ULTIMATE KCET

CRASH COURSE 2026

Chemistry | Lecture - 01

Mole concept

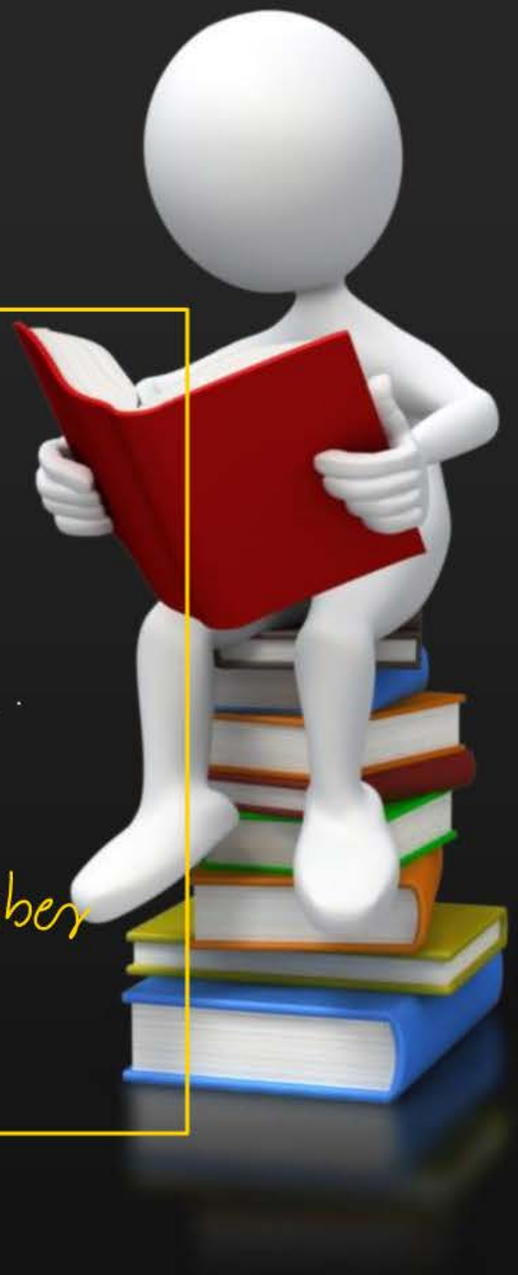
By – Sreeja Ma'am

Recap of previous lecture

1. Biomolecules – Synopsis
2. MCQ

Topics to be covered

1. Biomolecules - continuation — MCQ solving
2. Mole, Molarity, Molality, Molefraction Mass %, empirical formula — MCQ.
3. Revision → Absolute atomic, Atomic mass number Mole concepts.



Question

Glycogen is a branched chain polymer of α-D-glucose units in which chain is formed by C1—C4 glycosidic linkage whereas branching occurs by the formation of C1-C6 glycosidic linkage. Structure of glycogen is similar to _____.

A Amylose

B Amylopectin

C Cellulose

D Glucose

Question

Which of the following polymer is stored in the liver of animals?

A Amylose

B Cellulose

C Amylopectin

D Glycogen

→ starch
↓
Storage
polysaccharide
of
plant

Question

Sucrose (cane sugar) is a disaccharide. One molecule of sucrose on hydrolysis gives _____.

A. 2 molecules of glucose

B. 2 molecules of glucose + 1 molecule of fructose

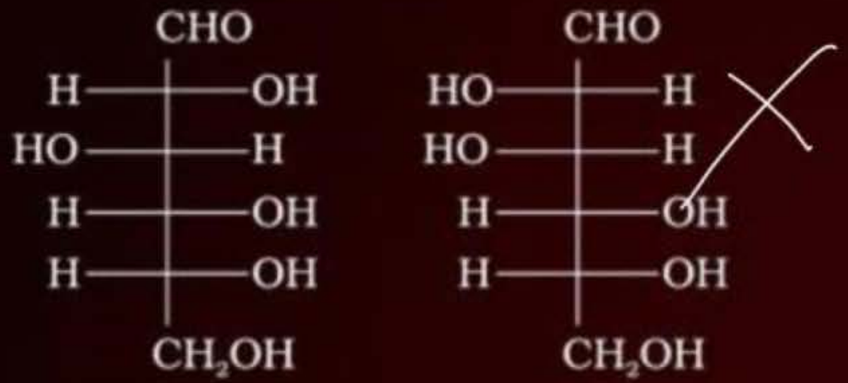
C. 1 molecule of glucose + 1 molecule of fructose

D. 2 molecules of fructose

Question

Which of the following pairs represents anomers?

A



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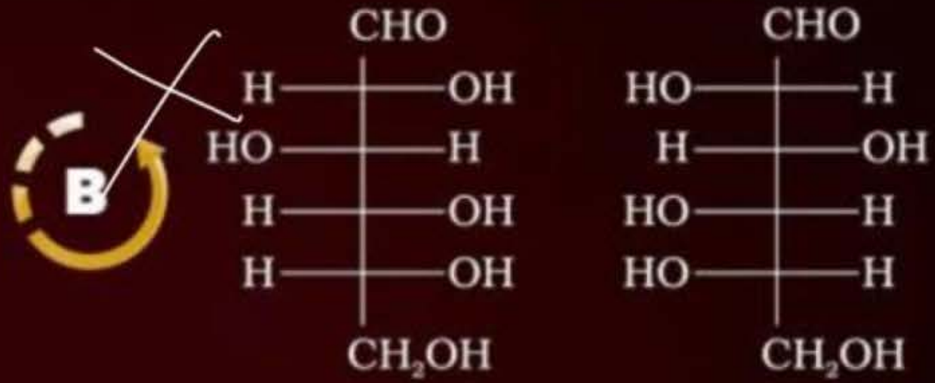

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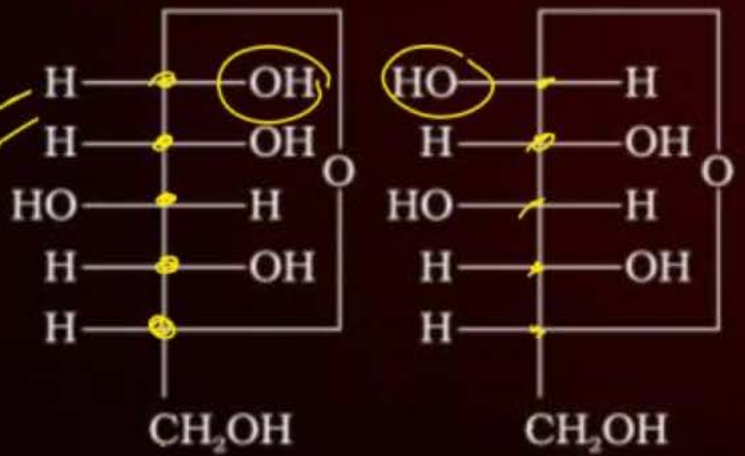
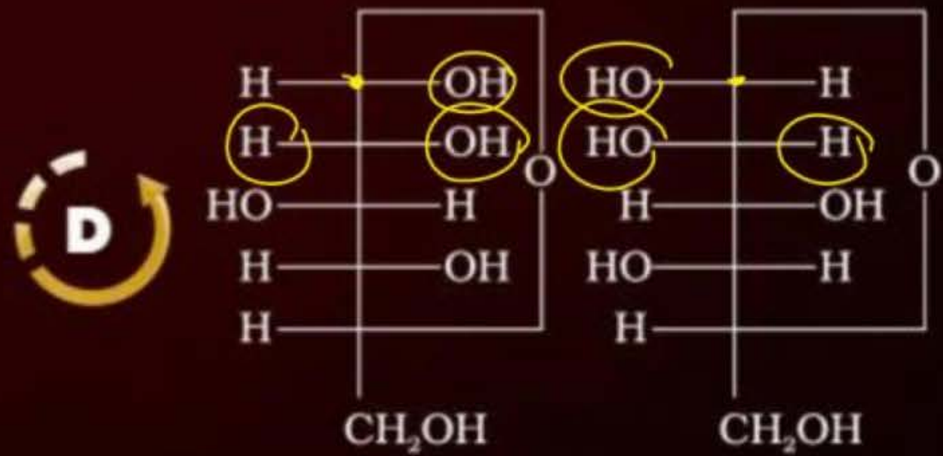


D



Question

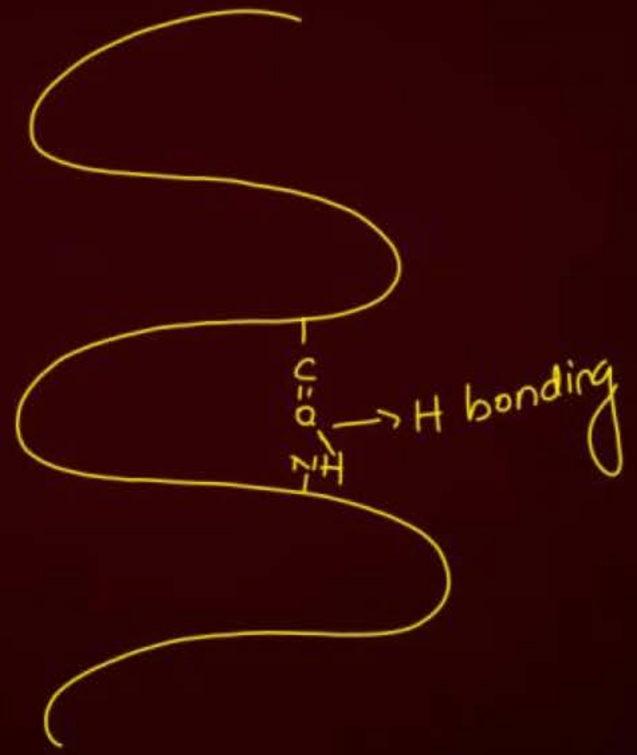
Proteins are found to have two different types of secondary structures viz. α-helix and β-pleated sheet structure. α-helix structure of protein is stabilised by:

A. Peptide bonds

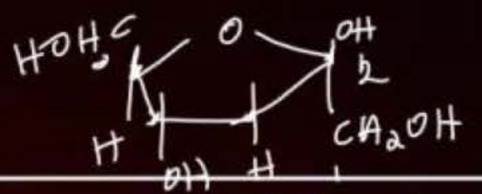
B. van der Waals forces

C. Hydrogen bonds

D. Dipole-dipole interactions

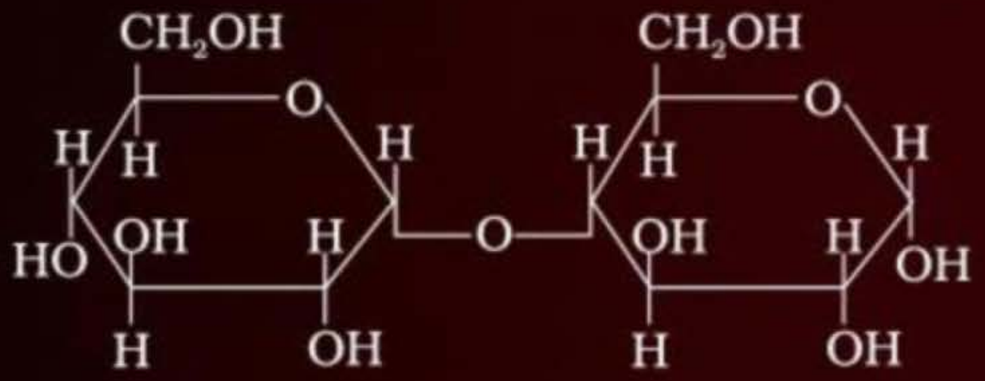


Question

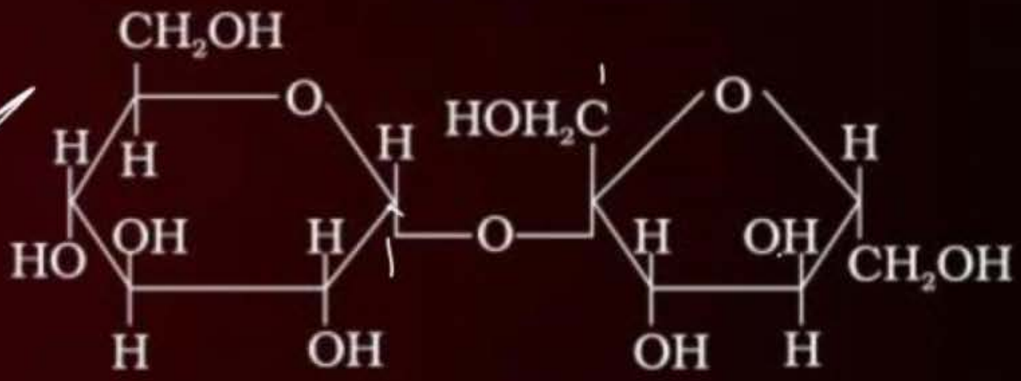


In disaccharides, if the reducing groups of monosaccharides i.e. aldehydic or ketonic groups are bonded, these are non-reducing sugars. Which of the following disaccharide is a non-reducing sugar? → Sucrose

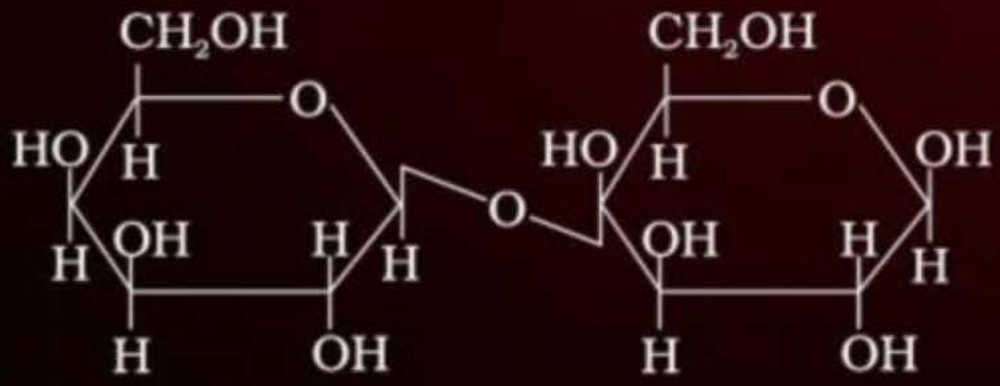
(A)



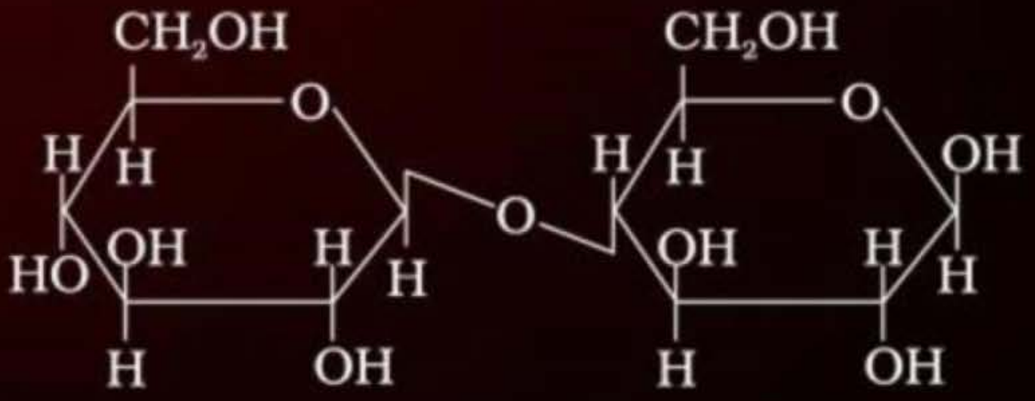
(B)



(C)



(D)



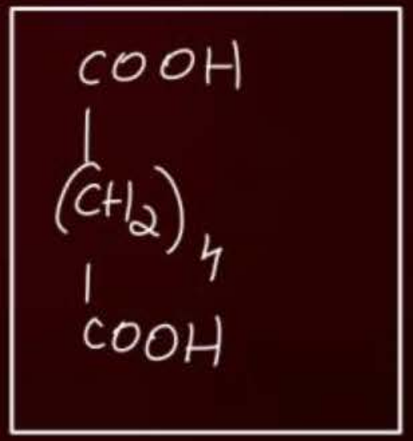
Question

Which of the following acids is a vitamin?

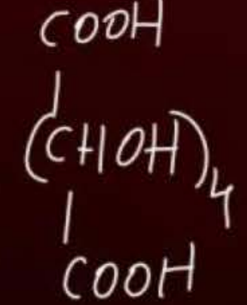
(A) **Aspartic acid** → acidic amino acid

(B) ~~**Ascorbic acid**~~

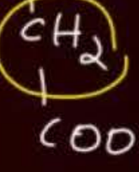
(C) **Adipic acid** → dicarboxylic acid



(D) **Saccharic acid** →

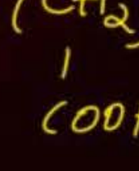


→ Saccharic acid



→ oxalic acid

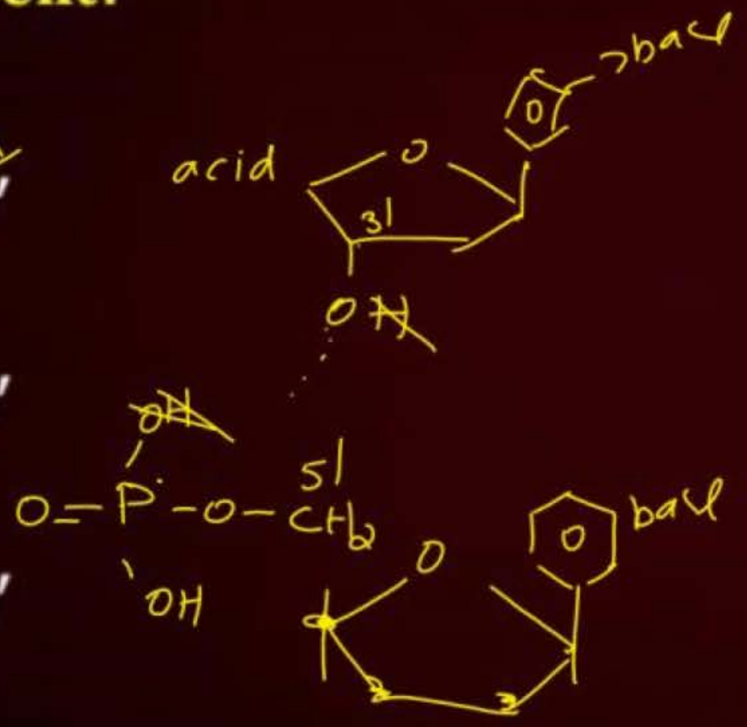
→ Malonic acid.



→ Succinic acid.

Question

Dinucleotide is obtained by joining two nucleotides together by phosphodiester linkage. Between which carbon atoms of pentose sugars of nucleotides are these linkages present?



A. 5′ and 3′

B. 1′ and 5′

C. 5′ and 5′

D. 3′ and 3′

Question

Nucleic acids are the polymers of _____.

A. Nucleosides

B. Nucleotides

phosphate + sugar + base

C. Bases

D. Sugars

Question

Which of the following statements is not true about glucose?

(A) It is an aldohexose. ✓

(B) On heating with HI it forms n-hexane. ✓

(C) It is present in furanose form. ✗

pyranose

furanose

(D) It does not give 2,4-DNP test.

aldehyde is not free

Cyclic form of aldehyde.

do not answer all the reaction

Question

Which of the following B group vitamins can be stored in our body?

A. Vitamin B_1

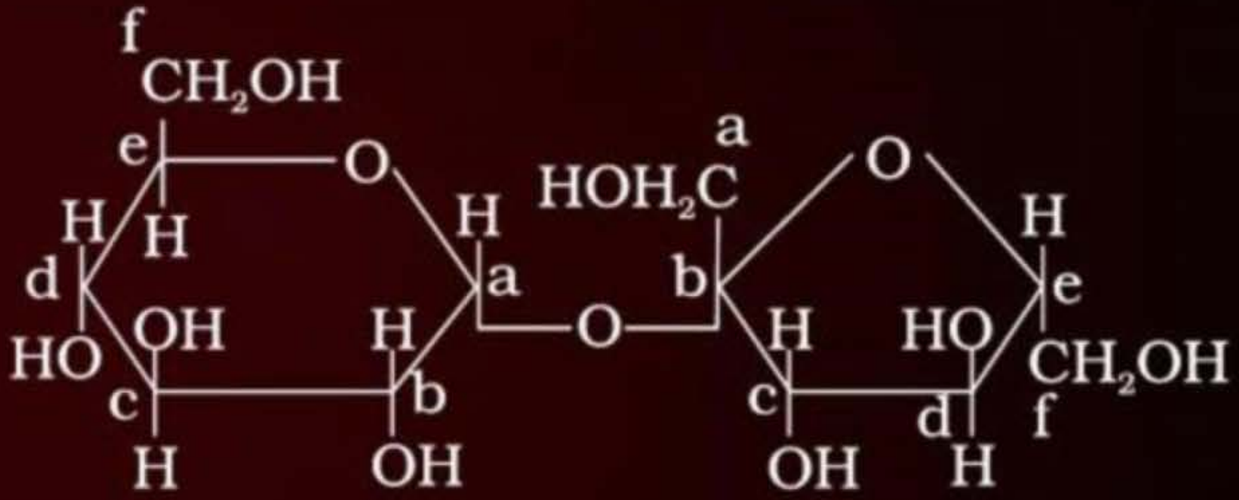
B. Vitamin B_2

C. Vitamin B_6

D. Vitamin B_{12} } fat soluble.

Question

Structure of a disaccharide formed by glucose and fructose is given below. Identify anomeric carbon atoms in monosaccharide units.



(A) 'a' carbon of glucose and 'a' carbon of fructose.

(B) 'a' carbon of glucose and 'e' carbon of fructose.

(C) 'a' carbon of glucose and 'b' carbon of fructose.

(D) 'f' carbon of glucose and 'f' carbon of fructose.

Question

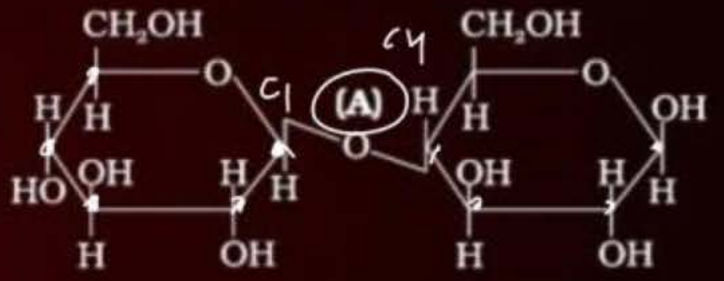
Three structures are given below in which two glucose units are linked. Which of these linkages between glucose units are between C1 and C_4 and which linkages are between C_1 and C_6?

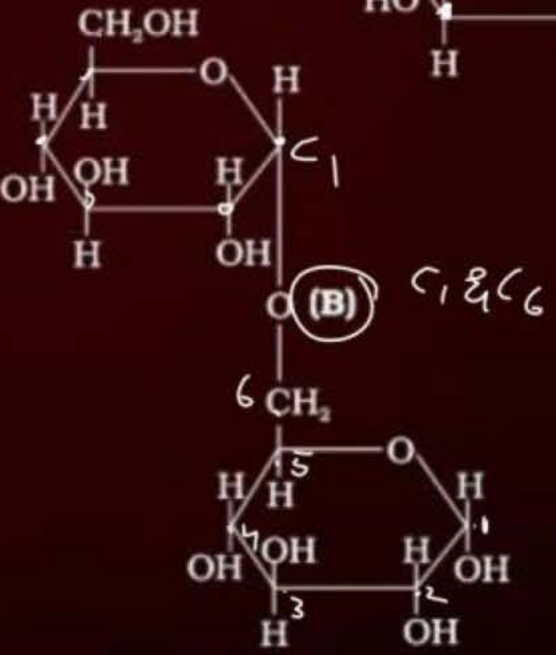
A (A) is between C_1 and C_4, (B) and (C) are between C_1 and C_6

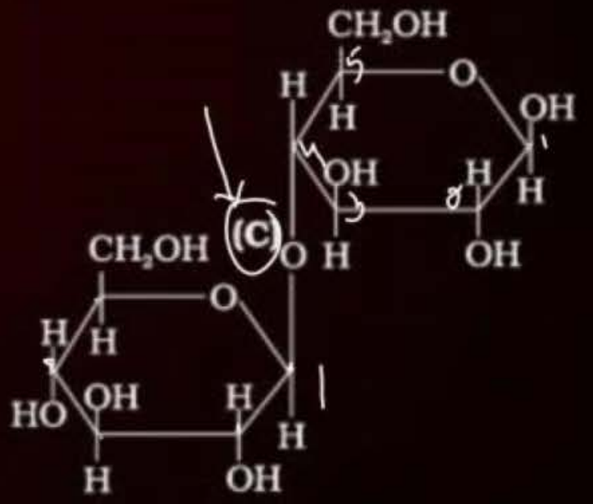
B (A) and (B) are between C_1 and C_4, (C) is between C_1 and C_6

C (A) and (C) are between C_1 and C_4, (B) is between C_1 and C_6

D (A) and (C) are between C_1 and C_6, (B) is between C_1 and C_4







Question

Amino acids are classified as acidic, basic or neutral depending upon the relative number of amino and carboxyl groups in their molecule. Which of the following are acidic?

(A) $(CH_3)_2CH-\underset{\underset{NH_2}{|}}{CH}-COOH$

(B) $HOOC-CH_2-CH_2-\underset{\underset{NH_2}{|}}{CH}-COOH$ — glutamic acid

(C) $H_2N-CH_2-CH_2-CH_2-COOH$

(D) $HOOC-CH_2-\underset{\underset{NH_2}{|}}{CH}-COOH$ — Aspartic acid

Question

hydrogen bonding & disulphide.

In fibrous proteins, polypeptide chains are held together by _____.

(A) van der Waals forces

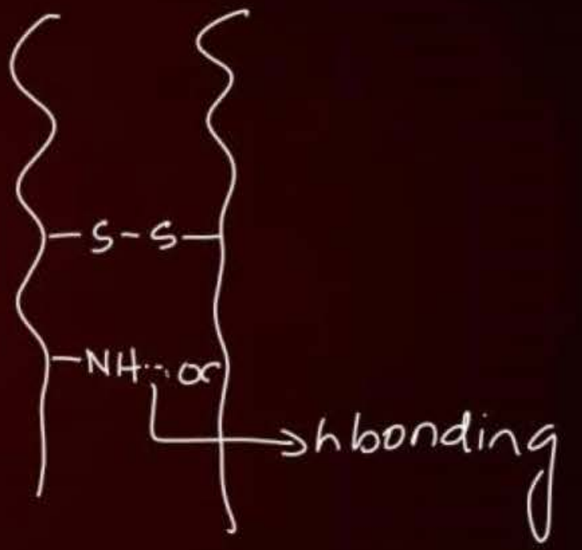
(B) disulphide linkage ✓

(C) electrostatic forces of attraction

(D) hydrogen bonds ✓

3° structure of protein

3° structure of protein.



QUESTION

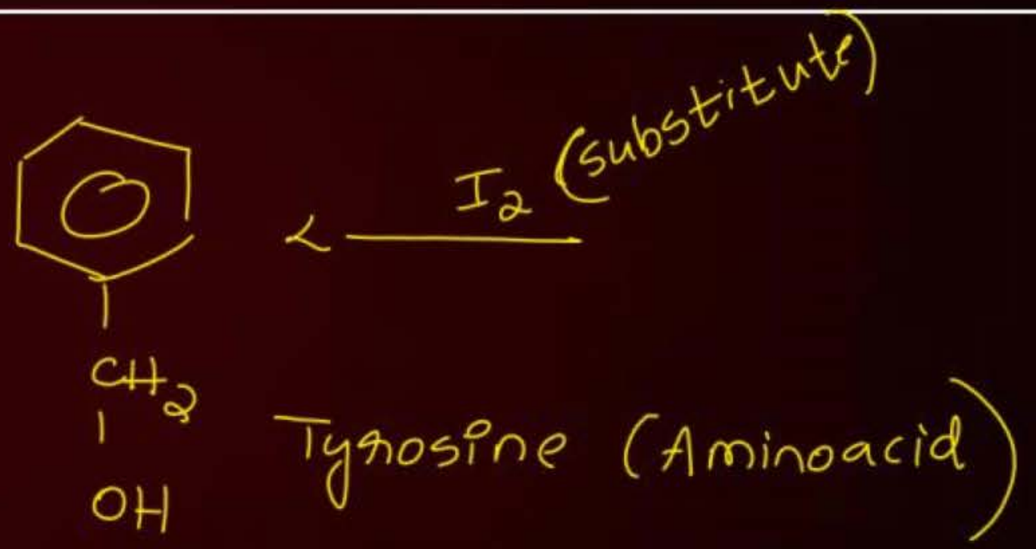
Hormones are secreted by ductless glands of human body. Iodine containing hormone is [2017]

A adrenoline

B thyroxine

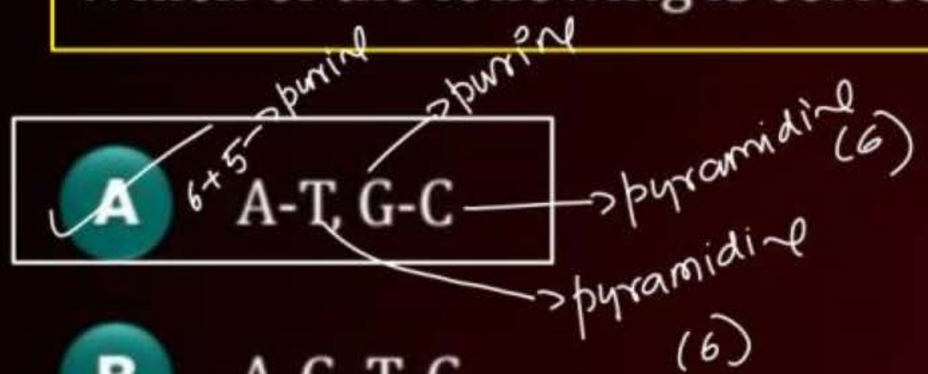
C testosterone

D Insulin



QUESTION

Which of the following is correct about H-bonding in DNA ? [2016]



A A-T, G-C

B A-G, T-C

C G-T, A-C

D A-A, T-T

QUESTION

Cheilosis and digestive disorders are due to the deficiency of [2015]

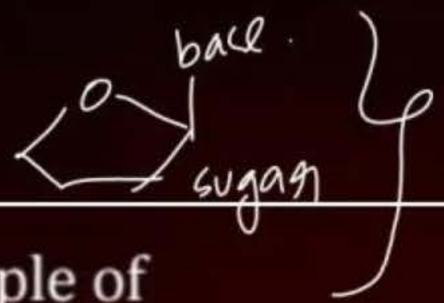
A thiamine

B ascorbic acid

C riboflavin

D pyridoxine

QUESTION



11 years back

Adenosine is an example of [2015]

A nucleotide

B purine base

C pyrimidine base

D nucleoside

5+6 ← purins → Adinine, Guanine

pyramidanine → Cytosine, Thyamine, Uracil

2024

QUESTION

Which one of the following is an essential amino acid? [2015]

A Tyrosine

B Cysteine

C isoleucine

D Serine

Essential

PVT TIM HALL

phenylalanine	Threonine	Histidine
Valine	isoleucine	Arginine
Tryptophan	Methionine	leucine
		Lysin.

QUESTION

The number of disulphide linkages present in insulin are

[2013]

A 4

B 3

C 2

D 1

QUESTION

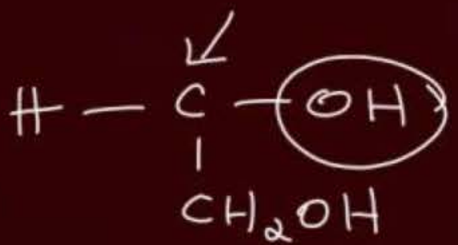
The letter 'D' in D-glucose signifies

[2010]

A configuration at all chiral carbons

B dextrorotatory

C that it is a monosaccharide



D configuration at a particular chiral carbon

QUESTION

A metal present in vitamin B_{12} is

[2007]

A aluminium

B zinc

C iron

D cobalt

Mole concept

1 Mole $\longrightarrow 6.022\times10^{23}$ electrons / neutrons / protons / ions / molecules / atom

Molarity $= \frac{\text{Mole}}{\text{volume(L)}}$

* Mole $=$ Molarity $\times$ volume(L)

* Mole $= \boxed{\frac{\text{Given mass}}{\text{Molar mass}}}$

* Mole $= \boxed{\frac{\text{Given volume}}{22.4\,L}}$

or

$22.4\,dm^3$

or

22,400 mL

or

$22,400\,cm^3$

1 Mu $\longrightarrow$ 1 molecule

1 g $\longrightarrow 6.022\times10^{23}$ molecule

$\longrightarrow N_A$

$\longrightarrow$ 1 Molar mass

$\longrightarrow$ 1 mole

1 Gram-molecule

G-Molecule.

Molar mass

Molecule mass in gram

or

atomic mass in gram.

H_2O, O_2 $\qquad$ H $\qquad$ ^{16}O

Molar mass of H_2O

$= 1\times2+16 = 18\,g$

Atomic mass (absolute atomic mass)

Mass of an atom.

$^{1}_{}H \longrightarrow 1\ amu$

$^{16}_{8}O \longrightarrow 16\ amu$

$^{23}_{11}Na \longrightarrow 23\ amu$

actual weight every student

Atomic mass number

$A = n + P$

$H = 1$

$^{16}_{8}O$ — 8P, 8N $\longrightarrow 16$

$^{23}_{11}Na \longrightarrow 23$ < 11 P, 12 N

Total students count

$_{1}H$ $_{2}He$

$_{3}Li$ $_{4}Be$ $_{5}B$ $_{6}C$ $_{7}N$ $_{8}O$ $_{9}F$ $_{10}Ne$

$_{11}Na$ $_{12}Mg$ $_{13}Al$ $_{14}Si$ $_{15}P$ $_{16}S$ $_{17}Cl$ $_{18}Ar$

$_{19}K$ $_{20}Ca$ $_{21}Sc$ $_{22}Ti$ $_{23}V$ $_{24}Cr$ $_{25}Mn$ $_{26}Fe$ $_{27}Co$ $_{28}Ni$ $_{29}Cu$ $_{30}Zn$

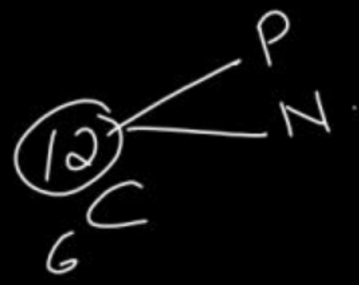
No. of Protons $\Rightarrow Z$ → atomic number.

Atomic mass number.

$A = p + n$

$^{12}_{6}C$ ⟶ mass number.

$^{12}_{6}C$ ⟶ Atomic no



12 amu ⟶ 1 atom of carbon

12 g ⟶ 1 mole of carbon

↓

molar mass carbon.

↓

N_A

↓

6.022×10^{23} particles

In a neutral atom

Protons = Electrons

12 < 6P, 6N

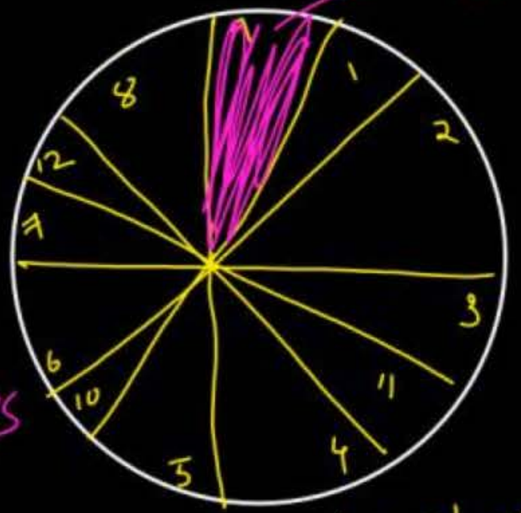
12 amu

12 atomic mass unit

$1\,kg = 1000\,g$

$\therefore 1\,g = 10^{-3}\,kg$

$^{12}_{6}C$, $^{13}_{6}C$, $^{14}_{6}C$ — isotopes



1 carbon atom

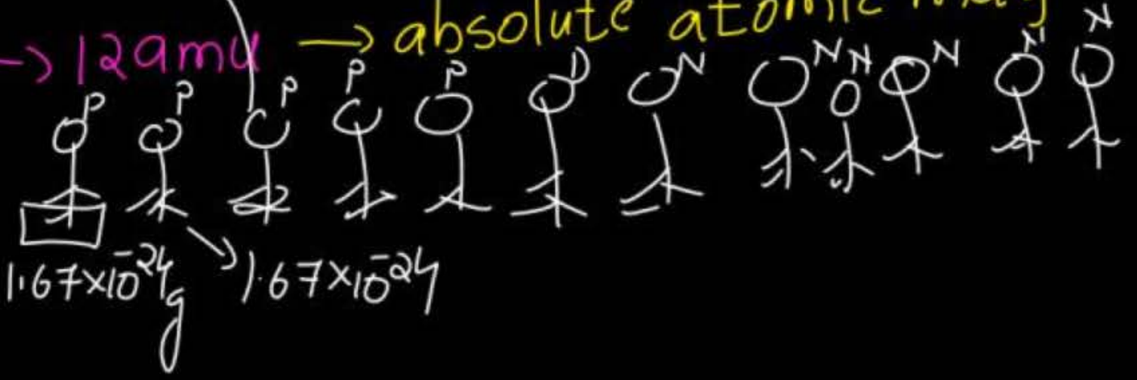
→ weight → a.m.u = $\frac{1}{12}^{th}$ the mass of 1 atom of carbon-12 isotope

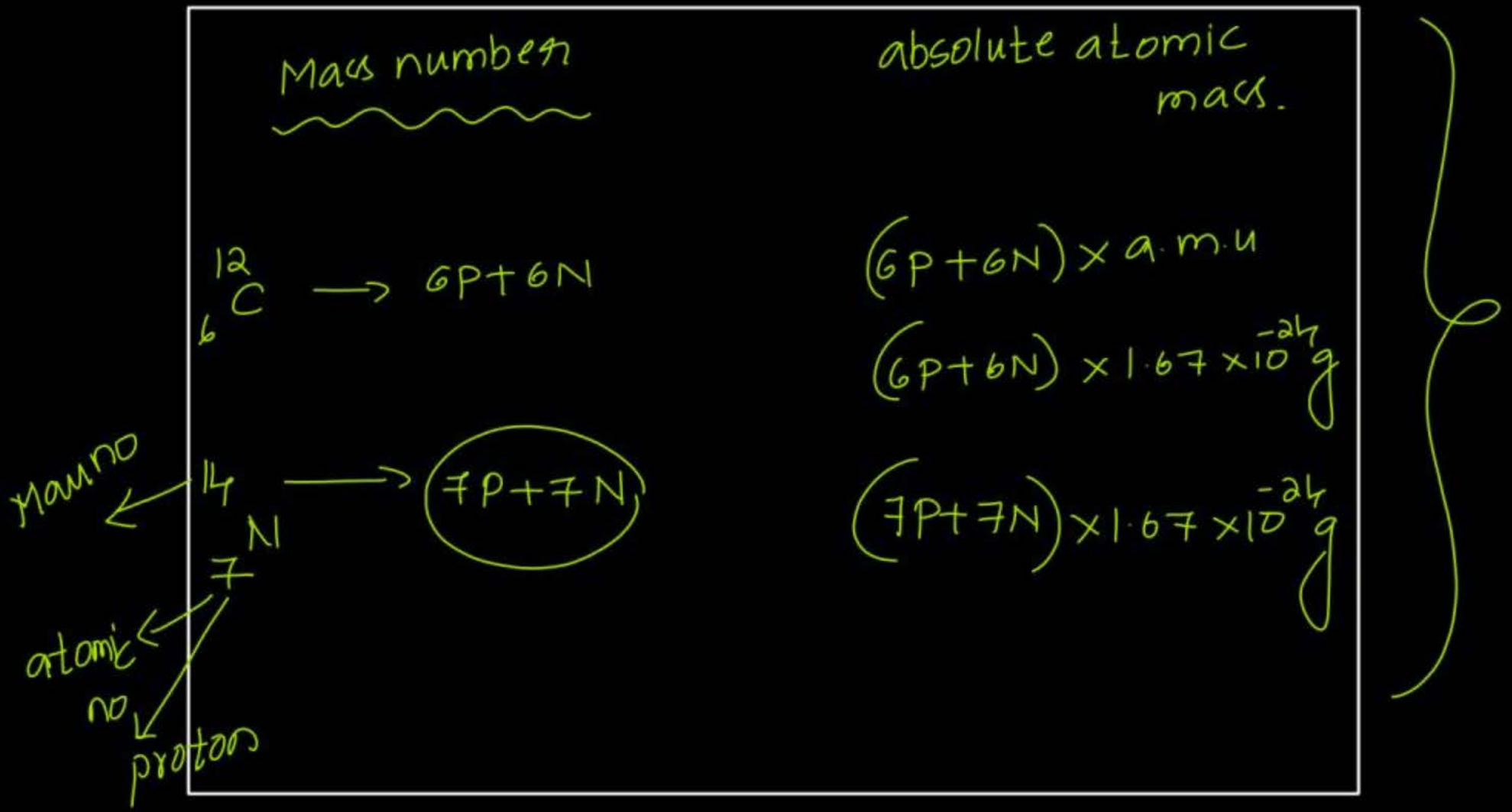
$1\,a.m.u = 1.67 \times 10^{-24}\,g$

$= 1.67 \times 10^{-24} \times 10^{-3}\,kg$

$1.67 \times 10^{-24}\,g = 1.67 \times 10^{-27}\,kg$

$^{12}C \rightarrow 12\,amu$ → absolute atomic mass




Mass number
absolute atomic mass.
$^{12}_{6}C \longrightarrow 6P+6N$
$(6P+6N) \times a.m.u$
$(6P+6N) \times 1.67 \times 10^{-24} g$
Mass no
$^{14}_{7}N \longrightarrow (7P+7N)$
$(7P+7N) \times 1.67 \times 10^{-24} g$
atomic no
protons

1000 g ⟶ 1 kg

1000 mL ⟶ 1 L.

6.022×10^{23} particles ⟶ **1 mole.**

Atomic mass in grams ⟶ Molar mass.

^{12}C ⟶ 12 amu ⟶ 1 atom

12 g ⟶ 1 mole ⟶ 6.022×10^{23} carbon atoms.

CO_2 ⟶ $^{12}C + ^{16}O + ^{16}O$ ⟶ 12 + 16 + 16 = 44 amu ⟶ 1 molecule.

44 g ⟶ 1 mole.

Calculate molar mass of the following

^{14}N

Urea $\longrightarrow NH_2-CO-NH_2 \longrightarrow [14\times2+12\times1+16\times1+1\times4]$ ^{12}C ^{1}H

$28+12+16+4=60g \rightarrow 1mole$ ^{16}O

glucose $\longrightarrow C_6H_{12}O_6 \longrightarrow 6\times12+12\times1+6\times16=180g \longrightarrow 1mole$

Sucrose $\longrightarrow C_{12}H_{22}O_{11} \longrightarrow 12\times12+22\times1+11\times16=342g \longrightarrow 1mole$.

$CH_4 \longrightarrow 12\times1+4=16g$

$NH_3 \longrightarrow 14\times1+1\times3=17g$

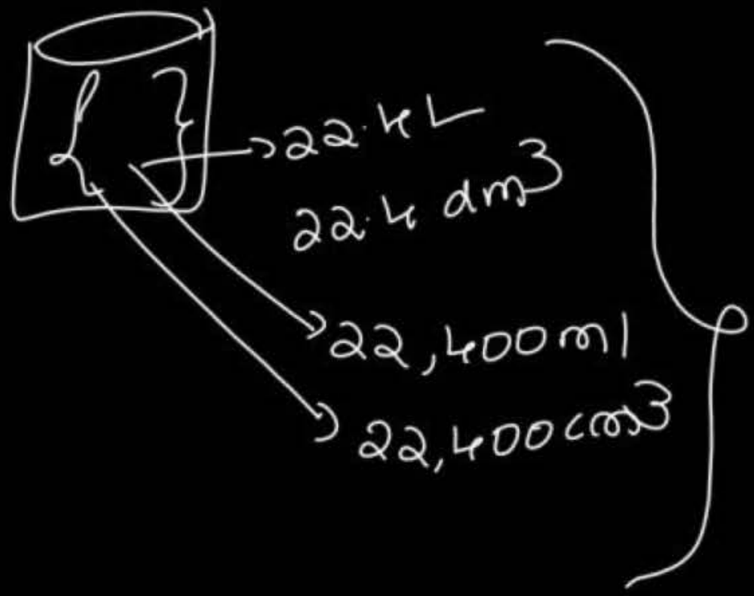
1 mole ⟶ 22.4 L ⟶ at STP ⟶ T = 273 K or 0°C
1 bag.

Shortcuts

$$\text{Mole} = \frac{\text{Given mass}}{\text{Molar mass}}$$

$$\text{Mole} = \frac{\text{Given volume}}{22.4\ \text{L}}$$

$$\text{Mole} = \frac{\text{No. of particles}}{N_A\ (6.022 \times 10^{23}\ \text{molecules})}$$



Question

A pure compound contains 2.4g of C. 1.2×10^{23} atoms of H. 0.2 moles of oxygen atoms. Its empirical formula is [2021] KCET

(A) C_2HO

(B) $C_2H_2O_2$

(C) CH_2O

(D) CHO

	Given mass	0.2	Mole ratio
^{12}C	2.4g $\rightsquigarrow$ Moles	$\frac{2.4}{12 \cdot 1} = 0.2$ mole.	$\frac{0.2}{0.2} = 1$
H	1.2×10^{23} atoms	$\frac{0.2 \quad 23}{1.2 \times 10 \quad} = 0.2$ mole	$\frac{0.2}{0.2} = 1$
O	0.2 mole. $\longrightarrow$	0.2 mole	$\frac{0.2}{0.2} = 1$

$C_1H_1O_1$

Question

$C = 0.12$
$H = 0.02$
$C + H = 0.14$

$0.30 - 0.14 = 0.16\,g \longrightarrow$ weight of oxygen.

0.30 g of an organic compound containing C, H and oxygen on combustion yields 0.44 g of CO_2 and 0.18 g of H_2O If one mole of compound weighs 60, then molecular formula of the compound is [2015]

A CH_2O

B C_3H_8O

C C_4H_8O

D $C_2H_4O_2$

0.30g of organic compound.

$0.C \longrightarrow CO_2 + H_2O + O$

0.3g 0.44g 0.18g

$CO_2 \rightarrow 44g$ (12+32)

$44g \longrightarrow 12g$ $\quad \frac{0.44 \times 12}{44} = \frac{44 \times 12}{100 \times 44}$

$0.44g \longrightarrow ?$ $\quad = 0.12$

$H_2O \rightarrow 2+16 = 18g$

$18g \longrightarrow 2g$

$0.18g \longrightarrow ?$

$\frac{0.18 \times 2}{18} = \frac{18 \times 2}{100 \times 18}$

$= 0.02g$

		Mole	Mole ratio
C ⟶	0·12	$\frac{0.12}{12} = \frac{12}{100\times12} = 0.01$	$\frac{0.01}{0.01} = 1$
H ⟶	0·02	$\frac{0.02}{0.02} = 0.02$	$\frac{0.02}{0.01} = 2$
O ⟶	0·16	$\frac{0.16}{16} = 0.01$ mole	$\frac{0.01}{0.01} = 1$

CH_2O ⟶ 12+2+16 = 30g ⟶ empirical formula.

$$n = \frac{\text{Molecular formula weight}}{\text{Empirical formula}} = \frac{60}{30} = 2$$

$n = 2$

Molecular formula = $(CH_2O)_n$
$= (CH_2O)_2$
$= C_2H_4O_2$

Question

$H_2O \longrightarrow 2+16 = 18$

The number of water molecules present in a drop of water weighing 0.018 g is [2013]

A 6.022×10^{26}

B 8.022×10^{23}

C 6.022×10^{19}

D 6.022×10^{20}

$$\text{Mole} = \frac{0.018\text{g}}{18} = \frac{18}{1000 \times 18} = 10^{-3}$$

$$\text{Mole} = \frac{\text{No. of molecules/atoms}}{N_A}$$

$$10^{-3} = \frac{9}{N_A}$$

$$= 6.022 \times 10^{23} \times 10^{-3}$$

$$= 6.022 \times 10^{20} \longrightarrow H_2O \text{ water molecules}$$

Question

The total number of electrons in 18 mL of water (density = 1 g mL^{-1}) is [2012]

A 6.02×10^{25}

B 6.02×10^{24}

C $6.02 \times 18 \times 10^{23}$

D 6.02×10^{23}

$$\text{Mole} = \frac{\text{No. of particles}}{N_A}$$

$d = \frac{\text{mass}}{\text{volume}}$

$1\ g\ mL^{-1} = \frac{\text{mass}}{18\ mL}$

$18 \times 1 = 18\ g$

$H_2O \rightarrow 1\ \text{mole} = \frac{18}{18} = 1\ \text{mole}$

$_1H + _1H + _8O$

$1e^- + 1e^- + 8e^- = 10e^-$

1 molecule $\rightarrow 10e^-$

6.022×10^{23} molecule $\rightarrow$?

$1\ H_2O \rightarrow 10e^-$

$1\ \text{mole} = 6.022 \times 10^{23}\ H_2O \times 10^1$

$= 6.022 \times 10^{24}\ e^-$

Question

If 500 mL of a 5M solution is diluted to 1500 mL, what will be the molarity of the solution obtained?

A 1.5 M

B 1.66 M

C 0.017 M

D 1.59 M

$V_1 = 500\ mL$

$M_1 = 5M$

$V_2 = 1500\ mL$

$M_2 = ?$

$M_1V_1 = M_2V_2$

$\frac{500 \times 5}{1500} = M_2$

$\frac{25}{15} = \frac{5}{3}$ $1.6\ M$

Concentration → Measure of solute on solvent

Mass % $= \frac{\text{Mass of solute in grams}}{\text{Mass of solution in grams}} \times 100$

$\left(\frac{w}{w}\right)$ %

5% (w/w)

5g of solute in 100g of solution.

Volume % $= \frac{\text{Volume of solute in mL}}{\text{Volume of solution in mL}} \times 100$

5% (V/V)

5ml of solute in 100ml of solution

$\left(\frac{\text{Mass}}{\text{volume}}\right)$ % $= \frac{\text{Mass of solute (in grams)}}{\text{Volume of solution (mL)}} \times 100 =$ 5% (m/v)

5g of solute in 100mL of solution

Molarity $= \frac{\text{No. of moles}}{\text{volume of solution in (L)}} = \boxed{\frac{w_b \times 1000}{M_b \times V_{(ml)}}}$

Molarity

$$M = \frac{a\% \times d \times 10}{M_b}$$

d = density of solution

a% = Mass %

M_b = Molar mass of solute

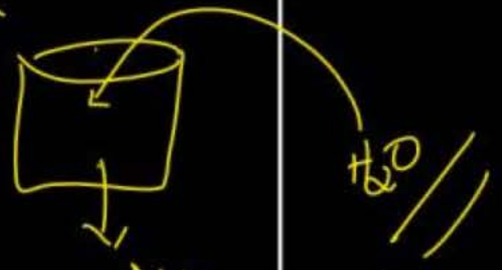
$M_1V_1 + M_2V_2 = M_3 = \frac{M_1V_1 + M_2V_2}{V_{total}}$

HCl + HCl → (calculation on molarity when two diff concentration are mixed)

dilution formula

$M_1V_1 = V_2M_2$

$\therefore M_2 = \frac{M_1V_1}{V_2}$



density of 13% H_2SO_4 is 1.09 g/mL, calculate molarity

a% = 13%

d = 1.09 gml^{-1}

M_b = 98g

$H_2SO_4 \rightarrow M_b = 2+32+64 = 98g$ (2 + 32 + 16×4)

$M = \frac{13 \times 1.09 \times 10}{98}$ (5 / 49)

$M = 1.446$

Molality

$$(m) = \frac{\text{No. of moles of solute}}{\text{Mass of solvent (kg)}}$$

$$m = \frac{w_b \times 1000}{M_b \times w_a}$$

Mol kg^{-1}

$$m = \frac{1000\,a}{(100-a)\,M_b}$$

a = Mass %.

M_b = Molar mass of solute.

a = Mass %.

M_b = Molar mass of solute.

→ Shortcut formula.

Shortcut

$$m = \frac{1000\,x_b}{(1-x_b) \times M_A}$$

M_A → molar mass of solvent

x_b → mole fraction of solute.

Mole fraction & molality

Mole fraction

$$\chi_A + \chi_B + \chi_C \cdots\cdots = 1$$

$$\chi_A = 1 - \chi_B$$

$$\chi_B = \frac{n_B}{n_B + n_A}$$

$$\chi_A = \frac{\text{Mole of one component}}{\text{Moles of all the component}}$$

$$\chi_A = \frac{n_A}{n_A + n_B}$$

Question

The number of atoms present in one mole of an element is equal to Avogadro number. Which of the following element contains the greatest number of atoms?

A 4g He

B 46g Na

C 0.40g Ca

D 12g He

Question

If the concentration of glucose ($C_6H_{12}O_6$) in blood is 0.9 g L^{-1}, what will be the molarity of glucose in blood?

A 5 M

B 50 M

C 0.005 M

D 0.5 M

$w_b = 0.9\ g$

$M_b = 180\ g$

$V = 1\ L$

$$M = \frac{w_b \times 1000}{M_b \times V}$$

$$= \frac{0.9}{180} = \frac{\frac{9}{1000}}{1800} \quad 0.005M$$

Question

What is the mass percent of carbon in carbon dioxide?

A 0.034%

B 27.27%

C 3.4%

D 28.7%

$CO_2 \longrightarrow 12 + 16 \times 2$

$44g \longrightarrow 12g$

$100g \longrightarrow ?$

$\% C = \frac{100 \times 12 \times 3}{44 \times 3} = 27.27\%$

$\frac{300}{11}$

$\% \text{ element} = \frac{\text{Mass of element}}{\text{total mass of compound}} \times 100$

Question

Which of the following statements is correct about the reaction given below:
$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(g)$

A. Total mass of iron and oxygen in reactants = total mass of iron and oxygen in product therefore it follows law of conservation of mass.

B. Total mass of reactants = total mass of product; therefore, law of multiple proportions is followed.

C. Amount of Fe_2O_3 can be increased by taking any one of the reactants (iron or oxygen) in excess.

D. Amount of Fe_2O_3 produced will decrease if the amount of any one of the reactants (iron or oxygen) is taken in excess.

Question

Homework
limiting
reagent

Sulphuric acid reacts with sodium hydroxide as follows :

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

When 1L of 0.1M sulphuric acid solution is allowed to react with 1L of 0.1M sodium hydroxide solution, the amount of sodium sulphate formed and its molarity in the solution obtained is

A $0.1\ mol\ L^{-1}$

B $7.10\ g$

C $0.025\ mol\ L^{-1}$

D $3.55\ g$

Question

Which of the following pairs have the same number of atoms?

A 16 g of O_2(g) and 4 g of H_2(g)

B 16 g of O_2 and 44 g of CO_2

C 28 g of N_2 and 32 g of O_2

D 12 g of C(s) and 23 g of Na(s)

Exemplar Qsn.

Question

Which of the following solutions have the same concentration?

A 20 g of NaOH in 200 mL of solution

B 0.5 mol of KCl in 200 mL of solution

C 40 g of NaOH in 100 mL of solution

D 20 g of KOH in 200 mL of solution

Question

Which of the following terms are unitless?

A Molality

B Molarity

C Mole fraction

D Mass percent

Question

One of the statements of Dalton's atomic theory is given below:
"Compounds are formed when atoms of different elements combine in a fixed ratio"
Which of the following laws is not related to this statement?

A Law of conservation of mass

B Law of definite proportions

C Law of multiple proportions

D Avogadro law

Thank You