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"I don't love studying. I hate studying. I like learning. Learning is beautiful."

"An investment in knowledge pays the best interest."

Hi, My Name is

IIT JEE

(Fiitjee)

MERU JAIN

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bill 10/10

(1)

CHEMISTRY - I

(1) STOICHIOMETRY

(2) GAS LAWS

(3) ATOMIC STRUCTURE

(4) CHEMICAL BONDING

(5) PERIODIC PROPERTIES

(6) S-BLOCK ELEMENTS

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occupies 22.4 l. of volume if it is 1 mole
$PV = nRT$ R = Universal gas constant ($8.314\ J/mol\cdot K$)
($0.0821\ l\cdot atm/mol\cdot K$)

P = 1 atm = 76 g

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Stoichiometry

(2)

☆ Mole :-

☆ Calculation of moles

(1) $\frac{\text{no. of particle}}{N_A} = \text{no. of moles}$

(2) $\text{no. of moles} = \frac{\text{weight}}{\text{molecular weight}}$ (gm) (gm)

(3) $\text{no. of moles of atom} = \frac{\text{wt}}{\text{Atomic wt.}}$ [gm]

(4) $\text{no. of moles} = \frac{\text{vol of gas at stp (l)}}{22.4\ (l)}$

(Q-1) Find the no. of e^- in 4.5 g of water at 25°C

H_2O = water

(A-1) $\frac{4.5}{18}$ no. of mole

$\Rightarrow \frac{4.5}{18} N_0$ atoms $\therefore \frac{4.5}{18} N_0 \times 10$ [as 10 e- are there in every particle]

$\Rightarrow \frac{4.5}{18} \times 6.02 \times 10^{23}$ e^-

$\Rightarrow 15.05 \times 10^{23}$

$\Rightarrow 1.505 \times 10^{24}$

(Q-2) A vessel contains 20 g of dry ice (CO_2). If 3.01×10^{22} particles are withdrawn from the vessel and temp. of vessel is increased to 25°C. Find the vol of gas at S.T.P

$\frac{20}{44} = n$ $\therefore \frac{5}{11}$ moles

$\frac{5}{11}$ or $\frac{5}{11} \times 6.022 \times 10^{23}$ particle

$\left(\frac{5}{11} \times 6.022 \times 10^{22} \times 10\right) - \left(3.01 \times 10^{22}\right)$

$\Rightarrow 3.01 \times 10^{22}\left[\left(\frac{5}{11} \times 2 \times 10\right) - 1\right]$

$\Rightarrow 3.01 \times 10^{22}\left[\frac{100-11}{11}\right]$

$\Rightarrow 3.01 \times 10^{22} \times \frac{89}{11}$ 8.09 particles

$\Rightarrow 24.35 \times 10^{22}$ particles

$\Rightarrow 2.435 \times 10^{23}$ particle

$\therefore \frac{2.435 \times 10^{23}}{6.022 \times 10^{23}}$ moles $\therefore$

$\frac{2.435}{6.022} = \frac{v}{22.4}$ or $v = \frac{22.4 \times 2.435}{6.022}$

$\frac{54.5440}{6.022}$ ℓ or 9.06 ℓ

(Q-3) Find Vol of Nitrogen (N_2) produced by combustion of an artificial sweetner (Aspartic) $C_{14}H_{28}N_2O_5$ at S.T.P if 100 g of it is taken for combustion.

CHEMISTRY -

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(1) CHEMICAL KINETICS

(2) CHEMICAL EQUILIBRIUM

(3) IONIC EQUILIBRIUM

(4) BORON N CARBON FAMILY

(5) THERMODYNAMICS

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CHEMICAL KINETICS

Branch of science which deals with rate of reaction and reaction mechanism is known as chemical kinetics.

★ Types of Reactions on the basis of rate of reaction

(1) Very fast reaction
(2) Very slow reactions
(3) Moderate reactions

(1) $NaCl + AgNO_3 \longrightarrow AgCl\downarrow + NaNO_3$
$NaOH + HCl \longrightarrow NaCl + H_2O$
} Very fast

(2) $H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$
} Very slow
Rusting of Fe

(3) $Fe^{2+} + MnO_4^- + H^+ \longrightarrow Fe^{3+} + Mn^{2+} + H_2O$
$C_2O_4^{2-} + MnO_4^- + H^+ \longrightarrow CO_2 + Mn^{2+} + H_2O$

★ Number of steps involved

(1) Elementary reaction / Simple reaction / Single step reaction
(2) Non-elementary reaction / Complex reaction
∴ multi-step reaction

Rate of reaction

(1) Average rate of reaction
(2) Instantaneous rate of "

$$A \longrightarrow P$$

$$\left.\begin{matrix} -ve \text{ w.r.t. } A \\ +ve \text{ w.r.t } P \end{matrix}\right\}$$

$$r_{avg} = \mp \frac{\Delta c}{\Delta t}$$

$$r_{ins} \quad \lim_{\Delta t \to 0} \mp \frac{\Delta c}{\Delta t}$$

$$\Rightarrow \mp \frac{dc}{dt}$$

Law of mass Action [LOMA]

According to LOMA at constant temperature rate of reaction is directly proportional to the active mass of the reactants

Active mass of the reactants is its molar concentration

i.e consider the reaction

$$aA + bB \longrightarrow P + Q$$

According to law of action

$$r \propto [A]^m [B]^n$$

$$\text{or} \quad r = K[A]^m [B]^n \quad \ldots \text{Rate law}$$

Where K = Rate constant / Velocity constant
= Specific reaction Rate

m = order of reaction w.r.t A

n = order of reaction w.r.t B

m+n = overall order

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CHEMISTRY - 3

(1) GOC / ISOMERISM

(2) ELETROPHILIC AROMATIC SUBSTITUTION

(3) ALKANE / ALKENE / ALKYNE

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General Organic Chemistry

Factors affecting cleavage of a bond

(1) Inductive effect

Partial shifting of shared pair of electron due to differen in electronegativity of 2 atoms is known as inductive effect or I effect.

This is of 2 types

→ −I effect : Electron withdrawing group.

→ +I effect : Electron releasing group.

$$C - \overset{\delta\delta+}{C} - \overset{\delta\delta+}{C} - \overset{\delta+}{C} - \overset{\delta-}{X}$$ → Halogen

- Any group which is having more withdrawing power than that of Hydrogen, it will be group with −I Effect while it is having less electron withdrawing power than that of hydrogen it will be considered as a group with +I effect i.e. electron releasing.

Features

1) In inductive effect only partial shifting of bond pair takes place ie. charges will always be partial
2) It is a permanent effect which operates only on sigma electrons
3) In inductive effecting, after shifting of electrons, orbitals remains same
4) With increase in distance it decreases rapidly and usually it is ~~inf~~ ineffective after 3-4 carbon atoms

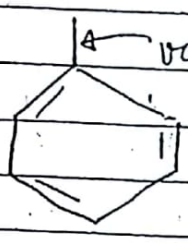
R = Alkyl group ⇒ Alkane - H

(5) The relative order of -I effect

$$-\overset{R}{\underset{R}{\overset{|}{N}}}-R > -\overset{\oplus}{N}H_3 > -NO_2 > -CN > -\overset{O}{\overset{||}{C}}-OH$$

$$> -F > -Cl > -Br > -Ph > -H$$

Ph = Phenyle



Releasing +I effect

$$-O^{\ominus} > -\overset{O}{\overset{||}{C}}-O^{\ominus} > CH_3-\overset{CH_3}{\overset{|}{C}}-CH_3 > CH_3-\overset{H}{\overset{|}{C}}-CH_3 >$$

$$CH_3-\overset{H}{\overset{|}{C}}-H > CH_3- > -H$$

☆ Inductive effect also includes field effect, passing through the interaction of solvents as well as interaction of groups through space

Application of Inductive effect

Compare the following as mentioned

(1) $CH_3-CH_2-\underset{F}{\overset{|}{CH}}-\overset{O}{\overset{||}{C}}-OH$

(1) > (2) > (3)

$CH_3-\underset{F}{\overset{|}{CH}}-CH_2-\overset{O}{\overset{||}{C}}-OH$

$CH_2(F)-CH_2-CH_2-\overset{O}{\overset{||}{C}}-OH$ (A.S)

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CHEMISTRY - 4

(1) HALOALKANE/ARENE

(2) ALCOHOL ETHER PHENOL

(3) KETONES/ALDEHYDE

(4) CARBOXYLIC ACID

(5) NITROGEN COMPOUNDS

(6) GLUCOSE, ETC

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(2)

Alkyl halide, Aryle halide

Nucleophilic Substitution reaction

- The substitution reaction in which the attacking reagent is a nucleophile is called nucleophilic substitu reaction. The
- Nucleophilic substitution reactions are classified into 3 typ

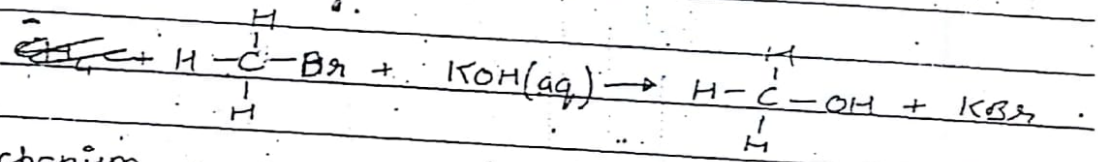
(1) SN^2 reaction
(2) SN^1 reaction
(3) SN^i reaction

SN^2 reaction

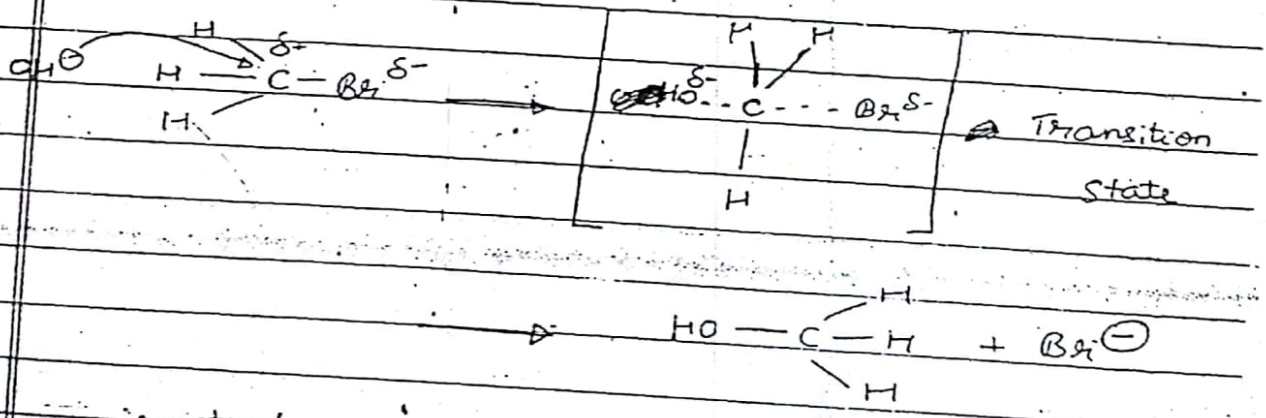
Nucleophilic substitution bi-molecular reaction.

Mechanism

(1)



Mechanism

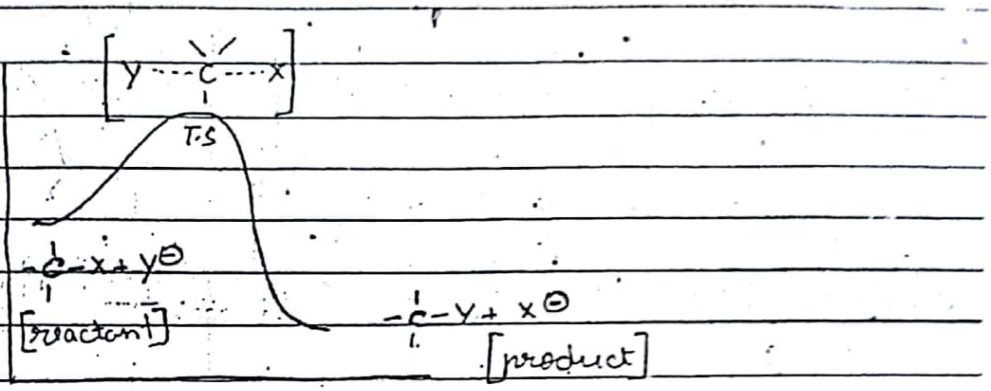


(2) → SN^2 reaction/ Mechanism takes place in 1 step
→ In SN^2 reaction the nucleophile attacks the atom bonded to the leaving group from the rear/back side of the leaving group.
→ In SN^2 reaction no intermediate is formed
→ In SN^2 reaction bond breaking and bond making

takes place simultaneously

→ S_N2 reaction proceeds through the formation of transition state.

③



④ Kinetics of S_N2

→ The rate of S_N2 reaction is directly proportional to the concentration of substrate as well as the concentration of nucleophile

$$\text{Rate} \propto [\text{Substrate}][\text{Nucleophile}]$$

$$\text{or Rate} \propto [CH_3-Br][OH^-]$$

$$\text{Order} = 1+1 \Rightarrow 2$$

⑤ Stereochemistry of S_N2 reaction

→ S_N2 reaction proceed with the complete inversion of configuration. In S_N2 reaction the inversion of configuration takes place because the nucleophile attacks the substrate molecule from the opposite side of the leaving group.

→ This is also known as Walden Inversion

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CHEMISTRY - 5

(1) SALT ANALYSIS

(2) SOLID STATE

(3) LIQUID SOLUTION

(4) ELECTROCHEMISTRY

(5) SURFACE CHEMISTRY

(6) CO-ORDINATION COMPOUND

(7) P-BLOCK

(8) ORES N METALLURGY

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PHYSICS - I

(1) VECTORS

(2) MECHANICS - I

(3) KINEMATICS

(4) MECHANICS - II

(5) WORK, ENERGY, POWER

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PHYSICS - II

(1) CENTRE OF MASS / COLLISION

(2) ROTATION

(3) FLUIDS

(4) GRAVITATION - I

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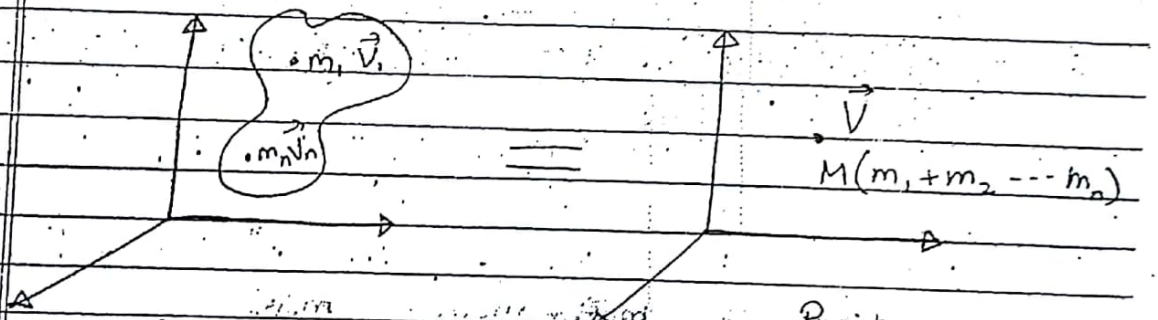
CENTRE OF MASS

The concept of centre of mass is an imaginary concept which converts a body into point mass so that all laws of motion and kinematics can be applied for the study of translational motion of a body.

Centre of mass is the point in the space where total mass of the system is considered as to be concentrated and which represents the complete translational motion of the body.



$\vec{P}_{sys} = m_1\vec{v}_1 + m_2\vec{v}_2 \cdots m_n\vec{v}_n$

$P_{point\ mass} = m\vec{V}$.

According to defination

$\vec{P}_{sys} = \vec{P}_{pt.\ mas}$

$\Rightarrow M\vec{V} = m_1\vec{v}_1 + m_2\vec{v}_2 \cdots m_n\vec{v}_n$

$\vec{V}_{cm} = m_1\vec{v}_1 \cdots m_n\vec{v}_n / M$

$\Rightarrow \vec{V}_{cm} = \dfrac{\sum m_i\vec{v}_i}{\sum m_i}$ Velocity of centre of mass

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PHYSICS 3

(1) GRAVITATION - II

(2) SHM/ELASTICITY

(3) WAVE MOTION

(4) THERMODYNAMICS

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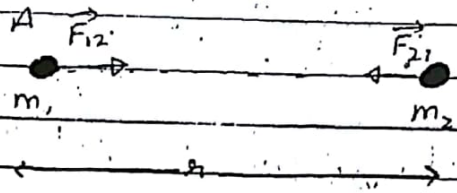
Motion of 2 point masses under their mutual interaction

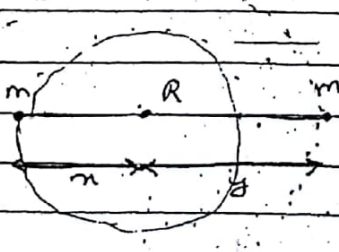


$$|\vec{F}_{12}| = |\vec{F}_{21}| = \frac{G m_1 m_2}{r^2}$$

$\vec{F}_{21}$ is acting towards pt. mass m_1
$\vec{\tau}$ of $\vec{F}_{21}$ about pt. A is zero
Angular momentum of point mass m_2 about Point A is conserved

if 2 point masses are performing motion under the influence their mutual attraction only then the angular momentum of 1 point mass about another point mass remains conserved.
NOTE: This is true for 1 pt mass and Spherical body or both spherical body

Circular ~~to~~ motion of Binary system



$$x = \frac{m_2 r}{m_1 + m_2}$$

$$y = \frac{m_1 r}{m_1 + m_2}$$

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PHYSICS - 4

(1) ELETROSTATICS

(2) CURRENT

(3) MAGNETICS

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* Charge is quantised
* charge is conserved

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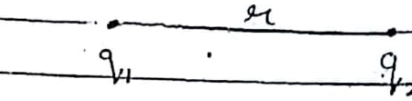
Electrostatics

Coulomb's law (Apply for point charge)



$$|F| \propto q_1 q_2$$

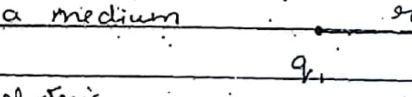
$$\propto \frac{1}{r^2}$$

$$|F| = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2} \Rightarrow \frac{k q_1 q_2}{r^2} \quad k = 9\times10^9 \frac{Nm^2}{C^2}$$

ϵ_0 = permitivity of free space $\epsilon_0 = 8.86\times10^{-12}$

- The force on q_1 due to q_2 and vice a versa is independent of medium but not force ~~of~~ on q_1 is changed.

In a medium



dielectric
~~dielectric~~
~~dielectric~~ constant of medium

$$|F| = \frac{1}{4\pi\epsilon_0 K}\left(\frac{q_1 q_2}{r^2}\right)$$

$$\Rightarrow |F| = \frac{1}{4\pi\epsilon}\left(\frac{q_1 q_2}{r^2}\right) \quad \text{where } \epsilon = \epsilon_0 K$$

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PHYSICS-5

(1) EMI - AC

(2) OPTICS

(3) WAVE OPTICS

(4) MODERN PHYSICS

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MATHS - 1

(1) BASIC MATHS

(2) TRIGONOMETRY

(3) STRAIGHT LINES

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MATHS - II

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(1) CIRCLES

(2) PARABOLA

(3) LOGARITHM

(4) COMPLEX NUMBERS

(5) PROGRESSION N SERIES

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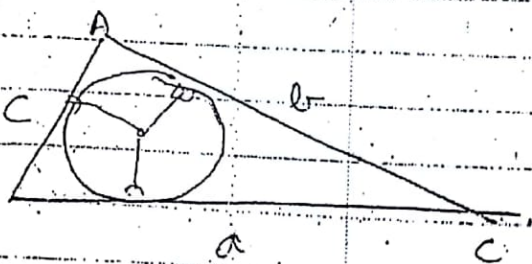


$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

Area $= \frac{1}{2} \times AB \times AC \times \sin A$

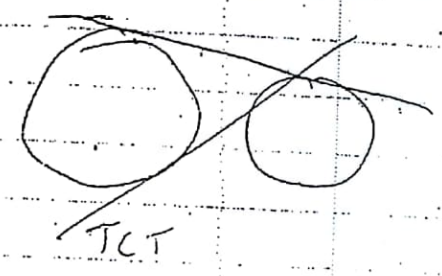
radius of incircle $= \frac{\Delta}{s}$

where Δ = area

s = semicenter

Direct common tangents – Tangent to circle lie on the same side of tangent, tangent = DCT

Transverse C.T – circle lie on opposite side

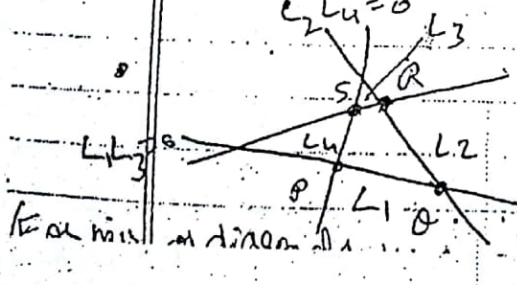


For the circle $x^2 + y^2 + 2gx + 2fy + c = 0$, the geometrical meaning of c is the square of tangent length from origin to circle

[if origin lies outside]

In general c is the power of origin w.r.t the circle.

'point circle' – The point (α, β) is sometime called a point circle whose centre is the same point and radius $= 0$ eq^n $= (x-\alpha)^2 + (y-\beta)^2 = 0$



Any path (curve/pair of lines) passing thro the 4 pts of intersection of 4 lines is of the form $L_1L_3 + \lambda L_2L_4 = 0$

λ = parameter, λ is different

Mathematics

(1) Permutation

N Combination

(2) Binomial Theorem

(3) Ellipse

(4) Hyperbola

(5) SOT

Module-3

(Q) Find maximum number of points of intersection of 10 straight lines in a plane.

$^{10}C_2 \Rightarrow \frac{10^5 \times 9 \times 8!}{8! \times 2} \Rightarrow 45$

(Q) Find number of pt. of int. with m lines and n circles in every possible.

~~$^{n+1}C_2$~~ ~~For line = $^{m}C_2 \times 1$~~

~~For circle =~~

for line = $^{m}C_2$ -

for circle = $^{n}C_2 \times 2$

for line or circle = $^{m}C_1 \cdot {}^{n}C_1 \times 2$

$\therefore$ Total = $^{m}C_2 + {}^{n}C_2 \times 2 + {}^{m}C_1 \cdot {}^{n}C_1 \times 2$

(Q) Find no. of rectangle possible on 8×8 chess board

We have to chose 2 verticles lines and 2 horizontal line

~~$^{64}C_2 + {}^{60}C_3 + {}^{9}C_4 + \dots + {}^{9}C_{64}$~~

$^9C_2 \cdot {}^9C_2$

(i) No. of squares

1×1	8^2
2×2	7^2
⋮	⋮
8×8	1^2

$\therefore 204$

Student Notebooks

①

(1) FUNCTIONS

(2) LIMITS, CONTINUITY DIFFERENCIABILITY

(3) AOD

(4) INVERSE TRIGO BASICS

(5) INDEFINITE INTEGRALS

(6) DEFINITE INTEGRALS

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(7)

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Find the solution of

(1) $\frac{(x-1)^{1/2}(x-4)}{(x+5)^2(x-3)^3} \geq 0$ $x \geq 1$ $\frac{(x-4)}{(x+5)^2(x-3)^3} \geq 0$

+ −5 + 3 − 4 +

$x \in [1,3) \cup [4,\infty)$

(2) $\frac{(x^2-x+1)(x-1)^5}{(x-2)^3} < 0$ $\frac{(x-1)^5}{(x-2)^3} < 0$ $x \in (1,2)$

(3) $\frac{(|x|-1)(x-1)}{(x+1)(x-2)} \geq 0$

$x \geq 1$ $\frac{(x-1)^2}{(x+1)(x-2)} \geq 0$

+ −1 − 1 − 2 +

$x \in (2,\infty) \cup \{1\}$

$x < 1$ $\frac{(x+1)(x-1)}{(x+1)(x-2)} \leq 0$

+ 1 − 2 +

$\therefore \phi$

$\therefore (2,\infty)$

Find the solution of the inequality

(1) $\sqrt{(x-1)(x+5)} > -x-3$

~~$(x-1)(x+5) > (x+3)^2$~~

$x \leq -5$ or $x \geq 1$ ✓ [always valid]

$x \leq -5$

$\sqrt{(x-1)(x+5)} > -x-3$

$(x-1)(x+5) > (x+3)^2$

So $x < -7$

$(-\infty,-7) \cup [1,\infty)$

M-5

MATHS - 5

(1) AREA

(2) DIFFERENCIAL EQUATION

(3) PROBABILITY

(4) DETERMINANTS

(5) MATRICES

(6) VECTORS & 3-D

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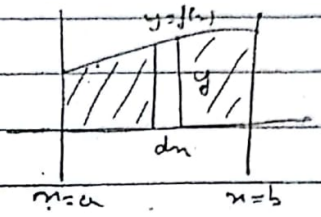
AREA

Area –

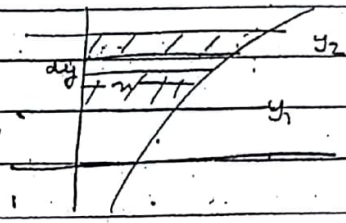
- area between $y = f(x)$, $x = a$, $x = b$ and X-axis

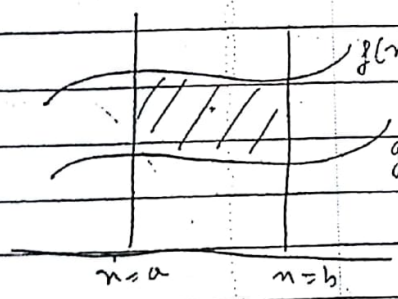
$$A = \int_a^b |f(x)|\, dx$$



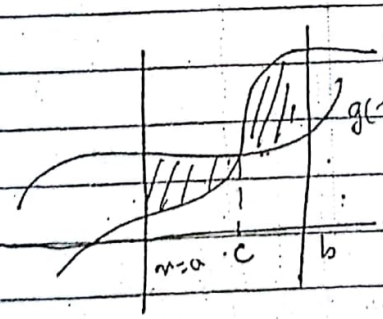
- area b/w $y = f(x)$, $y = y_1$, $y = y_2$, Y-axis

$$A = \int_{y_1}^{y_2} |x|\, dy$$





$$\text{Area} = \int_{x=a}^{b} |f(x) - g(x)|\, dx$$



$$\text{Area} = \int_a^b |f(x) - g(x)|\, dx$$

$$= \int_a^c g(x) - f(x)\, dx + \int_c^b f(x) - g(x)\, dx$$