cars?

Ans) $e_y = +1.5$ $\% \Delta Y = 2\%$

$$1.5 = \frac{\% \Delta Q}{2} \rightarrow \% \Delta Q = 3\% \text{ (decline)}$$

ii) What is the impact of increase in the price of petrol on the demand for cars?

Ans) $e_c = -0.30$ $\% \Delta P_y = 10\%$

$$\% \Delta Q_x = -3\%$$

iii) What is the price elasticity of demand?

Ans) Total decline = 20%

6% for petrol and per capita

$$\% \Delta Q = (20-6)\% = 14\%$$

$$e_p = \frac{\% \Delta Q}{\% \Delta P} = \frac{14}{5} = 2.8$$

8) Emperical studies about the automoblile demand in a country have indicated that the price elasticity for cars in 1.2 and income elasticity is 2.8 in the year 2014. The present sales of car in the country is 8 million. If the price increases by 10% and income will increase by 5% next year.

i) What will be its effect on the sales of car?

ii) Find the expected sales of car in the next year.

Ans) i) $e_p = 1.2$ $\quad e_y = 2.8$ $\quad Q = 8$ million

$\% \Delta P = 10\%$ $\quad \% \Delta Y = 5\%$

$$1.2 = \frac{\% \Delta Q}{\% \Delta P}$$

$\% \Delta Q = 12\%$ (decrease)

ii) $2.8 = \dfrac{\% \Delta Q}{\% \Delta Y} \Rightarrow \% \Delta Q = 14\%$

net increase = 2%

Expected sales = 8 million + 2% of 8 millions

= 8.16 million.

13/01/17

Q) Heartbeat headphones are retailed at $200 per unit following a $ 20 increase in price of heartbeat headphones, there is an increase in the demand for a rival brand of headphones by 7.5%. What is the cross price elasticity of this price change?

% increase

$$e_c = 7.5 \times \frac{20}{200} = 0.75$$

Q) Consider the following goods and their cross elasticity.

Goods	Cross elasticity
Air conditioning units and kW of electricity	- 0.34 - Complimentary
Coke and Pepsi	0.63 - substitutes
High fuel consuming sports utility vehicles and gasoline	- 0.28 - Complimentary
Mc Donald's Burger and Burger King Burgers	0.28 - substitutes
Butter & Margarine	1.54 - "

) What are the sign of each of cross price elasticities imply about the relationship between goods?

ii) Use the information in the table, to calculate how a 5% increase in the price of pepsi affects the demand for coke.

$\% \Delta P_y = 5\%$ $\quad e_c = 0.63$

$\% \Delta Q_x = 0.63 \times 5 = 3.15\%$

8) Suppose the seller of textile clothes wants to lower the price of the cloth from Rs. 150 per meter to Rs 142.5 per meter. If its present sales are 2000m per month and further it is estimated that price elasticity of demand for the product is 0.7. Find whether or not the T_R will increase as a result of this decision to lower the price level.

Given: $e_p = 0.7$, $P_1 = 150$

$P_2 = 142.5$

$\Delta P = 7.5$

$$e_p = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

$$0.7 = \frac{\Delta Q}{7.5} \times \frac{150}{2000}$$

$\Delta Q = 70$

New Q = 2070 m

Old T_R : 300000 (150×2000)

New T_R = 294975

↳ T_R will decrease

Q) Demand for a ~~goo~~ book is given by the eqn

$Q = 20000 - 60P$. Calculate the point price elasticity at the price 200

$$e_p = \frac{dQ}{dP} \times \frac{P}{Q}$$

$$Q = 20000 - 60(200)$$

$$Q = 8000$$

$$e_p = -60 \times \frac{200}{8000} = -1.5$$

Relationship between e_p, AR and MR ⇒

AR - Average Revenue

MR - Marginal Revenue (incremental revenue)

$$TR = P.Q$$

17/01/17

$$AR = \frac{TR}{Q} = \frac{P.Q}{Q} = P$$

$$\boxed{AR = P}$$

$$MR = \frac{d\,TR}{dQ}$$

$$MR = \frac{d(P.Q)}{dQ}$$

$$MR = P.\frac{dQ}{dQ} + Q.\frac{dP}{dQ}$$

$$MR = P + Q \cdot \frac{dP}{dQ}$$

$$MR = P\left(1 + \frac{Q}{P} \cdot \frac{dP}{dQ}\right)$$

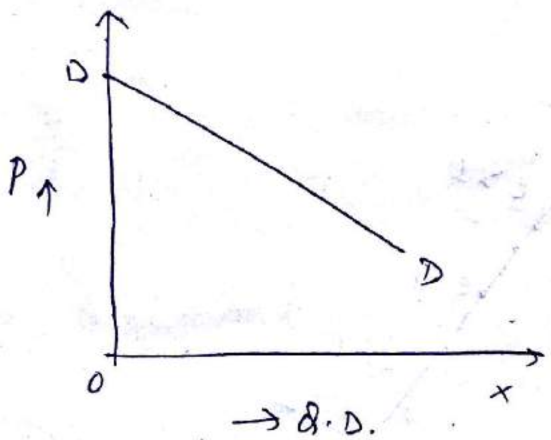
$$\left\{ e_p = \frac{dQ}{dP} \cdot \frac{P}{Q} \right\}$$

$$MR = P\left(1 + \frac{1}{e_p}\right)$$

$$MR = P\left(1 - \frac{1}{|e|}\right)$$

$$\boxed{MR = AR\left(1 - \frac{1}{e}\right)}$$

let the monopolist face a downward slopping demand line.



$$X = a_0 - a_1 P$$

$$\Rightarrow P = \underbrace{\frac{a_0}{a_1}}_{a_0^*} - \underbrace{\frac{1}{a_1}}_{a_1^*} x$$

$$TR = P \cdot x$$

$$= a_0^* x - a_1^* x^2$$

$$AR = \frac{TR}{x}$$

$$\Rightarrow AR = a_0^* - a_1^* x$$

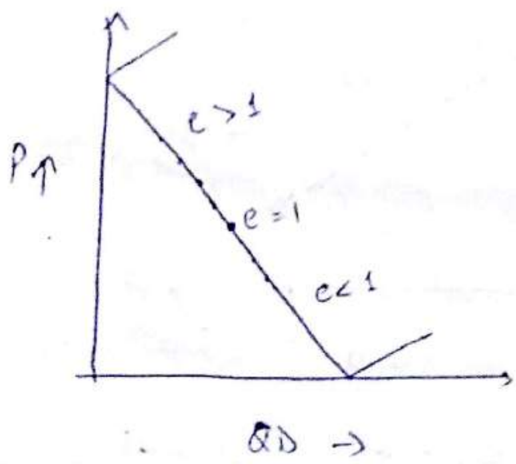
$$\Rightarrow \boxed{AR = P}$$

$$MR = \frac{dTR}{dx}$$

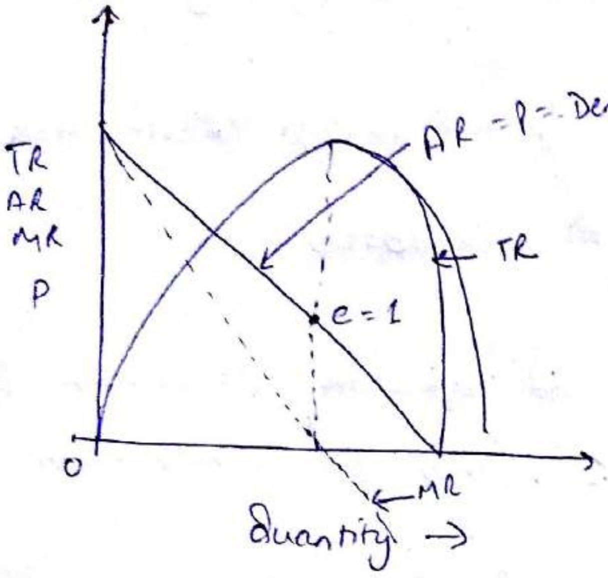
$$MR = a_0^* - 2a_1^* x$$

MR line is a straight line like AR line, but the slope of MR is twice of the slope of AR, so MR line has to lie below the AR line.

Measuring the price elasticity on a straight line demand curve at different points



$$\boxed{\begin{aligned} \text{when } e = 1 \;&;\; MR = 0 \\ e > 1 \;&;\; MR = +ve \\ e < 1 \;&;\; MR = -ve \end{aligned}}$$



when MR = 0 ; TR will be maximum

Q) The demand function faced by a company for its personal computers is P = 50000 - 4Q.

i) Write the MR function

$$P = 50000 - 4Q$$

$$R \quad PQ = 50000Q - 4Q^2$$

$$\frac{dR}{dQ} = 50000 - 8Q \rightarrow MR$$

ii) At what price and quantity MR = 0

$$50000 - 8Q = 0$$

$$Q = \frac{50000}{8} = 6250$$

$$P = 50000 - 4(6250)$$

$$P = 25000$$

iii) At what price and quantity TR is maximum

at MR = 0, TR is max

$\Rightarrow P = 25000$

8) Given the demand equation $P = 50000 - 4Q$. Find that elasticity $e = 1$, when TR is maximum.

$$MR = 0$$

$$\frac{dP}{dQ} = 50000 - 8Q$$

$$P = 25000$$

$$Q = 6250$$

$$Q = 12500 - \frac{1}{4}P$$

$$\frac{dQ}{dP} = -\frac{1}{4} \cdot 4$$

$$\frac{P}{Q} = \frac{25000}{6250} = 4$$

$$\frac{dQ}{dP} \cdot \frac{P}{Q} = e = 1 \rightarrow \text{Proved } e = 1$$

18/01/17

2) Given the demand function for coffee $Q = 150 - 10P$. ~~and~~
Find the quantity and price where TR is max.

$$\cancel{P.Q = 150P - 10P^2}$$

$$10P = 150 - Q$$

$$\cancel{10\frac{dP}{dQ} =}$$

$$10PQ = 150Q - Q^2$$

$$10\frac{dP}{dQ} = 150 - 2Q$$

$$15 - 2Q = 0$$

$$P = 7.5$$

$$Q = 75$$

ii) Find the value of MR when TR is max.

$$MR = 15 - \frac{Q}{5}$$

$$= 15 - \frac{75}{5} = 0$$

$$MR = 0$$

ii) Find the elasticity when TR is maximum.

$$e_p = \frac{dQ}{dP} \times \frac{P}{Q}$$

$$= -10 \times \frac{7.5}{75} = -1$$

CONSUMER EQUILIBRIUM =)

Consumer equilibrium point is a point where the consumer gets maximum satisfaction.

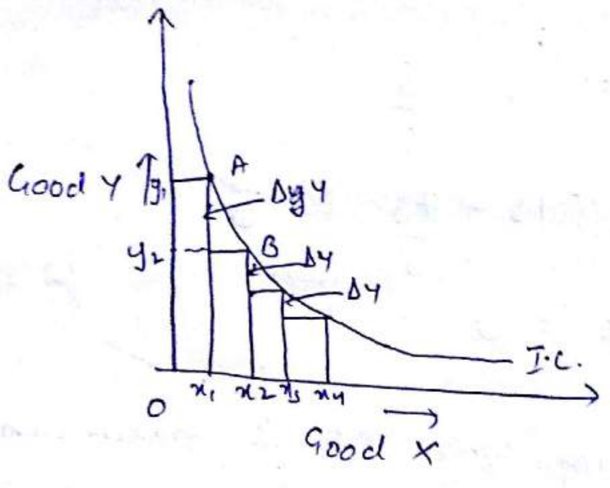
There are two goods X & Y.

M - Money income
P_x - Price of X
P_y : Price of Y

} - constraints

INDIFFERENCE CURVE =)

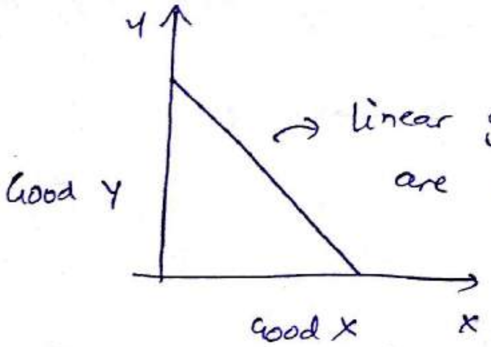
Indifference curve is a locus of combination of two commodities / goods giving the consumer the same level of satisfication.



I.C. is convex to the origin because two goods are normally not perfect substitutes. Therefore, the consumer has to sacrifice less and less of Y for every additional unit of X to maintain this same level of satisfaction.

20/01/17

ΔY is falling for every additional value of X.



Marginal Rate of Substitution (MRS) :→

MRS indicates the rate at which the comodities can be substituted at the margin in such a manner that the total utility remains constant

MRS X for Y (MRS_{XY})

MRS_{xy} indicates the amt. of Y the consumer is willing to sacrifice for an additional unit of X.

$$-\frac{\Delta Y}{\Delta X} = -\frac{dY}{dx} = \text{slope of IC}$$

$$\downarrow$$

$$= MRS_{XY} \text{ (slope of indifference curve)}$$

$$\boxed{\text{Loss in utility} = \text{Gain in utility}}$$

$$-\Delta Y \cdot MU_y = \Delta X \, MU_x$$

$$\Rightarrow -\frac{\Delta Y}{\Delta X} = \frac{MU_x}{MU_Y} = \text{slope of IC} = MRS_{XY}$$

$$\boxed{MRS_{XY} = \frac{MU_X}{MU_Y}}$$

$$\Rightarrow \frac{\partial U}{\partial x} \cdot dx + \frac{\partial U}{\partial y} \cdot dy = 0$$

MU_x MU_y

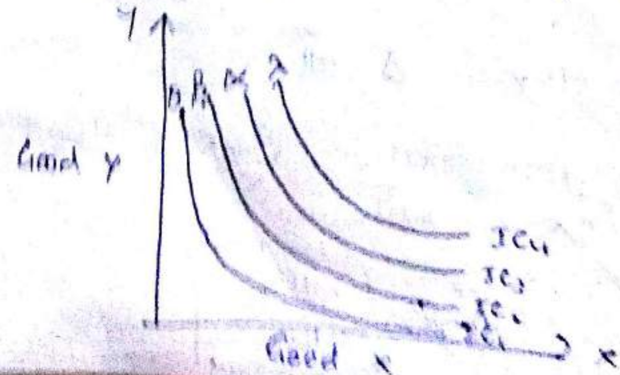
$$\Rightarrow MU_x \, dx + MU_y \, dy = 0$$

$$\Rightarrow -\frac{dy}{dx} = \frac{MU_x}{MU_y}$$

MRS_{xy} is falling i.e. slope is falling, so it is known as DMRS (decreasing marginal rate of substitution).

→ IC is convex to the origin because of the operation of DMRS.

I → A high IC gives higher level of satisfaction.



→ No two IC ...

other.

at point ...

below A ...

above A : ...

→ In between ...

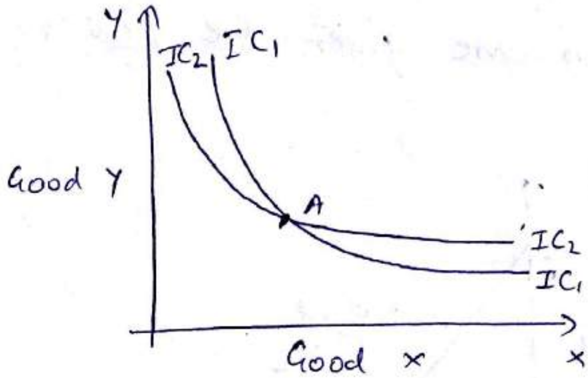
Goo...

because no...

→ A famil...

$IC_4 > IC_3 > IC_2 > IC_1$

→ No two IC can either touch or intersect each other.

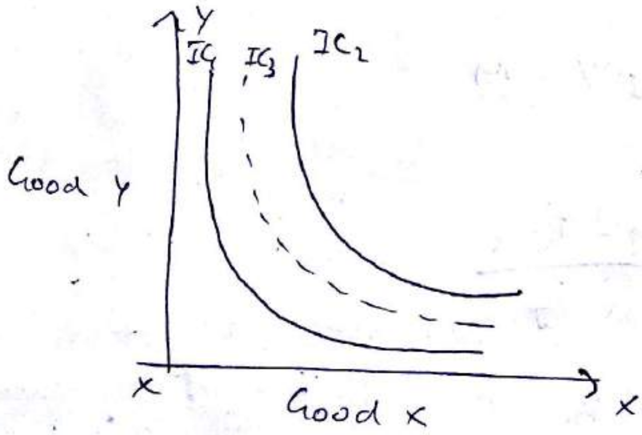


<u>at point A</u> : $IC_1 = IC_2$

<u>below A</u> : $IC_2 > IC_1$

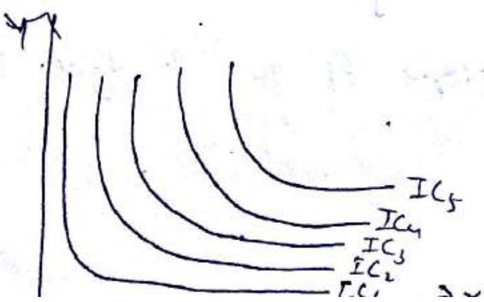
<u>above A</u> : $IC_1 > IC_2$

→ In between two IC a third IC can pass through,



because no two ICs can intersect each other.

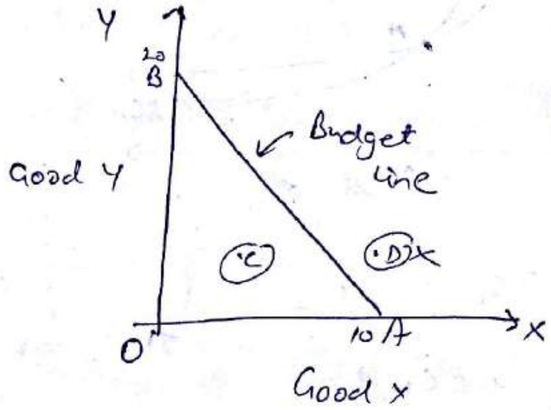
→ A family of ICs is considered as an <u>IC Map</u>.



<u>IC-MAP</u>.

Budget Line :-

Budget line shows all combinations of two goods that the consumer can buy by spending his entire money income given the prices of the goods.



Budget equation:-

$$\frac{X}{P_x}, \frac{Y}{P_y}$$

$$P_x \cdot X + P_y \cdot Y = M$$

$$Y = \frac{M - P_x \cdot X}{P_y}$$

$$\frac{dY}{dX} = -\frac{P_x}{P_y}$$

$$\Rightarrow -\frac{dY}{dX} = \frac{P_x}{P_y}$$ → slope of the budget line.

Geometrically the slope of the budget line is $\frac{OB}{OA}$

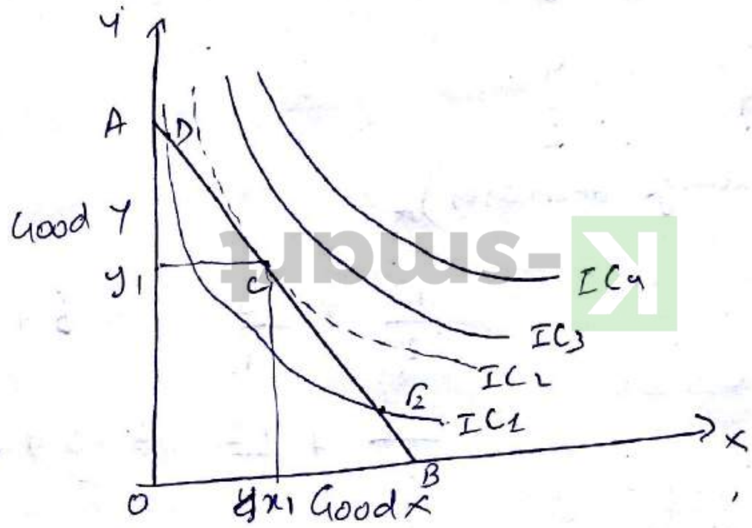
$$OB = \frac{M}{P_y}$$

$$OA = \frac{M}{P_x}$$

$$\Rightarrow \frac{OB}{OA} = \frac{P_x}{P_y}$$

Slope of the budget line is the ratio of prices.

31/01/17



For consumer equillibrium:

1) The slope of the indifference curve must be equal to the slope of the budget line.

2) At the point of equillibrium, the ~~bud~~ indifference curve must be convex to the origin.

$Ox_1 + Oy_1$ is the best combination for the consumer and the consumer derives maximum satisfaction at the point C. The consumer should not come to IC1 because it is a lower indifference curve

$$\frac{MU_x}{MU_y} = \frac{P_x}{P_y}$$ → Equilibrium condition.

$$\Rightarrow \frac{MU_x}{P_x} = \frac{MU_y}{P_y}$$

8)

Quantity	MU_x	MU_y
1	12	16
2	10	12
3	8	8
4	6	4
5	4	2

(marginal utility always decreases)

Income = 10\$

P_x = 2\$

P_y = 4\$

$\frac{12}{2} \neq \frac{16}{4} = 6 \neq 4$

$\frac{10}{2} \neq \frac{12}{4} = 5 \neq 3$

X	Y
3 units	1 unit

$\frac{8}{2} = \frac{16}{4}$

→ $3X + 1Y$

$(3 \times 2) + (1 \times 4) = 10\$$ (→ income)

→ 4X 2Y

$\frac{6}{2} = \frac{12}{4}$

$4X + 2Y$

$(4 \times 2) + (2 \times 4) = \$16$ → (beyond budget income

8) $P_x = 2$, $P_y = 1$

Budget = 5\$

Quantity	MUx	MUy
1	24	9
2	18	8
3	12	6
4	6	1

$2x + 1y = 4 + 1 = 5\$$

$(2\times2) + (1*1) = 5\$$ (equilibrium)

24/01/17

Time Value of Money :-

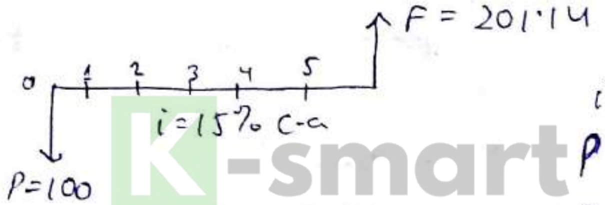
(Growth of capital)

Growth of capital per unit of time. Unit of time maybe annually, semi-annually, quaterly or monthly. Interest rate is responsible for the growth of capital.

$i = 15\%$

0	1	2	3	4	5
100	115	132.25	152.09	174.90	201.14

$\longrightarrow$ growth of capital



Cash flow diagram

i - rate of interest compounded periodically
P - initial investment
F - Future amount/ (Compound amt.)
n - no. of interest period

Interest formula →

1) Single payment compound amount

$F = ?$

given P, i, n

$F_1 = P + Pi = P(1+i)$

$F_2 = F_1(1+i) = P(1+i)^2$

$F_3 = P(1+i)^3$

$\boxed{F_n = P(1+i)^n}$ $\qquad F = P(F/P\ i\ n)$

2) Single payment present worth

$$P = \frac{F}{(1+i)^n} = F \times \frac{1}{(1+i)^n}$$

$$P = F\,(P/F\ i\ n)$$

Q) A person wishes to have a sum of ₹1lakh for his son's education after 10 years from now. What is the single payment that he should deposit now to get the desired amount? The bank gives 4% rate of interest compounded annually.

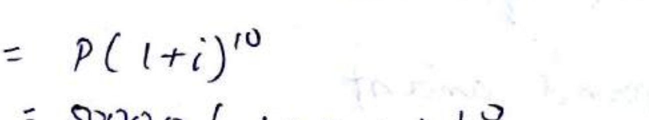
$$P = \frac{F}{(1+i)^n} = \frac{100000}{(1+0.04)^{10}} = ₹67556.42$$

Q) You deposit ₹50000 now in your bank account. What will be the maturity value after 10 years if the money is growing at 15% annually?

$$F = P(1+i)^{10}$$
$$= 50000\,(1+0.15)^{10}$$

$$P = ₹2,02,277$$

Q) Find the present worth of the following cash diagram



$i = 10\%$

$n = 6$

$$P = \frac{F}{(1+0.1)^2} = 41322 + \frac{50000}{(1+0.1)^6} + \frac{50000}{(1.1)^3}$$

$$P = \frac{20000}{(1.1)^2} + \frac{40000}{(1.1)^3} + \frac{50000}{(1.1)^6}$$

$$P = ₹\ 74805$$

$$F = 20000(1.1)^4 + 40000(1.1)^3 + 50000$$

25/01/17

3) Equal payment series sinking fund.

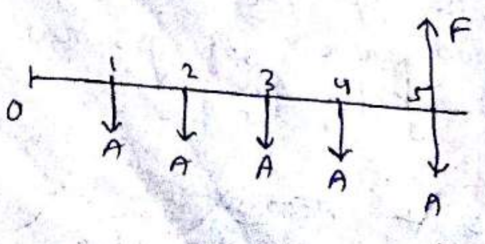
Sinking fund in a fund ~~collected~~ established to accumulate a future sum of money (F) through the collection of an uniform series of payments. Here, all payments are a constant value (A) and payments are deposited at the end of the interest period

1) A = annual equivalent amount

F = Compound amount

Objective - To find A

Given - F, i, n



EOY (end of year)	Amount of 'A'	Future worth
1	1000	$1000(1.08)^4$
2	1000	$1000(1.08)^3$
3	1000	$1000(1.08)^2$
4	1000	$1000(1.08)^1$
5	1000	1000
		$F = 5866.601$

$i = 8\%$

Using general notations ;

$$F = A(1+i)^{n-1} + A(1+i)^{n-2} + \cdots A(1+i)^{n-(n-1)} + A(1+i)^{n-n}$$

$$F = A\left[(1+i)^{n-1} + (1+i)^{n-2} + \cdots + (1+i)^{n-(n-1)} + (1+i)^{n-n}\right] \quad \text{--- (1)}$$

Multiplying both sides of eq^n (1) by $(1+i)$

$$F(1+i) = A\left[(1+i)^n + (1+i)^{n-1} + \cdots + (1+i)^2 + (1+i)\right] \quad \text{--- (2)}$$

Subtracting eq^n (1) from eq^n (2)

$$Fi = A\left[(1+i)^n - 1\right]$$

$$\Rightarrow \boxed{A = \frac{F \times i}{\left[(1+i)^n - 1\right]}} = \boxed{F \times (A/F\ i\ n)}$$

4) Equal payment series compound amount

$$\boxed{F = A \times \left[\frac{(1+i)^n - 1}{i}\right]}$$

$$F = 1000\left[\frac{(1\cdot 08)^5 - 1}{0\cdot 08}\right] \quad \text{(from prev. question)}$$

$$F = 5866.601$$

$$\boxed{F = A \times [F/A \ i n]}$$

8) A person who is now 35 years old is planning for his retire life. He plans to invest an equal sum of ₹ 10,000 at the end of every year for the next 25 years at the rate of interest 8% compounded annually. Find the maturity value when the person in 60 years.

$A = 10000$

$n = 25$

$i = 8\%$

$$F = A \times \left[\frac{(1+i)^n - 1}{i}\right]$$

$$= 10000\left[\frac{1.08^{25} - 1}{0.08}\right]$$

$$F = 731059.39$$

8) You spend ₹12000 every year on games. How much would be the amount if you decided not to game for upcoming 40 years. Given the interest rate at 6%.

$$A = 12000$$

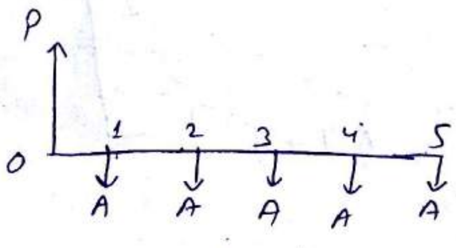
$$F = A \times \left[\frac{(1+i)^n - 1}{i}\right]$$

$$= 12000\left[\frac{1.06^{40} - 1}{0.06}\right]$$

$$F = ₹18,57,143.59$$

27/01/17

5) Equal payment series capital recovery factor



i%

Objective : To find 'A' (recovery amount).

given : P, i, n

$$P = \frac{F}{(1+i)^n}$$

$i=8\%$ EOY	Amt. of 'A'	Present worth
1	1000	$1000(1.08)^{-1}$
2	1000	$1000(1.08)^{-2}$
3	1000	$1000(1.06)^{-3}$
4	1000	$1000(1.08)^{-4}$
5	1000	$1000(1.08)^{-5}$ $\boxed{P = 3992.71}$

$$P = 3792.71 \text{ (loan amount)}$$

Using general notations, we can write the conversion table :

$$P = A(1+i)^{-1} + A(1+i)^{-2} + \dots + A(1+i)^{-n+1} + \dots + A(1+i)^{-n}$$

$$P = A\left[(1+i)^{-1} + (1+i)^{-2} + \dots + (1+i)^{-n+1} + (1+i)^{-n}\right] \quad (1)$$

Multiplying both sides of eq^n (1) by $(1+i)^{-1}$

$$P(1+i)^{-1} = A\left[(1+i)^{-2} + (1+i)^{-3} + \dots + (1+i)^{-n} + (1+i)^{-n-1}\right] \quad (2)$$

Subtracting eq^n (1) from eq^n (2) :

$$P\left[(1+i)^{-1} - 1\right] = A\left[(1+i)^{-n-1} - (1+i)^{-1}\right] \quad (3)$$

$$P\left[\frac{-i}{1+i}\right] = A\left[(1+i)^{-n-1} - (1+i)^{-1}\right]$$

Multiplying both sides of eq^n (3) by $-(1+i)$

$$Pi = A\left[\frac{(1+i)^n - 1}{(1+i)^n}\right]$$

$$\Rightarrow \boxed{A = P \times \left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]}$$

$$\boxed{A = P(A/P\ i\ n)}$$

6) Equal payment series present worth

$$\boxed{P = A \times \left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]}$$

$$\boxed{P = A(P/A\ i n)}$$

~~8) You spend ₹12000~~

8) A judge punished you to pay an amount of ₹9000 every year for 15 years. to an old man who got badly hurt by an accident you caused. You are a rich man and wish to pay at once now. Market rate of interest is 5%, how much money you'll pay to the old man now.

$$P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

$$P = 9000\left[\frac{1.05^{15} - 1}{0.05 \times 1.05^{15}}\right]$$

$$P = ₹\ 93416.92$$

8) You are soon going to be a graduate and want to know how high your annual salary should be if you wish to be a 10 millionaire within 10 years. $i = 6\%$

$$A = \frac{F \times i}{(1+i)^n - 1} = 758679.58$$

Q) Demand and supply schedule of a commodity are given as:

P	10	12	14	16	18	20
D =	500	450	400	350	300	250
S =	320	360	400	440	480	520

Find the equilibrium price

$P = 14$ (equillibrium price, because $D = S$)

Q) Given the supply schedule as:

P	50	100	150
Q_s	25	50	75

Find the expected supply function.

$$B = \frac{\Delta Q}{\Delta P} = \frac{50}{100} = 0.5$$

$$Q = A + BP$$

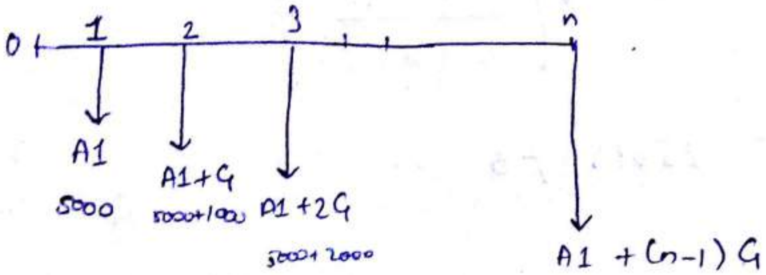
$$25 = A + 0.5 \times 50$$

$$A = 0$$

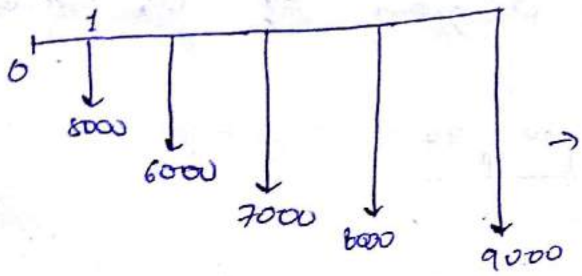
$$\Rightarrow \boxed{Q = 0.5P}$$

14/02/17

① Uniform Gradient Series Annual Equivalent Amount



$A1 = 5000$
$G = 1000$



→ Gradient series for 5 years

PW (10%) → present worth

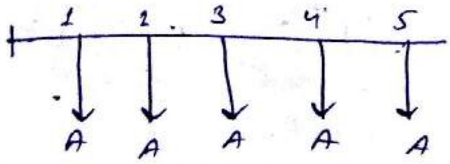
$$PW = \frac{5000}{(1.1)^1} + \frac{6000}{(1.1)^2} + \frac{7000}{(1.1)^3} + \frac{8000}{(1.1)^4} + \frac{9000}{(1.1)^5}$$

$\Rightarrow PW = 25815.735$

$$\boxed{A = A1 \pm G\left[\frac{(1+i)^n - in - 1}{i(1+i)^n - i}\right]}$$

$$A = 5000 + 1000\left[\frac{(1.1)^5 - 0.1\times 5 - 1}{0.1(1.1)^5 - 0.1}\right]$$

$A = 6810.125$ (at the end of every year)



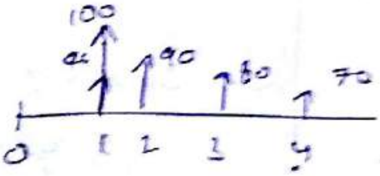
$\rightarrow A = 6810.12$

$$P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

$$P = 6810.125\left[\frac{1.1^5 - 1}{0.1 \times 1.1^5}\right]$$

$$P = 25815.73$$

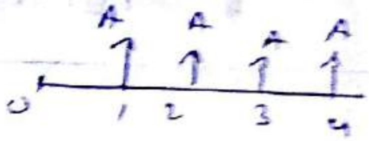
8) Find the annual equivalent amount of the following cash flow diagram at 10% interest at



$$A = A1 - G\left[\frac{(1+i)^n - in - 1}{i(1+i)^n - i}\right]$$

$$A = 100 - 10\left[\frac{1.1^4 - (0.1\times4) - 1}{0.1\times(1.1)^4 - 0.1}\right]$$

$$A = 86.188$$



$$P = 86.138\left[\frac{1.1^4 - 1}{0.1 \times 1.1^4}\right]$$

$$P = 273.204$$

$$F = P(1+i)^n = 399.99$$

15/02/17

Net Present Value Method of Comparison ⇒ (NPV Method)

$$\boxed{NPV = GPV - C_0}$$

GPV → Gross Present Value

C_0 → cost at zero time

MARR - Minimum attractive rate of return

Discount rate

Interest rate

NPV > 0 → proposal is accepted.

NPV < 0 → proposal is rejected

NPV = 0 → situation of indifference

Only positive will be accepted.

Q) An investment of 136000 \$ (C_0) generates the following cash inflow. Determine the NPV at the discount rate 10%.

Year	1	2	3	4	5
Cash inflow (\$)	30000	40000	60000	30000	20000

$$NPV(10\%) = \frac{30000}{(1.1)^1} + \frac{40000}{(1.1)^2} + \frac{60000}{(1.1)^3} + \frac{30000}{(1.1)^4} + \frac{20000}{(1.1)^5} - 136000 = 2318.296 \$$$

NPV > 0 ; accepted

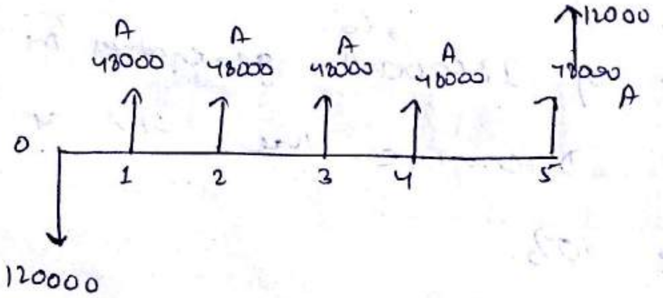
8) Your company is looking for purchasing a front-end loader at a cost of \$120000. The loader would have a useful life of 5 years with a salvage value of \$12000 at the end of 5^{th} year. The loader can earn \$95 per hour. It costs \$30 per hour to operate and \$25 per hour is paid to the operator. Using 1200 billable hour per year determine the NPV for the purchase of at a MARR of 20%. Should your company purchase the loader?

17/02/17

Loader

Net income per hour = \$95 − \$30 − \$25 = \$40

1200 billable hours = 1200×40 = \$48000 per year.



$$NPV(20\%) = -120000 + 48000(P/A\ i\ n) + 12000(P/F\ i\ n)$$

$$= -120000 + 48000\left[\frac{1.2^5 - 1}{1.2^5(0.2)}\right] + \frac{12000}{(1.2)^5}$$

NPV = \$28371.91 ∴ accepted (NPV > 1)

INTERNAL RATE OF RETURN (IRR) ⇒

IRR speaks about the efficiency of the investment, quality of the investment and the yield of the investment. IRR is the discount rate where NPV = 0

Q) Find the IRR of the following cash flows of a project and state whether the project should be accepted if the company requires a minimum return of 17%. (MARR)

Time	0	1	2	3	4
Cash flow	4000	1200	1410	1875	1150

$$NPV = \frac{1200}{1\cdot1} + \frac{1410}{(1\cdot1)^2} + \frac{1875}{(1\cdot1)^3} + \frac{1150}{(1\cdot1)^4} - 4000$$

NPV = ~~8450.138~~ 450.379 (at 10%)

NPV = − 81.28 (at 16%)

$$\boxed{IRR = \text{Lower rate} + \frac{NPV_{lower}}{NPV_{lower} - NPV_{higher}} \times (H_{rate} - L_{rate})}$$

$$= 0.1 + \frac{450.379}{450.379 + 81.28} \times (0.06)$$

IRR = 15.08% (20.0)

21/02/17

8) An investment of \$136000 generates the following cash inflows. Determine the IRR.

Year	1	2	3	4	5
Cash inflows	30000	40000	60000	30000	20000

$$NPV = \frac{30000}{x^1} + \frac{40000}{x^2} + \frac{60000}{x^3} + \frac{30000}{x^4} + \frac{20000}{x^5}$$

$NPV(10\%) = 2318.29$

$NPV(12\%) = -4205.63$

$NPV(11\%) = -1005.63$

$$r = 0.1 + \frac{2318.29}{2318.29 + 4205.63} \times (0.02)$$

$r = 10.7\%$

8) Find the IRR of the following cash flows by trial & error method.

Year	0	1	2	3	4	5
Cash (\$) flows	1000	500	400	200	200	100

$NPV(15\%) = 32.811$

$NPV(20\%) = -53.178$

$$r = 0.15 + \frac{32.811}{32.811 + 53.17}(0.05)$$

$r = 16.9\%$

(4marks)

Present

+v

-ve

22/02/17

1) P/A

P

2) P/A

P

3) A/C

A

8) Instal

is es

expecte

value

window

for 1st

3 yea

used

(4 marks)

Present Worth Method of Comparison (PW Method) ⇒

+ve → benefit / income / revenue / profit / salvage value

-ve → cost / investment

22/02/17

1) P/F i n

$$P = \frac{F}{(1+i)^n}$$

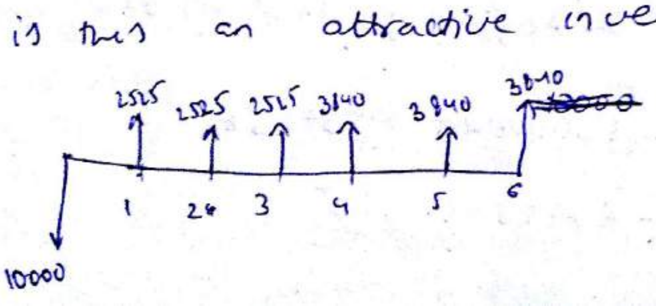
2) P/A i n

$$P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

3) A/G i n

$$A = A1 \pm G\left[\frac{(1+i)^n - in - 1}{i(1+i)^n - i}\right]$$

8) Installing thermal windows on a small office building is estimated to cost \$10000. The windows are expected to last for 6 years and have no salvage value at that time. The energy savings from the windows are expected to be \$2525 each year for 1st 3 years and \$3840 for each of the remaining 3 years. If the MARR is 15% and PW method is used; is this an attractive investment?



$$P = A\cancel{\left[\frac{(1+i)^n - 1}{i^n - 1}\right]} \quad A\cancel{\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]}$$

$$= \cancel{2525\left[\frac{1.15^3 - 1}{0.15^3 - 1}\right]} = 2525\left[\frac{1.15^3 - 1}{0.15(1.15)^3}\right]$$

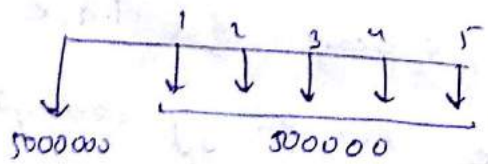
$$\cancel{= 1319.66}$$

$$\cancel{PW(15\%) = -10000 + 5765.14}$$

$$PW(15\%) = -10000 + \frac{2525}{1.15} + \frac{2525}{1.15^2} + \frac{2525}{1.15^3} + \frac{3840}{1.15^4} + \frac{3840}{1.15^5} + \frac{3840}{1.15^6}$$

$PW(15\%) = 1529.972$

8)



$i = 10\%$

$$P = 500000\left[\frac{1.1^5 - 1}{0.1(1.10)^5}\right]$$

$P = \cancel{1517656.643}\ 1895393.385$

$PW(10\%) = -5000000 - 1895393.385$

$= -6895393.385$

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8) Compare the PW of the following ~~to mech~~ two mechanical plant auctions. Assuming at interest rate of 12% compounded annually. Particulars are given below:

Particulars	Auction A	Auction B
Initial cost	\$ 50000	\$ 70000
Annual maintenance cost	\$ 6000	\$ 4000
Residual value (salvage)	\$ 8000	\$ 5000
Life	15 years	15 years

Auction A:

$$PW(12\%) = -50000 - 6000\left[\frac{1.12^{15}-1}{0.12(1.12^{15})}\right] + \frac{8000}{1.12^{15}}$$

$$= -50000 - 40865.18 + 1461.57$$

$$= -89403.61$$

Auction B:

$$PW(12\%) = -70000 - 4000\left[\frac{1.12^{15}-1}{0.12 \times 1.12^{15}}\right] + \frac{5000}{1.12^{15}}$$

$$= -70000 - 27243.457 + 913.48$$

$$PW(12\%) = -96329.97$$

28/02/17

Annual Worth Method of Comparison (AW method) ⇒

In this method, we express all the cash flows in terms of annual worth i.e. in terms of

1) A/P in

$$A = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right]$$

2) A/F in

$$A = \frac{F\,i}{[(1+i)^n - 1]}$$

3) A/G in

$$A = A_1 \pm G\left[\frac{(1+i)^n - in - 1}{i(1+i)^n - i}\right]$$

Q) A public utility company is trying to decide betwee 2 sizes of pipes for a new waterline. A 250 mm pipe will have an initial cost of \$40000 whereas a 300 mm line will cost \$46000. Since there is more head loss through the 250 mm pipe, the pumping cost for the smaller line is expected to be \$2500 per year more than for the 300 mm line. If the pipes are expected to last for 15 yrs, which size should be selected at the rate of interest 12% per year, use an annual worth analysis ?

$AW(12\%)_{250mm}$ = initial cost = -40000

= $-40000(A/P\ 12\%\ 15)$ ~~+~~ 2500

$AW(12\%)_{300mm}$ = $-46000[A/P\ 12\%\ 15]$ = -6753.91

$AW(12\%)_{250mm}$ = -5872.96 - ~~+~~2500

= ~~-3372.96~~ - 8372.96

Q) Find the AW of the following two methods and decide which method should be selected. Life of both the methods is 6 years and interest rate is 8% compounded annually.

Particulars	Amt of A	Amt. of B
Initial cost	160000	240000
Annual operating cost	60000	16000
Salvage value	30000	80000

$AW(8\%)_{(A)} = -160000[A/P\ 8\%\ 6] - 60000 + 30000\left[\frac{0.08}{1.08^6 - 1}\right]$

= ~~-34610.46~~ ~~-64610.46~~ - 90520.99

$$AW(8\%)_{(B)} = -240000[A/P\ in] - 16000 + 80000\left[\frac{0.08}{1.08^{?}}\right]$$

$$= \cancel{-12004.307}\ -57010.4618$$

<u>01/03/17</u>

Q) In the above question, life of A is 6 years and life of B is 9 years.

$$AW(8\%)_{(A)} = -90521.01$$

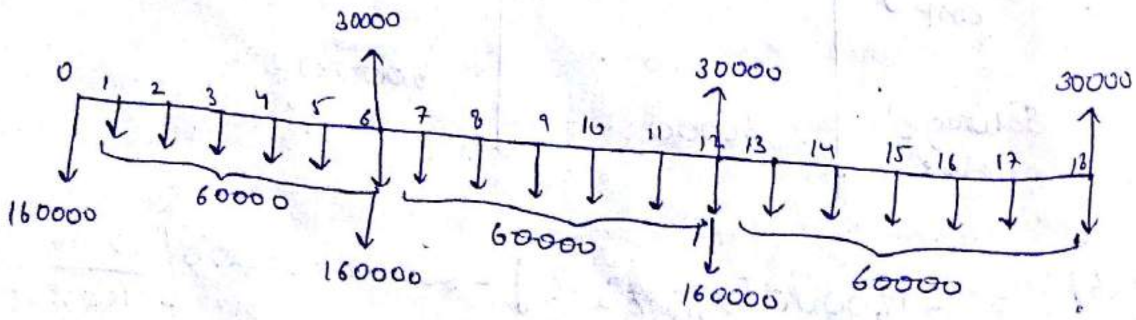
$$AW(8\%)_{(B)} = -240000\left[\frac{0.08 \times 1.08^{9}}{1.08^{9}-1}\right] - 16000 + 80000\left[\frac{0.08}{1.08^{9}-1}\right]$$

$$= -48012.75$$

-76271.27

In case of 2 unequal years for both the methods; find the LCM of both years and calculate it accordingly.

<u>Method A</u>:



$$AW(8\%) = -60000 - 160000\left[\frac{0.08\times1.08^{18}}{1.08^{18}-1}\right] - \frac{130000}{1.08^{6}}\left[\frac{0.08\times1.08^{18}}{1.08^{18}-1}\right]$$
(a)

$$-\frac{130000}{1.08^{12}}\left[\frac{0.08\times1.08^{18}}{1.08^{18}-1}\right] + 30000\left[\frac{0.08}{1.08^{18}-1}\right]$$

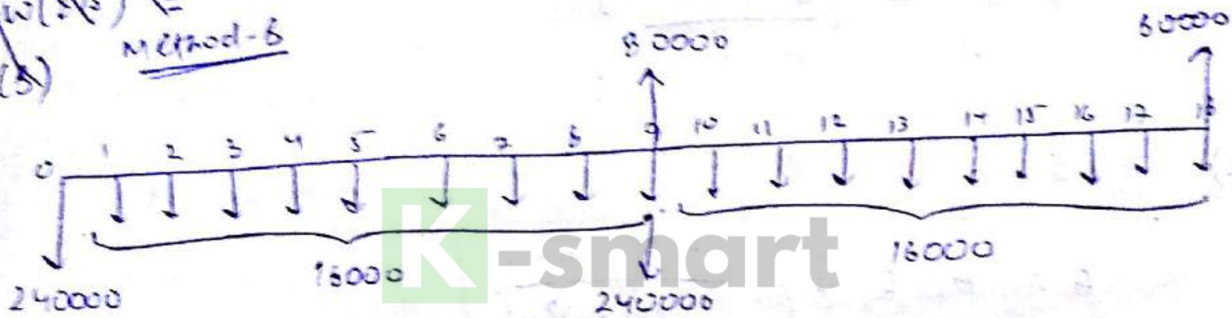
$\cancel{= -10125831}$

$= -27072.335 - 8741.254 - 5508.423 + 801.062$

$= -90521.$

AW(8%) =
(b)

Method-6



$$AW(8\%) = -16000 - 240000\left[\frac{0.08\times1.08^{18}}{1.08^{18}-1}\right] - \frac{160000}{1.08^{9}}\left[\frac{0.08\times1.08^{18}}{1.08^{18}-1}\right]$$
(b)

$$-\frac{160000}{1.08^{9}}\left[\frac{0.08\times1.08^{18}}{1.08^{18}-1}\right] + 80000\left[\frac{0.08}{1.08^{18}-1}\right]$$

$= -41608.503 - 8540.418 - 8540.418 + 2136.168$

$= -48012$

03/03/17

Future Worth Method (FW Method) :⇒

In this method we convert the cash flows to future time i.e. to F.

1) F/P i n

$$F = P(1+i)^n$$

2) F/A i n

$$F = A\left[\frac{(1+i)^n - 1}{i}\right]$$

3) A/G i n

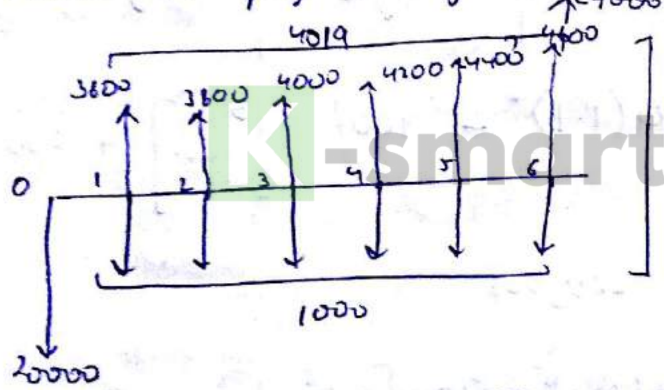
$$A = A_1 \pm G\left[\frac{(1+i)^n - in - 1}{i\{(1+i)^n - 1\}}\right]$$

Q) A high efficiency lighting project for a company ~~attach~~ will saves \$10000 a year, in energy cost. If that \$10000 a year is deposited into an energy management savings account that gives 10% interest. How much money will be available in 20 years to replace the old model with a new model?

$$F = A\left[\frac{(1+i)^n - 1}{i}\right]$$

$$F = 10000\left[\frac{1.1^{20} - 1}{0.1}\right] = \$572749.99$$

8) You have agreed ~~to~~ to make investment in your friend's agricultural farm. This would require an amount of \$ 20000 as initial investment on your part. Your friend promises you a revenue of \$3600 per year the 1st year and thereafter the revenue increases by \$200 per year. Your share of the estimated annual expenses is \$1000. You are planning to invest for 6 years. Your friend has made the commitment to buy out your share of the business at that time for \$24000. You have decided to set a personal MARR of 15% per year. Judge the profitability of the investment project by using FW method.



Every year getting \$3019 (4019-1000)

$$A = A_1 + G\left[\frac{(1+i)^n - in - 1}{i(1+i)^n - i}\right]$$

$$= 3600 + 200\left[\frac{1.15^6 - 0.15\times 6 - 1}{0.15(1.15)^6 - 0.15}\right]$$

$$A = \$\,4019$$

$$FW(15\%) = -20000(F/P\ i\ n) + 3019(F/A\ i\ n) + 24000$$

$$FW(15\%) = \$\,4166.32$$

(more benefits than the cost, proposal will be accepted) → since FW is +ve, it indicates that benefits are more than the cost paid.

5) Consider the following information about machine A and machine B and decide which machine should be selected on the basis of the FW method, given $i = 10\%$

Particulars	Machine A	Machine B
Cost	\$2500	\$3500
Annual operating cost	\$700	\$700
Salvage value	\$200	\$350
Life period	5 yrs	5 yrs

$$FW_{(A)}(10\%) = -2500(1.1)^5 - 900\left[\frac{1.1^5 - 1}{0.1}\right] + 200$$

$$= -\$9320.865$$

$$FW_{(B)}(10\%) = -3500(1.1)^5 - 700\left[\frac{1.1^5 - 1}{0.1}\right] + 350$$

$$= -\$9560.355$$

Finding FW, when the life of machine A and the life of machine B is 6 years.

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Benefit - Cost Analysis

(10 million = 1 Crore)

$$B/C \text{ ratio} = \frac{\text{Equivalent Benefits}}{\text{Equivalent costs}}$$

(AM)

if $B/C > 1$; accepted

$B/C < 1$; rejected

07/03/17

Q) A govt. bridge project requires an initial investment of ₹10 million, and operating maintenance cost of ₹250000 per year for 20 years life of the bridge. The annual user benefits of ₹2000000 per year are estimated to arise from savings in travel distance, time and fuel. If the interest rate is 7%, determine whether the needs to be implement by using B/C ratio method.

$$\underset{\text{(cost)}}{AW(7\%)} = -10000000\left[\frac{0.07 \times 1.07^{20}}{1.07^{20} - 1}\right] - 250000$$

$$= -1193929.257$$

$$\underset{\text{Benefits}}{AW(7\%)} = 2000000$$

$$B/C \text{ ratio} = \frac{2000000}{1193929.257} = 1.675 > 1 \text{ (accepted)}$$

PW (7%) (cost) $= 10000000 \left[1.07^{19} \right] - 150000 \left[\frac{1.07^{19} - 1}{0.07} \right]$

$= 48945719.71$

PW (7%) benefits $= 9000000 \left[\frac{1.07^{20} - 1}{0.07} \right]$

$= 81990984.61$

B/C ratio $= 1.675 > 1$ (accepted)

Q.) Rood Tyre company is considering the purchase of new tyre balancing equipment. The machine will cost $12699 and have an annual savings of $3000 with a salvage value of $250 at the end of 12 years. If the MARR is 6%, decide the desired ability of purchasing the equipment by B/C ratio method.

PW (6%) benefits $= 2000 \left[\frac{0.06 \times 1.06^{12}}{1.06^{12} - 1} \right] + \frac{250}{1.06^{12}} \cancel{\left[\frac{0.06 \times 1.06^{12}}{1.06^{12} - 1} \right]}$

$= 239.6503$

$= \cancel{2000 \left[\frac{1.06^{12} - 1}{0.06^{12} \times 1.06^{12}} \right]} + 250 \cancel{\left[\frac{1.06^{12} - 1}{0.06^{12} \times 1.06^{12}} \right]}$

15/03/17

Depreciation Calculation :-

Depreciation means fallin in the value of the fixed asset, or, it means spreading the cost of the ~~asset~~ asset over its lifetime..

Methods of Depreciation Calculation :->

① Straight line method
② Sum-of-years digit method
③ Declining Balance method

Straight Line Method ->

In this method, we charge a constant amount as depreciation at the end of every year.

$$d_k = \frac{C - SV_N}{N} \qquad (1 \le k \le N)$$

d_k -> annual depreciation in the year k

C -> cost basis

SV_N -> salvage value ~~at the~~

N -> life period

8) The cost of a vehicle is ₹100000. The salvage value at the end of its life of 10 years is ₹20000. Calculate annual depreciation and book value at the end of each year by straight line method.

$$d_k = \frac{100000 - 20000}{10} = 8000$$

Y	d_k	Book value
0	0	100000
1	8000	92000
2	8000	84000
3	8000	76000
4	8000	68000
5	8000	60000
6	8000	52000
7	8000	44000
8	8000	36000
9	8000	28000
10	8000	20000

Sum of years digit method → (SYD) (1 ques.)

Year	Years in reverse order	Depreciation factor (d.f)
1	5	5/15
2	4	4/15
3	3	3/15
4	2	2/15
5	1	1/15
	15	

$$\boxed{d = (P - F) \times d.f}$$

P → Cost

F → salvage value

$$d.f = \frac{n - t + 1}{n(n+1)/2}$$ → factor for any year

n → life period

t → particular year for which d.f. has to be calculated

17/10/17

8) Cost of a machine is ₹100000. Salvage value at the end of 5 years is ₹20000. Find the depreciation for each year by SYD method.

Year	Depreciation
1^{st}	$(100000 - 20000) \times \frac{5}{15}$
	$= 26,666$
2^{nd}	$(100000 - 20000) \times \frac{4}{15}$
	$= 21333$
3^{rd}	$80000 \times \frac{3}{15} = 16000$
4^{th}	$80000 \times \frac{2}{15} = 10666$
5^{th}	5333

Total depreciation = 80000

Declining Balance method :)

Q) An automobile company has purchased a wheel alignment device for ₹ 10 lakh. The device can be used for 10 years. The salvage value at the end of the life of the device is 10% of the purchase value. Calculate depreciation and book value of the device by declining balance method at depreciation rate of 20% per year.

let $k = 20\%$
$\Rightarrow k = 0.2$

Salvage value =
$S = 10\%$ of 10L
$= 1$ lakh

Year	Depreciation	Book value
0	0	1000000
1	$0.2 \times 10L = 2L$	8lakh
2	$0.2 \times 8L = 160K$	640K
3	$0.2 \times 640k = 128000$	512000
4	$0.2 \times 512000 = 102400$	409600
5	81920	327680
6	65536	262144
7	52428.8	209715.2
8	41943.04	167772.16
9	33554.432	134217.728
10	26843.5456	107374.18

Book value cannot be less than salvage value,

For a specific period, book value,

$$\boxed{\begin{aligned} D_t &= k(1-k)^{t-1} \times P \\ B_t &= k(1-k)^{t} \times P \end{aligned}}$$

k = dep. rate
P = purchase val.
t = period.

For 7^{th} year
$D_t = 52428.8$
$B_t = 209715.2$

Q) A machine was purchased at the cost of ₹ 28000 and ₹ 2000 was spent on its insulation. Calculate the depreciation at 20% p.a. by declining balance method. The salvage value after a period of 5 years is ₹ 10000

$k = 0.2$

~~28000~~ 28000 + 2000
= 30000

Years	Depreciation	Book value
0	0	30000
1	6000	24000
2	4800	19200
3	3840	15360
4	3072	12288
5	2457.6	9830.4 less than the salvage value

change of calculation;

thus strike out 2457.6 and 9830.4 and subtract 5 values from previous years book value (2288), then find out depreciation accordingly.

Payback Period =)

$$\text{Payback period} = \frac{\text{initial investment}}{\text{Annual benefit/annual cash inflows}}$$

Payback period reflects the time period by which the initial investment is recovered.

1) [illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

2) The initial investment on a project is ₹ [illegible] the annual cash inflows are [illegible] below for a period of 7 years

Year	1	2	3	4	5	6	7
Annual cash inflow	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Find the [illegible]

Year	cash inflows actual	cash inflows needed	PBP
1	400000	400000	1
2	500000	500000	1
3	300000	300000	1
4	400000	400000	1
5	600000	400000	$\frac{4\cancel{00000}}{6\cancel{00000}} \times 12$ = 8 months
6	700000	0	
7	500000	0	

$\boxed{\text{4 years 8 months}}$

Nominal v/s Effective Interest Rate ⇒

Q) A person invests a sum of ₹5000 in a bank at a nominal rate of interest of 12%. The compounding is done quaterly. Find the maturity amount of the deposit after 10 years.

$P = ₹5000$

$n = 10$

$i = 12\%$

$F = ?$

F/P in → required

Soln: no. of interest period per year = 4

revised no. of interest period = 40

interest rate per quater = 3%

$$F = P(1+i)^n$$

$$= 5000\,(1.03)^{40}$$

$$F = ₹\,16310.19$$

Effective Rate of Interest, $R = \left(1 + \frac{i}{c}\right)^c - 1$

c - no. of interest period per year.

$$R = \left(1 + \frac{0.12}{4}\right)^4 - 1$$

$$R = 0.1255 = 12.55\% \quad = 12.550881\% \text{ (exact)}$$

$$F = 5000\,(1+R)^n$$

$$= 5000\,(1.1255)^{10}$$

$$= 16308.91$$

$$F = 5000\,(1.12550881)^{10}$$

$$F = 16310.19$$

22/03/17

PRODUCTION

Production means change or transformation of physical inputs into physical output.

Production function is the technical or mathematical relationship between inputs and output.

TP / Q = output

(total product)

L & K = inputs; where L is the variable factor i.e. labour and K is the fixed factor i.e. capital (produced means of production)

Two time periods are →

1) Short period / Short run
2) Long period / Long run

In the short period, the variable factors are made variable only but the fixed factors are constant.

In the long period, all factors are variable.

1) Short run production function
2) Long run production function

SRPF (Short run production function) ; $\boxed{\Rightarrow Q = f(L, \bar{K})}$

LRPF (Long run production function) ; $\boxed{\Rightarrow Q = f(L, K)}$

Short Run Production Function :-

It means the study of the technical relationship between inputs and output in the short run i.e. when ~~one~~ L is variable and K is constant

Law of Variable Proportion : Variable proportion indicates the change in the factor proportion i.e. when K is constant in the short run and L is made variable. Law of variable proportion explains the return to the change in the factor proportion, or, this law explains the return to a factor

Typical Production Concepts :-

1) TP_L (Total product) / Q_L = $AP_L \times L$

2) AP_L (Average product) = $\frac{Q}{L}$

3) MP_L (Marginal product) = $TP_n - TP_{n-1} = \frac{dQ}{dL}$ $\left[MP_K = \frac{dQ}{dK}\right]$

As equal increments of one input are added the inputs of other productive services being held constant beyond a certain point the resulting ~~increm~~ increment of the product will decrease i.e

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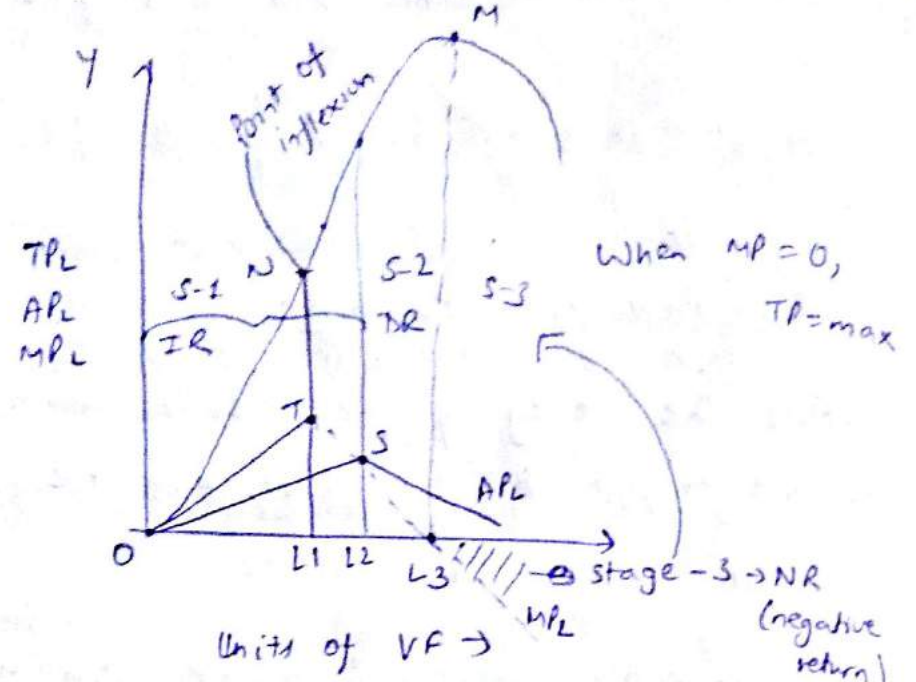
24/03/17



When MP = 0, TP = max

DR - diminishing return

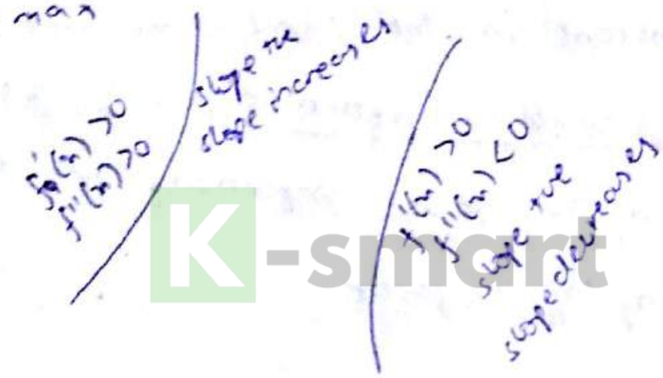
IR - incoming return

$y = f(x)$

(VF - variable factor)

At T, MP → max

At S → AP → max



Q	MP
20	—
28	8
35	7
40	5
44	4
46	2
47	1

Q	MP
20	—
25	5
31	6
38	7
46	8
55	9

As we go on applying more and more volume of the variable factors keeping the fixed factor constant after some time, first the marginal product and then the average product of the factor will diminish.

Relationship between AP_L and MP_L ⇒

when AP_L rises → $MP_L > AP_L$

when AP_L falling → $MP_L < AP_L$

when AP_L is max → $MP_L = AP_L$

$$Q = AP_L \times L$$

$$MP_L = \frac{dQ}{dL}$$

$$\Rightarrow MP_L = \frac{L \cdot dAP_L}{dL} + AP_L$$

(i) when AP_L is rising ⇒ $\frac{dAP_L}{dL} > 0$; $MP_L > AP_L$

ii) when AP_L is falling ⇒ $\frac{dAP_L}{dL} < 0$; $MP_L < AP_L$

iii) when AP_L is max ⇒ $\frac{dAP_L}{dL} = 0$; $MP_L = AP_L$

Q) Complete the following table:

No. of factor employment	TP	AP	MP
0	0	0	0
1	4	4	4
2	10	5	6
3	18	6	8
4	24	6	6
5	25	5	1

24 Q)

No. of factor employment	TP	MP	AP
0	0	0	0
1	225	225	225
2	525	262.5	300
3	900	300	375
4	1140	285	240
5	1125	225	
6			225

Q

No. of factor employment	TP	MP	AP
0	0	0	0
1	225	225	225
2	600	375	300
3	900	300	300
4	1140	240	285
5	1365	225	282.5
6	1350	-15	225

Q) A ce
L and
of th
follow
Assume
(i) find th
the to

(ii) Find
the a

b) A certain production process employs 2 inputs L and R (raw material). Output (Q) is a function of these 2 inputs. and is given by the following relationship $Q = 6L^2R^2 - 0{\cdot}10\,L^3R^3$.

Assume that the raw materials are fixed at 10 units.

(i) Find the no. of units of input L that maximizes the total product function

$$Q = 600L^2 - 100L^3 \quad (R = 10)$$

$$\frac{dQ}{dL} = 0 = Q_{max}$$

$$\frac{dQ}{dL} = 1200L - 300L^2 = 0$$

$$\Rightarrow L = 4$$

(ii) Find the no. of units of input L that maximizes the average product function.

$$Q = 600L^2 - 100L^3$$

$$\frac{Q}{L} = 600L - 100L^2$$

$\therefore AP_L$ is max

$$\frac{dAP_L}{dL} = 0$$

$$600 - 200L = 0 \Rightarrow L = 3$$

$$1200L - 300L^2 = 600L - 100L^2 \quad [AP_L = MP_L]$$

$$600L - 200L^2 = 0$$

$$L = 3$$

7) Find the units of input L where MP_L = max

$$MP_L = \frac{dTP}{dL} = 1200L - 300L^2$$

$$\frac{dMP_L}{dL} = 0 \quad (MP_L \text{ max})$$

$$1200 - 600L = 0$$

$$\Rightarrow L = 2$$

8) Given the short run production function as $TP_L = 10L - L^2$; find the no of labours beyond which MP_L = $-ve$

$$\frac{dTP_L}{dL} = 10 - 2L = 0 \quad (MP_L = 0 \; (TP_L = \max$$

$$L = 5$$

Cobb - Douglas Production function $\Rightarrow$

Functional form : $\boxed{Q = A L^{\alpha} K^{\beta}}$

23/03/17

Q - output

L and K - labour and capital respectively

α and β - output elasticities of labour and capital

A is a constant and is considered as the total factor productivity

→ $\alpha + \beta > 1$; so it is increasing return to scale

→ $\alpha + \beta < 1$; so it is diminishing return to scale

$\Rightarrow \alpha+\beta = 1$; so it is constant return to scale

Q) verify the return to scale from the following production function ; $Q = 5K^{0.3}L^{0.7}$

$L = 2,\ K = 3$

$\Rightarrow Q = 11.293$

$L = 4;\ K = 6$

$\Rightarrow Q = 22.586$

On doubling L and K, Q gets doubled

Q) $Q = 5K + 7L + KL$, what is the return to scale?

let $K = 2,\ L = 4$

$Q = 46$

let $K = 4,\ L = 8$

$Q = 108$

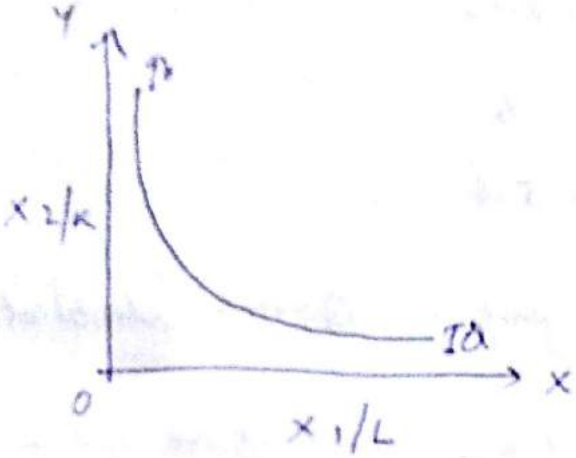
more than double, so it is increasing return to scale.

PRODUCER'S EQUILIBRIUM =)

ISO-QUANT/EQUAL PRODUCT CURVE

- Indifference curve is used in case of consumer equilibrium. Word Iso-quant is used in case of producer equilibrium.
- In case of indifference curve, we take 2 goods but in case of iso-quant we take two factors of production i.e. labour and capital.

Iso-quant is a locus of combination of two factors of production producing the same level of output, so a particular iso-quant is meant for a particular level of output



$$q_0 = f(x_1, x_2)$$

Properties :

1) Iso-quant is negatively sloped.

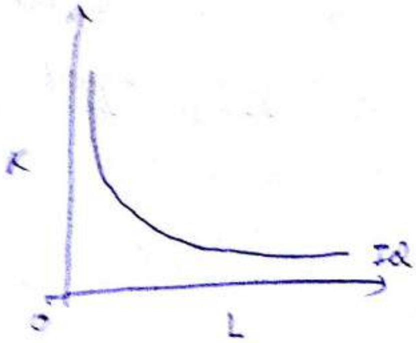
$$dq_0 = 0$$

$$\underbrace{\frac{\partial q_0}{\partial x_1}}_{MP_1} \cdot dx_1 + \underbrace{\frac{\partial q_0}{\partial x_2}}_{MP_2} dx_2 = 0$$

$$\Rightarrow MP_{x_1} \cdot dx_1 + MP_{x_2} dx_2 = 0$$

$$\Rightarrow \frac{dx_2}{dx_1} = -\left(\frac{MP_{x_1}}{MP_{x_2}}\right)$$

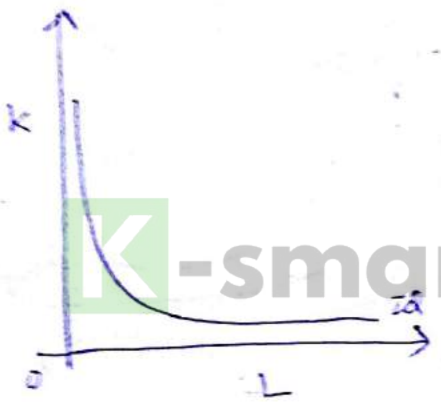
$\frac{dx_2}{dx_1}$ represents the slope of the iso-quant and is known as MRTS (Marginal Rate of Technical Substitution).



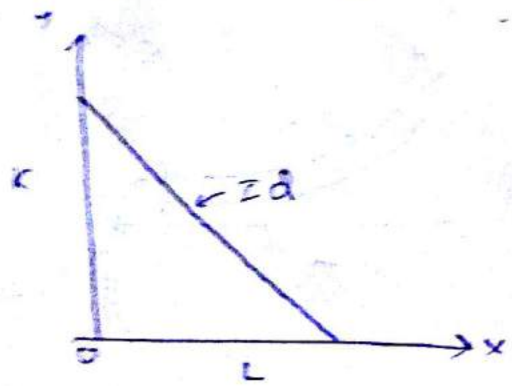
$$MRTS_{LK} = \frac{\Delta K}{\Delta L} = \frac{dK}{dL}$$

[illegible]/03/17

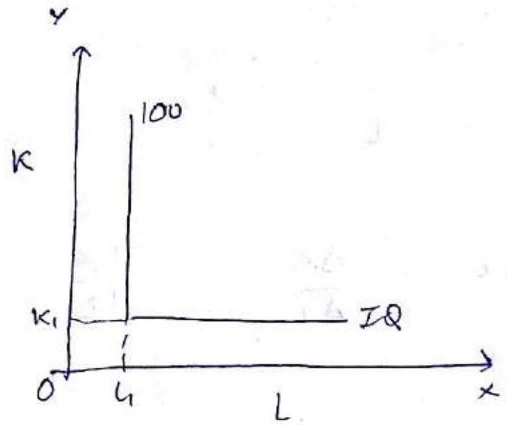
2) Iso-quant is convex to the origin..



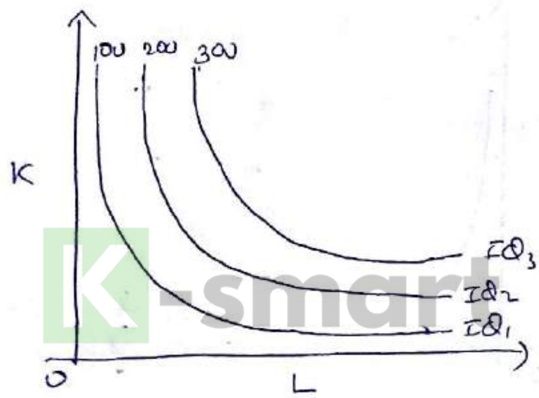
- Iso-quant is convex to the origin because of DMRTS (Diminishing Marginal Rate of Technical Substitution) i.e slope is decreasing. This is so because two factors of production are not perfect substitutes. If the factors of production are perfect substitutes then the shape of the iso-quant would be straight line.



If the 2 factors of production are perfect complements, the iso-quant would be right-angled.

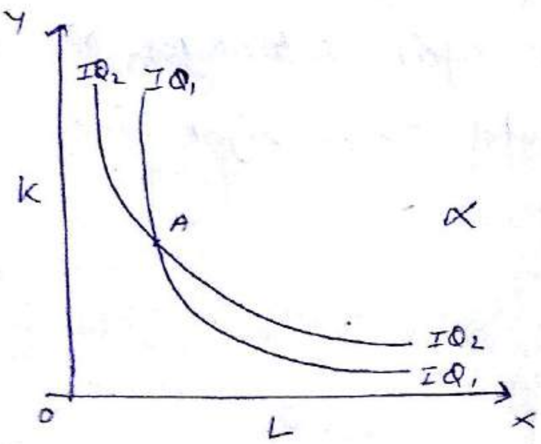


3) A higher iso-quant gives a higher level of output

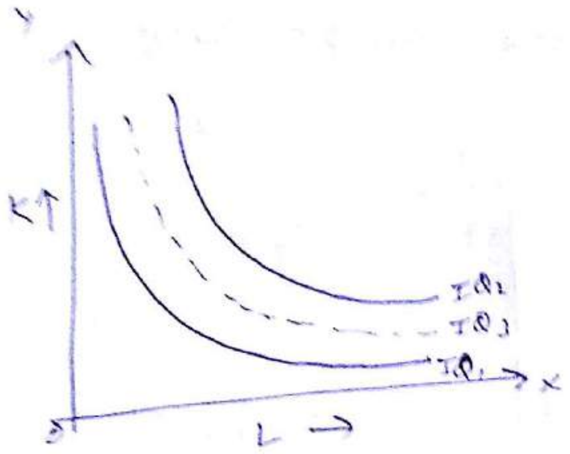


$$IQ_3 > IQ_2 > IQ_1$$

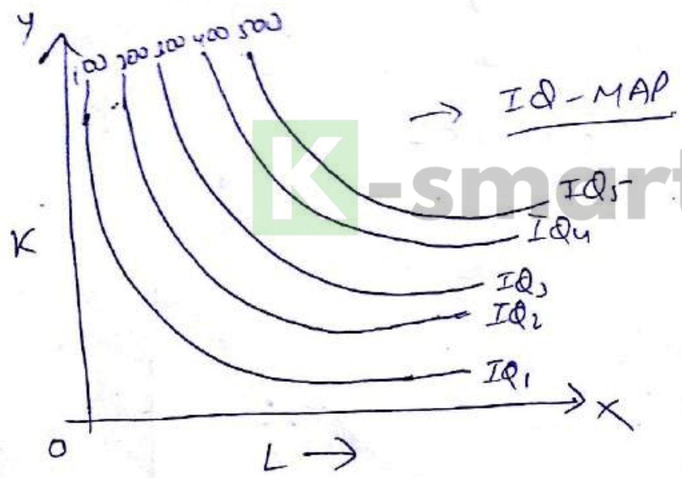
4) No two iso-quant can either touch or intersect each other.



5) In between ... drawn, because they cannot touch or intersect each other.



6) A family of iso-quants is known as an iso-quant map.



(#) Producer Equilibrium (to be taught)

Cost of Production ⇒

Cost functions are the derived functions and they are derived from the production functions.

$$C = f(Q)$$

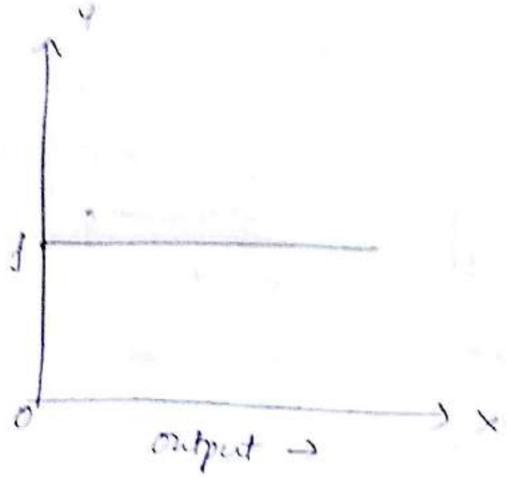
C/TC – total cost

① $TC = TFC + TVC$

TFC - Total fixed cost

TVC - Total variable cost

i) TFC

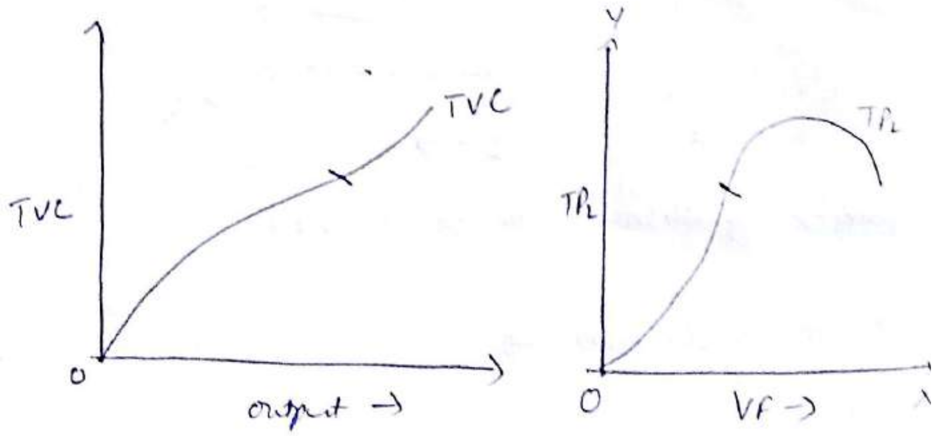


$Q = 0$; $TFC = Of$

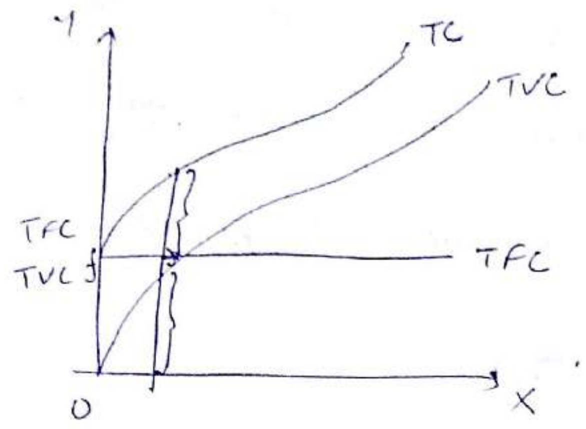
$TVC = 0$

$\Rightarrow TC = TFC$

ii) TVC



When $Q=0$ then $TVC = 0$ (proved above) so the TVC curves start from origin.



TC and TVC are parallel to each other at all levels of output because their vertical distance represents

$$\begin{bmatrix} TC = TFC + TVC \\ TC - TVC = TFC \end{bmatrix}$$

TFC, which is constant throughout.

② AC (Average cost) or (Average Total cost (ATC))

$$AC = \frac{TC}{Q} = \frac{TVC + TFC}{Q}$$

$$AC = \frac{TVC}{Q} + \frac{TFC}{Q}$$

$$AC = AVC + AFC$$

i) $AVC = \frac{TVC}{Q}$

$$TVC = L \cdot w$$

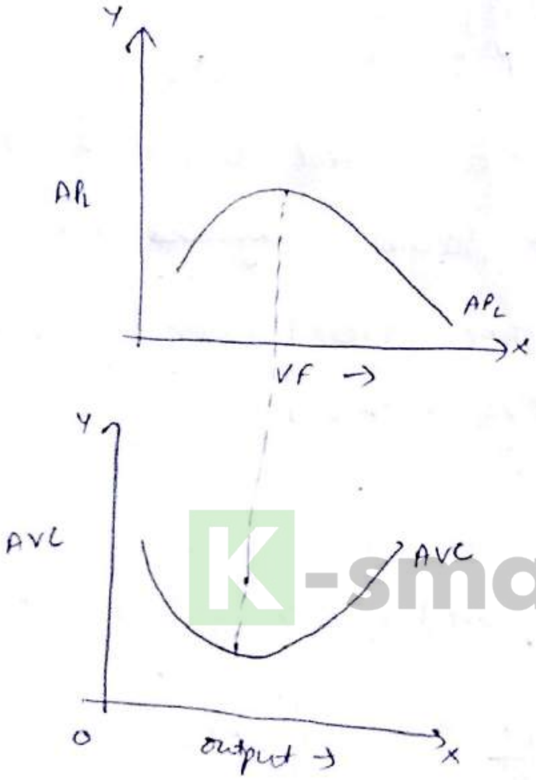
L = variable factor labour used

w = factor price

$$Q = AP_L \times L$$

$$AVC = \frac{\cancel{L} \cdot w}{AP_L \times \cancel{L}} = w\left(\frac{1}{AP_L}\right)$$

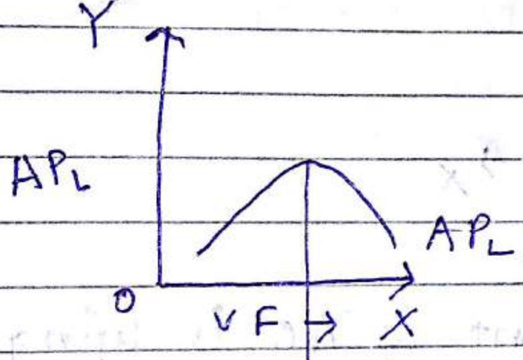
Therefore, AVC curve looks like the AP curve, whi[ch is] turned upside down with a minimum point of AVC corresponding to maximum point of AP.

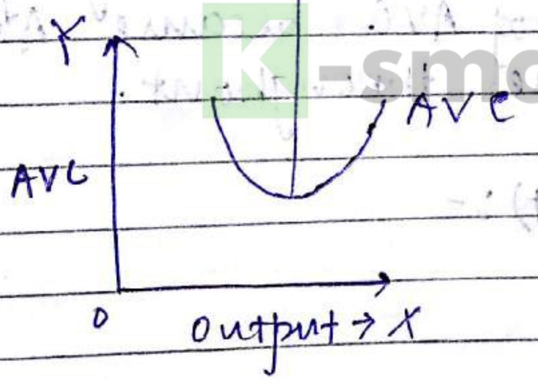


$Q = AP_L \times L$

$$AVC = \frac{\cancel{L} \times w}{AP_L \times \cancel{L}} = w\left(\frac{1}{AP_L}\right).$$

AVC curve looks like the AP curve when turned upside down with the minimum point of AVC corresponding to the max. point of AP.

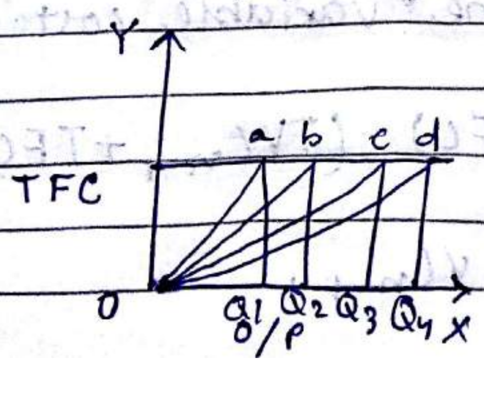


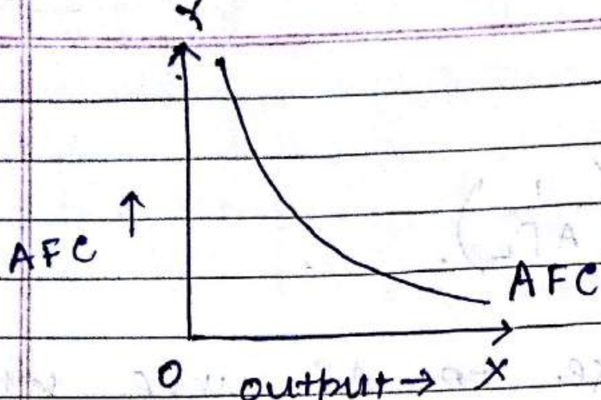


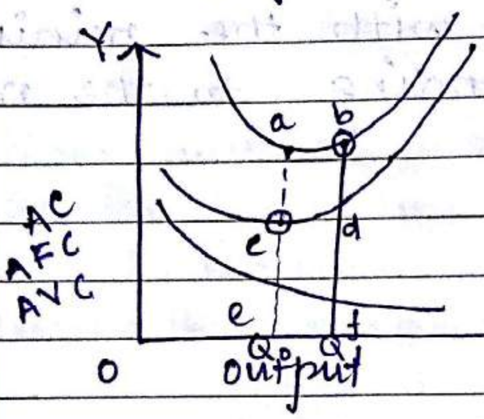
AFC :-

$$AFC = \frac{TFC}{Q}$$

AFC can be drawn from the slope of the lines drawn from the origin to TFC.







The minimum point of AC is lying to the right of minimum point of AVC because AC include AFC that decreases throughout.

⑤ MC (marginal cost) :-

$$MC = \frac{\Delta C}{\Delta Q}.$$

$$MC = \frac{dC}{dQ}.$$

$$MC_n = TC_n - TC_{n-1}.$$

MC is not affected by the fixed cost rather it is affected by the variable cost.

$$MC_n = (TVC_n + TFC) - (TVC_{n-1} + TFC)$$

$$= TVC_n - TVC_{n-1}.$$

$$MC = \frac{\Delta TVC}{\Delta Q}$$

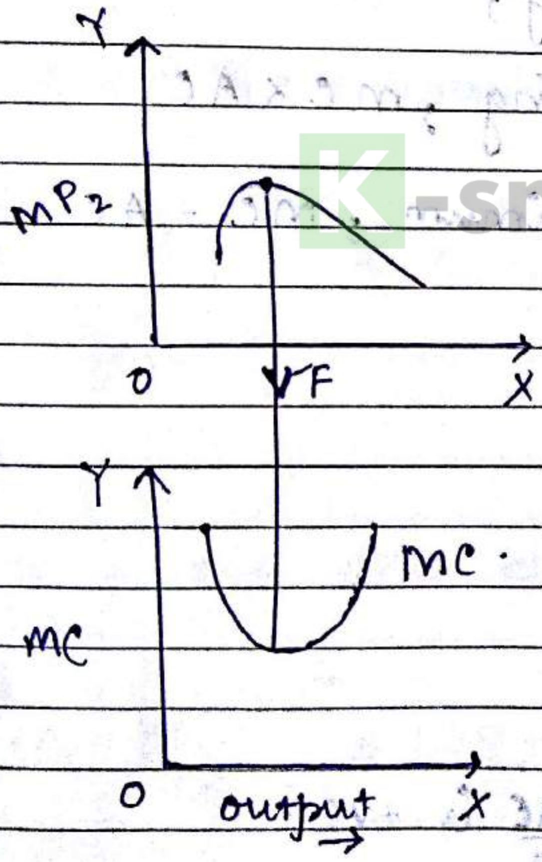
$$MC = \frac{dTVC}{dQ}$$

$$MC = \frac{\Delta TVC}{\Delta Q}$$

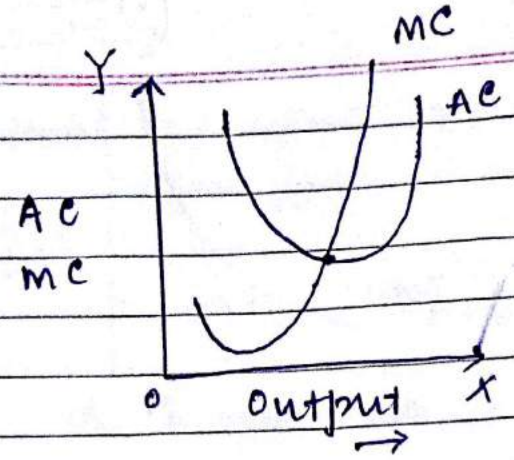
$$MC = \frac{\Delta L \cdot w}{\Delta Q}$$

$$MC = w\left(\frac{\Delta L}{\Delta Q}\right)$$

$$MC = w\left(\frac{1}{MP_L}\right) \qquad \left\{ MP_L = \frac{\Delta Q}{\Delta L} \right\}$$



⊛ Relationship between AC and MC :-



MC curve cuts the AC curve at its minimum point because MP curve cuts the AP curve at its maximum point.

- when AC is rising, MC > AC
- When AC is falling, MC < AC
- when AC is minimum, MC = AC.

$AC = \frac{C}{Q}$

$\Rightarrow C = AC \cdot Q$

$MC = \frac{dC}{dQ}$

$MC = Q \cdot \frac{dAC}{dQ} + AC$

i) slope is rising, $\frac{dAC}{dQ}$ is +ve

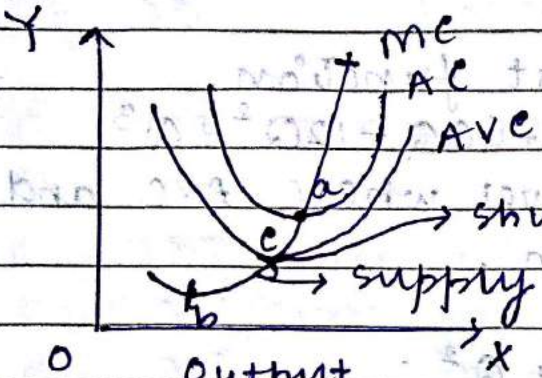
MC > AC

ii) AC is falling, $\frac{dAC}{dQ}$ is -ve.

MC < AC

iii) AC is minimum, $d\frac{AC}{dQ} = 0$ $\therefore MC = AC$.

Derivation of short-run supply curve from the MC curve:



b to c → isn't considered as supply curve

(Q) Given the cost function $C = 100 + 10Q + Q^2$.
a) What is the AFC of producing 2 units of O/P?

(A) a) $AFC = \frac{100}{2} = 50$.

b) What is the AVC of producing 2 units of O/P?

A b) $AVC = \frac{dTVC}{dQ} = \frac{10Q + Q^2}{Q} = 10 + Q = 12$.

c) What is MC of producing 2 unit of O/P?

A) c) $MC = \frac{dTVC}{dQ} = 10 + 2Q = 14$.

d) What is the AC?

Ans) $AC = \frac{C}{Q} = \frac{100}{Q} + \frac{10\cancel{Q}}{\cancel{Q}} + \frac{Q^{\cancel{2}}}{\cancel{Q}}$

$= 50 + 10 + 2 = 62.$

(Q) Given the total cost function.

$C(Q) = 100 + 60Q - 12Q^2 + Q^3.$

Find the output level where AVC and MC will be minimum.

Ans) $AVC = 60 - 12Q + Q^2$

$\frac{d(AVC)}{dQ} = 0$

$\Rightarrow -12 + 2Q = 0$

$\Rightarrow Q = 6$

$MC = \frac{dTVC}{dQ}$

$= 60 - 24Q + 3Q^2$

$\frac{d(MC)}{dQ} = 0$

$\Rightarrow -24 + 6Q = 0$

$\Rightarrow Q = 4.$

(Q) Given $TVC = 150Q - 20Q^2 + Q^3$.

Determine below what price the farms would shut down production.

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Ans) $AVC = 150 - 20Q + Q^2$.

$\frac{d(AVC)}{dQ} = 0$

$\Rightarrow -20 + 2Q = 0$

$\Rightarrow Q = 10$.

$AVC = 150 - 200 + 100 = 100 - 50 = 50$

(Q) $TVC = 75Q - 10Q^2 + Q^3$.
will the farm produce the product if the price of the product is ₹40?

Ans) $AVC = 75 - 10Q + \cancel{3Q^2} \cdot Q^2$.

$\cancel{\frac{d(AVC)}{dQ} = 0}$

$\cancel{\Rightarrow -10 + 6Q = 0}$.

$\cancel{\Rightarrow Q = \frac{10}{6}}$.

$\cancel{AVC = 75 - \frac{100}{6} + 3\left(\frac{100}{36}\right)}$.

$\cancel{= ₹ 66.6667}$.

$\frac{d(AVC)}{dQ} = 0$

$\Rightarrow -10Q + 2Q = 0$

$\Rightarrow Q = 5$.

$AVC = 75 - 10(\cancel{2}5) + \cancel{25 \times 5}\ 25$.

$= 50$.

NO.

(Q) The total cost and the level of output of a company is given below. Find TVC, AVC, AFC, AC and MC if the TFC is ₹100.

Quantity(Q)	TC(Total cost)	TFC	TVC
1	130	100	30
2	160	100	60
3	190	100	90
4	220	100	120
5	250	100	150
6	280	100	180

Ans)

AVC	AFC	AC	MC
30	100	130	30
30	50	80	30
30	33.33	63.33	30
30	25	55	30
30	20	50	30
30	16.67	46.67	30

(Q) When a farm produces 200 units the total cost of production is ₹4000. When the farm increases the output to 220 the total cost rises to ₹4900. When the farm produces 0 output the cost is ₹1000. What is the fixed cost per unit? when the farm produces 200 units?

(Ans) TFC = 1000 $\quad$ AFC $= \frac{1000}{200} = ₹5$

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(Q) Identify the different phases about the behaviour of output implied in the law of variable proportion from the following information.

Units of variable i/Ps	Marginal Product (MP_L)	
1	20	→ IR (Increasing Rate of Return)
2	25	
3	26	
4	20	→ Decreasing Return
5	17	
6	−10	→ Negative Return.

BREAK EVEN POINT :- (BEP).
It is a point where TR = TC.

$$\boxed{SP - AVC = CM}$$

SP = Selling Price
AVC = Average Variable cost
CM = contribution margin

Fixed cost ₹ 100000

$\frac{100000}{5} = 20{,}000$

SP − AVC = CM
20 − 15 = 5.

TC = TFC + TVC
= 100000 + 15×20,000
= ₹ 400000

TR = PQ
= 20 × 20,000
= ₹ 400000.

20,000

Total contribution = 5 x 20,000
= ₹100000.

At BEP,

TR = TC

Total contribution = Fixed cost

BEP is a no profit no loss point. It is an equilibrium point.
It is a critical point.
It is a balancing point.
The producer wants to reach at the BEP as quick as possible so that he can earn profit.

PROFIT VOLUME RATIO (P/V ratio):

$$P/V = \frac{CM}{sales} = \frac{\text{Total contribution}}{\text{Total sales}}$$

$$= \frac{5}{20} = \frac{1}{4} = 25\%$$

(For every rupee of sales, the producer is getting 25 paise for coverage of fixed cost).

P/V ratio indicates the contribution of every rupee towards the coverage of fixed cost.

MARGINAL EQUATION :-

$\boxed{Sales - VC = FC \pm P}$

P = Profit
VC = Variable cost

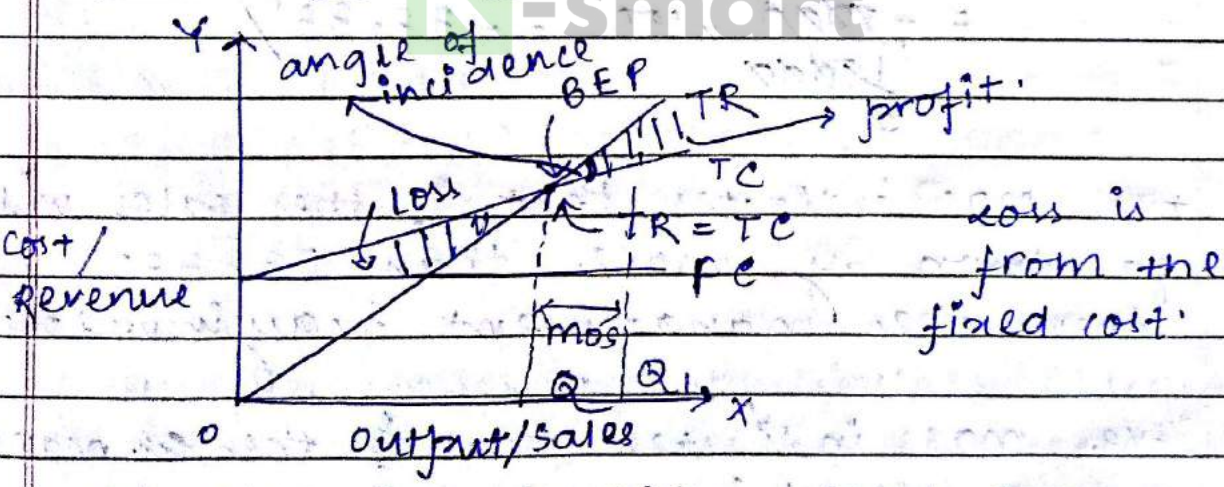
20000 X 20
= 400000

400000 − 300000
= 100000 + 0

15 X 20 000
= 300000

Before break even point, you lose (loss).
After BEP, you gain (profit).

BREAK EVEN CHART :-



Greater the angle of incidence, more is the profit

Gap between BEP and new quantity is MOS

Margin of safety (MOS) is the excess of actual sales over BE sales (Break even sales)

$$MOS = \text{Actual sales} - \text{Break even sales}$$

$$= 30{,}000 - 20{,}000 = 10{,}000 \text{ unit.}$$

$$MOS\% = \frac{AS - BES}{AS} \times 100$$

$$= \frac{30{,}000 - 20{,}000}{30{,}000} \times 100$$

$$= 33.3\%$$

$$MOS\% = \frac{15{,}000 - 20{,}000}{15{,}000} \times 100$$

$$= \frac{-\cancel{5000}}{\cancel{15000}_{3}} \times 100 = -33.33\%$$

* +ve MOS indicates that if the sales will go down by more than 33.33% then the management may incure loss

* -ve MOS indicates that the management should improve the sales by atleast 33.33% to avoid loss.

$$\text{Break even Quantity } (Q_B) = \frac{FC}{CM \text{ per unit}}$$

$$\text{Break even sales Value } (S_B) = Q_B \times SP.$$

$\frac{TFC}{P/V \text{ ratio}} = S_B.$ $P/V = \frac{CM}{SP} = \frac{SP - AVC}{SP}$

$$S_B = \underbrace{\frac{TFC}{SP - AVC}}_{Q_B} \times SP$$

(Q) From the following information find out the amount of profit earned during the year.

FC = ₹ 2,50,000

VC = ₹ 10 per unit = AVC.

SP = ₹ 15 per unit.

Q = 75,000 units

Ans) S − VC = FC ± P.

⇒ 75,000 × 15 − 10 × 75,000 = 2,50,000 ± P.

⇒ 3,75,000 = 2,50,000 ± P

⇒ P = ₹ 1,25,000

(Q) From the following particulars calculate

① BEP in terms of units and sales value.

② Sales required to earn profit of ₹ 90,000.

FC = ₹ 72,000

V C/unit = AVC = ₹ 15

SP per unit = ₹ 24.

Ans) $Q_B = \frac{FC}{CM \text{ per unit}} = \frac{72,000}{24 - 15} = 8000$

$S_B = Q_B \times SP = ₹ 1,92,000.$

② $S - VC = FC + P$

$\Rightarrow S - 15 \times 8000 = 72,000 + 90,000$

$\Rightarrow S = ₹2,82,000$

since the profit will be zero for Q_B so we cannot use it to calculate VC and thus S.

$$\text{sales required} = \frac{FC + \text{desired profit}}{\text{Cm per unit}}$$

$= 18000$

(Q) A farm has the volume of sales ₹40,0000000 and S_B = ₹25,0000000

Ans) $MOS = \frac{15}{40} \times 100 = 37.5\%$

If the sales goes down by more than 37.5% then the management will encure loss

(Q) Consider the following data of a company:

Sales = ₹1,20,000

FC = ₹25,000

VC = ₹45,000

i) Find contribution = sales − VC

= ₹75,000

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ii) Profit = ₹75,000 − ₹25000 (Contribution − FC)
= ₹50,000

After FC is covered, we will get the profit

iii) BEP :-

P/V ratio = $\frac{\text{Contribution}}{\text{Sales}} = \frac{75,000}{1,20,000} \times 100 = 62.5\%$

BEP = $\frac{25000}{0.625}$ = ₹40,000.

{BEP = $\frac{FC}{P/V\ ratio}$}

iv) MOS :

MOS = AS − BES
= 120000 − 40000
= 80000.

MOS = $\frac{\text{Profit}}{P/V\ ratio} = \frac{₹50,000}{0.625}$ = ₹80,000.

(Q) Consider the following data
Sales = ₹80,000
FC = ₹15,000
VC = ₹35,000
Find contribution, profit, BEP, MOS

Ans) Contribution = ₹45,000

ii) Profit = ₹ 30,000

iii) BEP = $\frac{FC}{P/V \text{ ratio}}$ P/V ratio = $\frac{₹ 45,000}{80,000}$ = 0.5625

= $\frac{₹ 15,000}{0.5625}$

= ₹ 26666.67.

iv) MOS = $\frac{\text{Profit}}{P/V \text{ ratio}}$

= $\frac{₹ 30,000}{0.5625}$

= ₹ 53 333.33.

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OPTIMUM INPUT COMBINATION :-
(AND PRODUCER'S EQUILIBRIUM).

(Q) Explain the producer's equilibrium with the help of isoquants.

$$\text{Slope of isoquant} = MRTS_{LK} = \frac{MP_L}{MP_K}.$$

An important problem faced by the producer is to decide about the particular combination of factors to be employed to produce a product. Although there are various combinations of factors (isoquants) which can yield a given level of output but the problem is the producer has to choose one combination of factor from these combinations.

A profit maximising producer will want to minimise the cost or maximise the output for a given level of cost. However the choice of a particular combination of factors by the enterprenuer always depends on:

(i) Technical possibilities of production i.e, isoquant map.

(ii) Prices of the factors (level and capital) used to produce a particular product

ISO-COST LINE:

Iso-cost line shows various combinations of two factors that the farm can buy with a given level of outlay (cost). For example,

$C = 300$ (cost)

Labour price $= ₹4 \cdot (w = 4)$ wage.

Capital price $= ₹5 \cdot (r = 5)$ rent.

L = Labour Unit

w = wage

Then labour payment $= L \times w$.

capital ~~[illegible]~~ $= K$

r = Rent

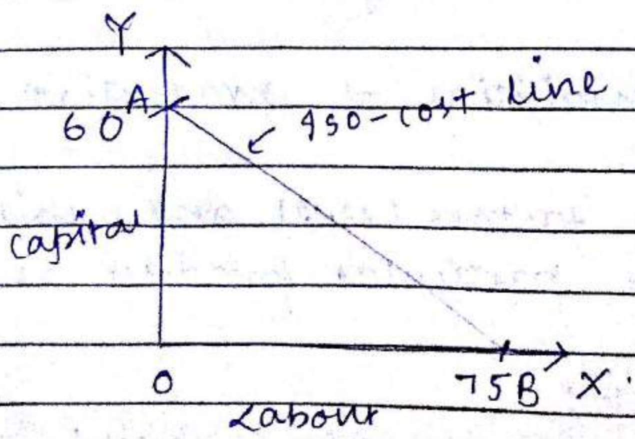
Then capital payment $= K \times r$.

$C = wL + rK$

Labour units used $= \frac{300}{4}$ (without capital)

$= 75L \quad = \frac{C}{r}$

Capital units used $= \frac{300}{5} = 60K. = \frac{C}{w}$.



$OA = \frac{C}{r}$ (graphically)

$OB = \frac{C}{w}$

The slope of the iso-cost line is $\frac{OA}{OB} = \frac{w}{r}$

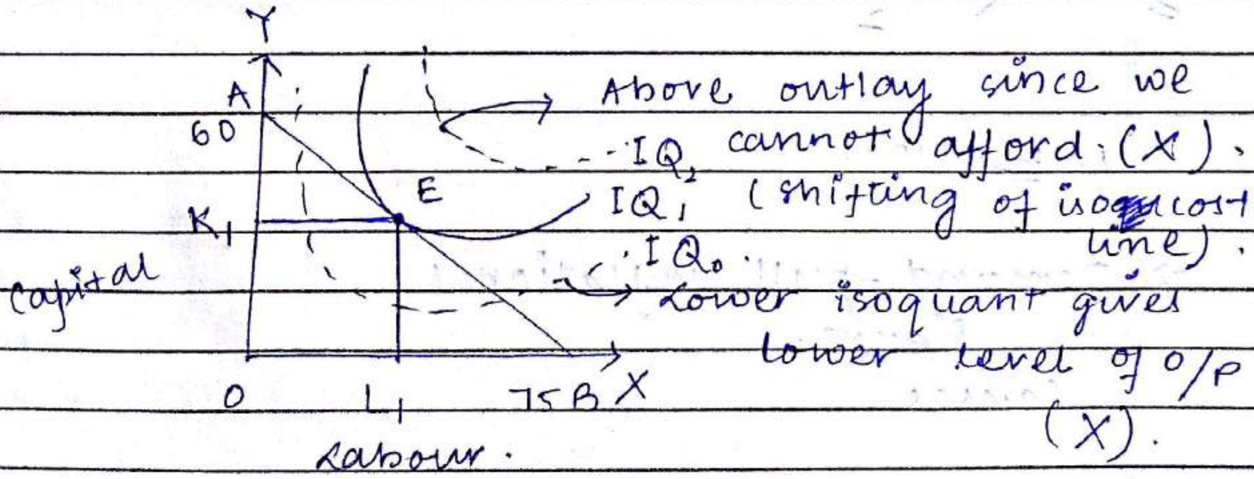
For producer equilibrium,

(1) The slope of the iso-cost line should be equal to the slope of the isoquant (at the equilibrium point) i.e, at the point of equilibrium the iso-cost line should be tangential to the isoquant.

(2) At the point of equilibrium, the isoquant must be convex to the origin.

so, $MRTS_{LK} = \frac{MP_L}{MP_K} = \frac{w}{r}$

$\Rightarrow \frac{MP_L}{w} = \frac{MP_K}{r}$



(Q) A farm producing O/P L and K in such quantities that $MP_L = 15$, $MP_K = 8$, $w = 3$ $r = 2$. Is the farm using efficient factor combination for production? (No)

Ans) as $\frac{MP_L}{w} \neq \frac{MP_K}{r}$ [$5 \neq 4$]

4marks (Q) Explain the producer's equilibrium condition. $\left(\frac{MP_L}{w} > \frac{MP_K}{r}\right.$ (Inefficient) $<$

(Q) The wage rate of labour is ₹6 and the price of raw material is ₹2. The MPL is 16 and MP_r is 4. Can the farm operate under these conditions and maximize profit?

Ans) $\frac{MP_L}{w} = \frac{MP_r}{r}$

$\Rightarrow \frac{16}{6} \neq \frac{4}{2}$

$\Rightarrow 2.67 > 2$. (x). [It is not an efficient condition]

(Q) A farm reports that MP of labour is 5 and $MRTS_{LK} = 2$. What is MP_K?

Ans) $MP_K = \frac{5}{2} = 2.5$.

INFLATION :-

→ Demand-pull inflation:
Figure.
Causes

→ Cost-push inflation:
Figure
Causes

→ Control of inflation:
Monetary policy (Bank rate)
Fiscal policy. (Explain the points)

nt)

Monetary policy :-

- Bank Rate
- open market operation.
- Cash Reserve ratio (CRR)
- Statutary Liquidity ratio. (SLR)

10 lines on each.

(Q) what is national income (NI)?

(Q) what is Gross Domestic Product (GDP)?

(Q) Define Gross National Product.? (GNP)

(Q) what is net domestic product (NDP)?

(Q) what is meant by net national product (NNP)?