

NEB- GRADE XII
Chemistry
Model Question [2077 (2020)]

Candidates are required to give their answers in their own words as far as practicable. The figures in the margin indicate full marks.

Time: 1.30 hrs.

Full Marks: 30

Group 'A'

Attempt any five questions

1. Write two important features of hybrid orbitals.

Ans: Hybrid orbitals are the result of a model which combines atomic orbitals on a single atom in ways that lead to a new set of orbitals that have geometries appropriate to form bonds in the directions predicted by the VSEPR model. Some important features of hybrid orbitals are

1. They hybrid orbitals have equivalent energies and identical shapes.
2. The number of hybrid orbitals is equal to the number of orbitals taking part in hybridization.
3. They hybrid orbital has electron density concentrated on one side of the nucleus i.e it has one lobe relatively larger than the other



4. The hybrid orbitals can form stronger bonds as compared to unhybridised or pure atomic orbitals because they can undergo more effective overlap.

The hybrid orbitals are directed in space in some preferred directions so as to have minimum repulsive interactions and attain maximum stability. Thus the type of hybridisation control the geometry of molecule.

2. Define the terms.

i) Primary standard solution

The term standard solutions refers to the solutions of reagents whose concentrations are exactly known. Two types of standard solutions known as primary standards and secondary standards are commonly encountered in volumetric exercises.

Primary standard is a substance that is available in sufficient purity from which a standard solution can be prepared by directly weighing accurately a quantity of it, dissolving it in distilled water and diluting the solution with distilled water to give a definite volume of the solution.

ii) Acidimetry

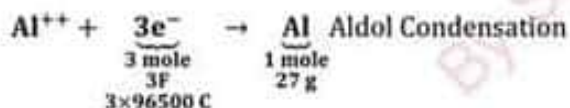
The determination of the strength of a solution of an acid by titration with a standard solution of base is called acidimetry or in short the titration of free bases with the standard acid is known as acidimetry.

3. How many coulombs are required to produce 50 gm. Of Al when electrode reaction is



Ans:

The given reaction is



To deposit 27g Al, 3×96500 C Charge are required

To deposit 50g Al, $\frac{3 \times 96500}{27} \times 50$ C Charge are required.

$$= 536111.1 \text{ C Charge}$$

Therefore 536111.1 Coulomb charge are required to deposit 50g Al

4. For a reaction $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$, The rate of disappearance of N_2O_5 is $4 \times 10^{-6} \text{ mol L}^{-1}\text{S}^{-1}$, what will be the rate of formation of NO_2

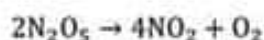
Ans:

Given

$$-\frac{d[\text{N}_2\text{O}_5]}{dt} = 4 \times 10^{-6} \text{ mol L}^{-1}\text{S}^{-1}$$

$$\frac{d[\text{NO}_2]}{dt} = ?$$

The given reaction is



Now,

$$\frac{1}{4} \frac{d[\text{NO}_2]}{dt} = -\frac{1}{2} \frac{d[\text{N}_2\text{O}_5]}{dt}$$

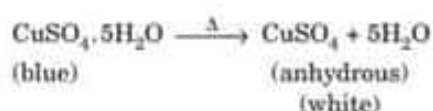
$$\frac{d[\text{NO}_2]}{dt} = \frac{4}{2} \times 4 \times 10^{-6}$$

$$= 8 \times 10^{-6} \text{ mol L}^{-1}\text{S}^{-1}$$

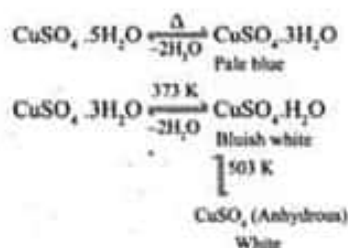
Thus the rate of formation of NO_2 is $8 \times 10^{-6} \text{ mol L}^{-1}\text{S}^{-1}$

5. Write the action of heat on blue vitrol.

Ans: They become white are called anhydrous copper sulphate



Full Reaction is

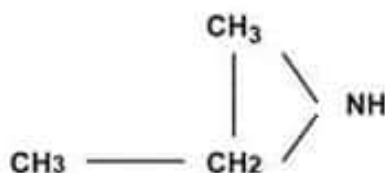


7. Write down the structure of a Primary amine and a secondary amine from C_3H_9N and given their IUPAC name.

Ans: Structure of Primary amine from C_3H_9N is

$CH_3CH_2CH_2NH_2$, It's IUPAC name is propane-1-amine.

Secondary amine from C_3H_9N is



It's IUPAC name is N-methyl ethanamine.

8. Define the terms:

i) titration error

ii) Unknown solution

What volume of 10 M HCl and 3 M HCl should be mixed to obtain one litre of 6 M HCl solution

Titration is the slow addition of one solution of a known concentration (called a titrant) to a known volume of another solution of unknown concentration until the reaction reaches neutralization, which is often indicated by a color change.

The difference between the equivalence point and the measured end point is called the **titration error**.

Unknown solution: Solution used in titration concentration of which is not known but is to be determined is called unknown solution.

Solution:

For 10M HCL

$$M_1 = 10M$$

$$V_1 = xL \text{ (Let's say)}$$

Form 3M xL,

$$M_2 = 3M$$

$$V_2 = (1-x)L$$

For mixture

$$M_m = 6M$$

$$V_m = 1L$$

Now

$$V_m M_m = V_1 M_1 + V_2 M_2$$

$$1 \times 6 = x \times 10 + (1-x)3$$

$$6 = 10x + 3 - 3x$$

$$3 = 7x$$

$$x = \frac{3}{7}$$

$$= 0.42857 L$$

∴ Volume of 10 M HCL required = 0.42857 L

$$= 0.42857 \times 1000 \text{ ml}$$

$$= 428.57 \text{ ml}$$

Volume of 3 M HCL required = (1-0.42857)L

$$= 0.57143 L$$

$$= 0.57143 \times 1000 \text{ ml}$$

$$= 571.43 \text{ ml}$$

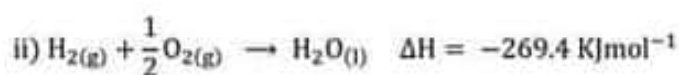
9. State enthalpy of combustion

If heat of formation of CO_2 , H_2O and $\text{C}_6\text{H}_{12}\text{O}_6$ are -395 KJmol^{-1} , $-269.4 \text{ KJmol}^{-1}$ and 1169 KJmol^{-1} respectively. Calculate the heat of combustion of glucose.

Ans: Enthalpy of combustion: Enthalpy of combustion of a substance is defined as the enthalpy change when 1 mole of the substance is completely burnt in air. It is represented by ΔH_c

Given,

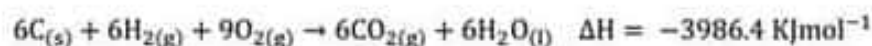
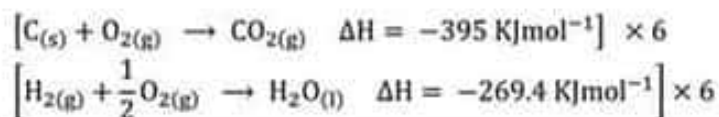




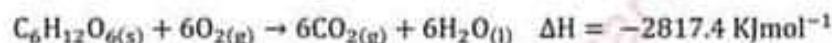
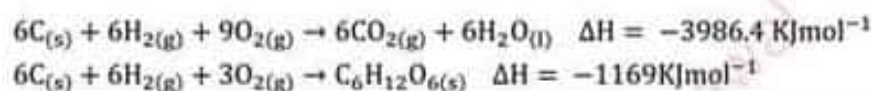
The required equation for combustion of glucose is



On Multiplying Equation (i) and (ii) by 6 and then adding



On Subtracting Equation (iii) from Equation (iv)



\therefore Heat of combustion of glucose = $-2817.4 \text{ KJmol}^{-1}$

10. Give chemical reaction for the preparation of ethanoic acid from

i) 1, 1, 1 - trichloro ethane

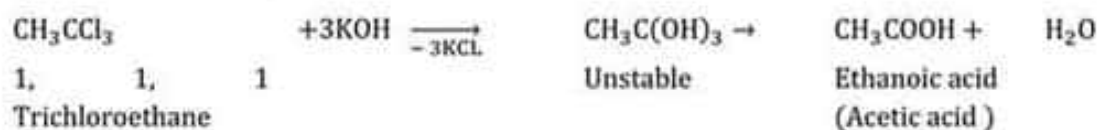
ii) Methyl magnesium iodide

iii) ethane nitril

How is ethanoic acid converted into methanoic acid.

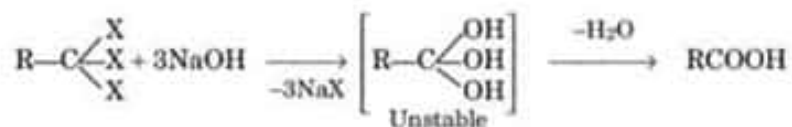
Ans: Ethanoic acid is also known as acetic acid. It is clear, colourless liquid which is soluble in water. It is weak acid and smells like vinegar.

i) ethanoic acid from 1, 1, 1 - trichloro ethane



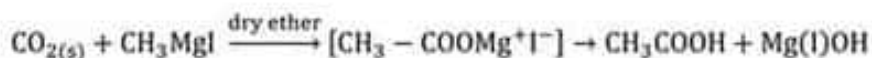
monocarboxylic acids can be prepared by hydrolysis with aqueous alkali solution

Mechanism is



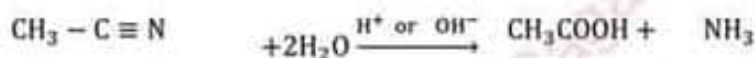
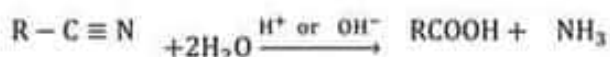
ii) ethanoic acid from Methyl magnesium iodide

The reaction is carried out by bubbling CO_2 through the ethereal solution of suitable Grignard reagent. The addition product formed is decomposed with mineral acid yields a fatty acid.



iii) ethanoic acid from ethane nitril

When an alkyl cyanide or nitrile is hydrolysed with boiling hydrochloric acid or sulphuric acid mixed with an equal volume of water, the $-\text{CN}$ group is hydrolysed fast into amides and then to a carboxyl group. This is very useful method for the synthesis of acids



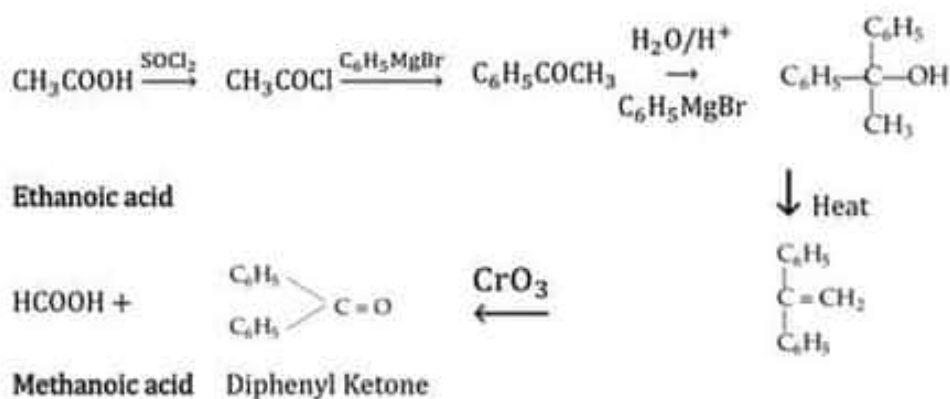
Ethanenitrile

Or Methyl cyanide

Ethanoic acid

Or Acetic acid

Conversion of ethanoic acid into methanoic acid.

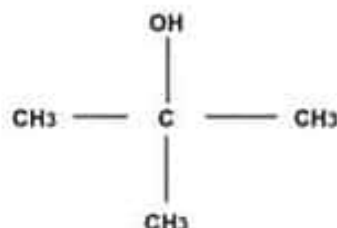


11. Write down a structural formula of tertiary alcohol and its IUPAC name of $C_4H_{10}O$. How would you apply Victor Mayer's method for the distinction of propan-1-ol from propan-2-ol? Write an example of the following reactions.

i) oxo-process ii) Baeyer's test

Convert propan-2-ol into propan-1-ol

Ans: Structural formula of tertiary alcohol of $C_4H_{10}O$ is



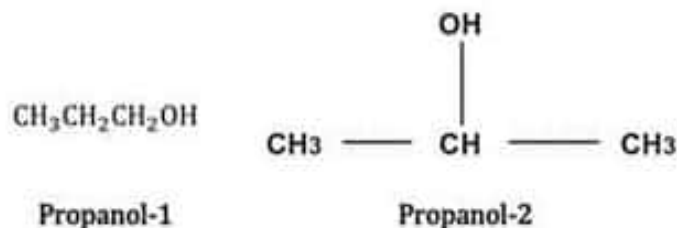
2 methyl propan 2 ol

Victor Mayer Method

Here primary, secondary and tertiary alcohols give different colours on undergoing a set of reactions.

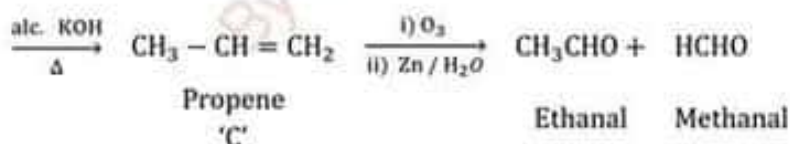
Primary alcohol	Secondary alcohol	Tertiary alcohol
RCH_2OH $\downarrow \text{P} + \text{I}_2$ RCH_2I $\downarrow \text{AgNO}_2$ RCH_2NO_2 $\downarrow \text{HONO}$ Nitrous acid $\text{R}-\text{C}-\text{NO}_2$ \parallel NOH Nitrolic acid <i>Produces blood red colour with alkali</i>	R_2CHOH $\downarrow \text{P} + \text{I}_2$ R_2CHI $\downarrow \text{AgNO}_2$ R_2CHNO_2 $\downarrow \text{HONO}$ Nitrous acid $\text{R}_2\text{C}-\text{NO}_2$ $ $ NO Pseudo nitrol <i>Blue colour</i>	$\text{R}_3\text{C}-\text{OH}$ $\downarrow \text{P} + \text{I}_2$ R_3CI $\downarrow \text{AgNO}_2$ R_3CNO_2 $\downarrow \text{HNO}_2$ No action <i>Colourless solution</i>

Distinguish of Propanol-1 and Propanol-2 using Victor Mayer method

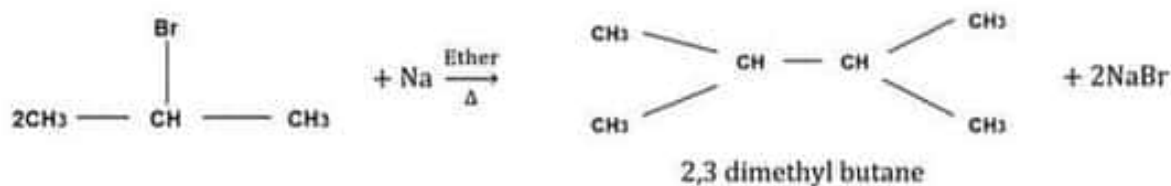


Propanol-1 and Propanol-2 can be distinguished by Victor Mayer method. The test involves following steps

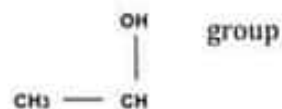
1. The given alcohol is first treated with red phosphorous and iodine by which iodo alkane is obtained
2. The iodo alkane is then treated with silver nitrate where by nitro alkane is formed
3. The nitroalkane thus formed is treated with nitrous acid followed with NaOH or KOH

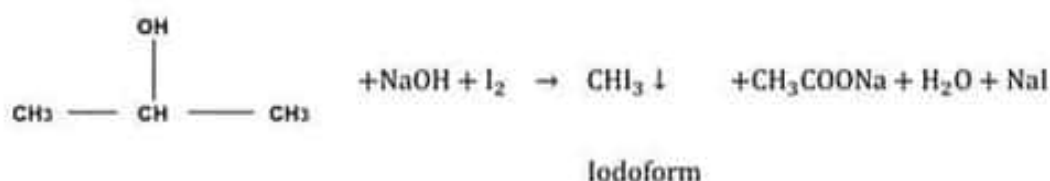


When 'B' is heated with sodium in presence of dry ether, 2,3-dimethyl butane is formed



Compound 'A' i.e propan-2-ol gives iodoform test because it contains





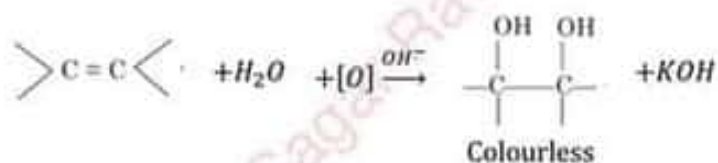
a) Oxo Process:

Alkenes react with carbon monoxide and hydrogen in presence of octacarbonyl cobalt at high temperature and pressure to yield aldehyde which when reduced give alcohol.



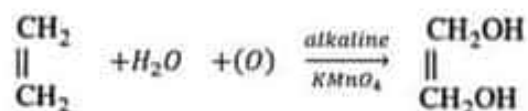
b) Baeyer's test (Alkaline KMnO_4 Test)

In this test, the pink colour of KMnO_4 disappears, when an alkaline KMnO_4 is added to an unsaturated hydrocarbon. The disappearance of pink colour may take place with or without the formation of brown precipitate of MnO_2

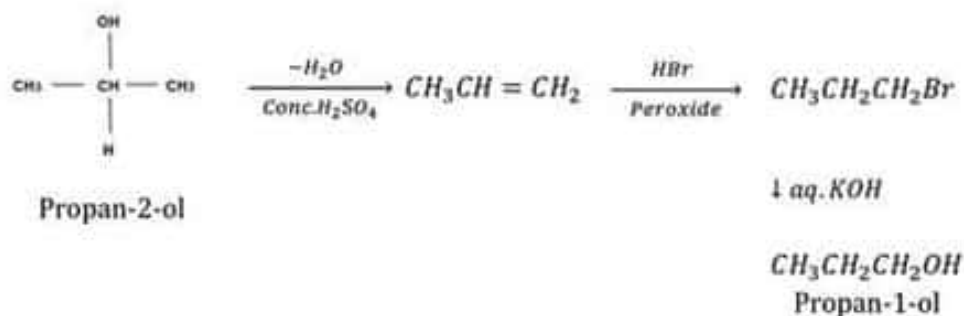


Dilute and alkaline solution of KMnO_4 is called Baeyer's reagent and is used to test unsaturation in organic compounds.

Example of Baeyer's test is



Conversion of Propan-2-ol into Propan-1-ol



12. Define i) rate law equation

ii) Half life period for a reaction

How is order of reaction differed from molecularity of reaction?

The following rate data were obtained for the reaction $2A + B \rightarrow C$

Expt No	[A] molL ⁻¹	[B] molL ⁻¹	Initial rate of formation of C molL ⁻¹ S ⁻¹
1.	0.1	0.1	6.0×10^{-3}
2.	0.3	0.2	7.2×10^{-2}
3.	0.3	0.4	2.88×10^{-4}
4.	0.4	0.1	2.4×10^{-2}

Calculate the rate of formation of C when $[A] = 0.5 \text{ mol L}^{-1}$ and $B = 0.2 \text{ mol L}^{-1}$

Ans:

Rate law:

An expression which shows how the reaction rate is related to concentration of reactants is called rate law or rate law equation.

Half life period for a reaction:

Half-life period $t_{1/2}$ is the time in which half of the reaction is completed, or the initial concentration(s) of reactant (s) is/are reduced to half. For a first order reaction, half-life period $t_{1/2}$ is

$$t_{1/2} = \frac{0.693}{k}$$

Where k is the reaction rate constant.

The half-life period $t_{1/2}$ for a first order reaction is independent of the initial concentration of the reactant.

For a zero order reaction

$$t_{1/2} = \frac{a}{2k}$$

For a first order reaction of a plot of $\log[C_t]$ against t should be a straight line with a slope equal to $-\frac{k}{2.303}$.

Thus the rate constant k can be calculated from the slope of the straight line.

Order of reaction versus Molecularity of reaction

Order of reaction		Molecularity of reaction	
1.	It can be fractional as well as zero	1.	It is always a whole number. It cannot be zero or fractional
2.	It can be determined experimentally only	2.	It can be calculated by simply adding the molecules of the slowest step
3.	It is applicable to elementary as well as complex reactions	3.	It is applicable only to elementary reactions. For a complex reaction, molecularity of the slowest step is same as the overall order of reaction.
4.	It cannot be obtained from balanced or stoichiometric equation	4.	It can be obtained.
5.	It is changed when one reactant is taken in large excess	5.	It undergoes no change.

The given reaction is



Let, rate law be

$$\text{Rate} = K [A]^x [B]^y$$

From experiment no. 1

$$6.0 \times 10^{-3} = K(0.1)^x (0.1)^y \text{ --- (i)}$$

From experiment no. 4

$$2.4 \times 10^{-2} = K(0.4)^x (0.1)^y \text{ --- (ii)}$$

Dividing equation (ii) by equation (i)

$$\frac{2.4 \times 10^{-2}}{6.0 \times 10^{-3}} = \frac{K(0.1)^x (0.1)^y}{K(0.4)^x (0.1)^y}$$

$$4 = 4^x$$

$$x = 1$$

From experiment no. 2

$$7.2 \times 10^{-2} = K(0.3)^x (0.2)^y \text{ --- (iii)}$$

From experiment no. 3

$$2.88 \times 10^{-1} = K(0.3)^x (0.4)^y \text{ --- (iv)}$$

Dividing equation (iii) by equation (iv)

$$\frac{2.88 \times 10^{-1}}{7.2 \times 10^{-2}} = \frac{K(0.3)^x(0.4)^y}{K(0.3)^x(0.2)^y}$$

$$4 = 3^y$$

$$2^2 = 2^y$$

$$y = 2$$

$$\therefore \text{Rate law is rate} = K[A][B]^2$$

From experiment no. 1

$$6.0 \times 10^{-3} = K(0.1)(0.1)^2$$

$$K = \frac{6.0 \times 10^{-3}}{(0.1)(0.1)^2} = 6.0 \text{ mol L}^{-1}\text{S}^{-1}$$

When $[A] = 0.5 \text{ mol L}^{-1}$ and $[B] = 0.2 \text{ mol L}^{-1}$, then

$$\text{Rate of formation of C} = K[A][B]^2$$

$$= 6.0 \times 0.5 \times (0.2)^2$$

$$= 0.12 \text{ mol L}^{-1}\text{S}^{-1}$$