2025-Chemistry Revision

Paper -5

Time: 60 minutes

1. Which of the following elements have the highest electro positivity?

   i. Na ii. Mg iii. Al iv. Si v. O

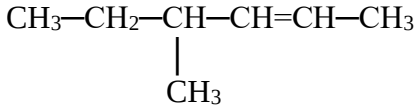
2. What is the formula of the oxide formed by M(atomic number 34) at its highest oxidization state?

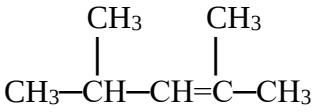
   i. MO_2 ii. M_2O_3 iii. MO_3 iv. M_2O_5 v. M_2O

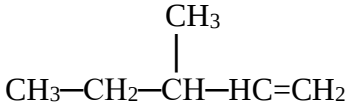
3. Which of the following molecule or ion has the same geometrical shape as SO_3^{2-} ion?

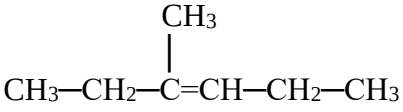
   i. SO_3 ii. BrO_3^- iii. $COCl_2$ iv. NO_3^- v. $XeOF_2$

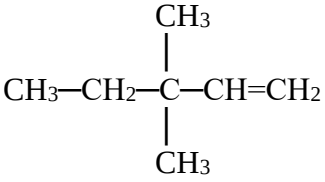
4. Which of the following molecules will show both optical isomerism and diastereoisomerism?

   1. 

   2. 

   3. 

   4. 

   5. 

5. Which of the following has the highest standard second ionization enthalpy?

   i. F ii. Ne iii. Cs iv. Na v. Mg

6. What is highest number of electrons that can be present with quantum number $l = 3$?

   i. 3 ii. 6 iii. 10 iv. 14 v. 12

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7. Which of the following solid has its molecules bonded only by weak dispersion forces?

   i. $H_2O(s)$ ii. $MgO(s)$ iii. $CO_2(s)$

   iv. $SiO_2(s)$ v. $Cu(s)$

8. The volume of HCl used when titrating $0.1\ \text{mol dm}^{-3}$ HCl with 25 cm^3 of Na_2CO_3 solution is 18 cm^3. Calculate the concentration to the nearest second decimal place of Na_2CO_3 in mol dm^{-3} if phenolphthalein was used as an indicator.

   i. 0.05 ii. 0.07 iii. 0.04 iv. 0.03 v. 0.01

9. In a certain oxidation process, hydrazine (N_2H_4) molecule removes 14 electrons and becomes an oxide of nitrogen. If the oxidation number of hydrogen didn't change, what is the oxide of nitrogen formed?

   i. N_2O ii. NO iii. NO_2 iv. N_2O_3 v. N_2O_5

10. 0.03 mol of NH_4NO_3 is present in a closed vessel of volume 1 dm^3. It dissociates completely into $N_2O_{(g)}$ and $H_2O_{(g)}$ when the vessel is heated to 400 K. The pressure of the vessel at this state is,

    i. $3 \times 10^5 \text{Pa}$ ii. $1 \times 10^5 \text{Pa}$ iii. $0.5 \times 10^5 \text{Pa}$ iv. $0.1 \times 10^5 \text{Pa}$ v. $0.03 \times 10^5 \text{Pa}$

11. The concentration of an aqueous solution of $Al_2(SO_4)_3$ is 6.84 ppm. Which of the following statements are correct regarding this solution? (Al = 27, S = 32, O = 16, $1\ \text{ppm} = 1\ \text{mg dm}^{-3}$)

    i. Concentration of $Al^{3+}$is 2.16 ppm. ii. Concentration of $Al^{3+}$is 13.68 ppm.

    iii. Concentration of SO_4^{2-} is 3.84 ppm iv. Concentration of SO_4^{2-} is 20.52 ppm

    v. Overall concentration of ions is $1.0 \times 10^{-4} \text{mol dm}^{-3}$

12. When a mixture of $NaHCO_3$ and Na_2CO_3 of mass 0.274 g was heated the final constant mass obtained is 0.212 g. Mass of Na_2CO_3 in the initial sample is, (Na=23, H=1, C=12, O=16)

    i. 0.062 g ii. 0.137 g iii. 0.106 g iv. 0.168 g v. 0.084 g

13. Chlorate (VII)ion/ClO_4^- acts as an oxidizer. Using 25 cm^3 of $0.05\ mol\ dm^{-3}$ potassium chlorate(VII) solution, 500 cm^3 of $0.02\ mol\ dm^{-3}$ aqueous titanium(III)chloride solution was completely oxidized to titanium(IV) ions. What is the product obtained by the reduction of chlorate(VII) ions

i. Cl_2 ii. Cl^- iii. ClO_2^- iv. OCl^- v. ClO_3^-

14. Among the species NO_2, NO_2^-, NO_2^+, the variation of $O - N - O$ bond angle is correctly shown by,

i. $NO_2^- > NO_2 > NO_2^+$ ii. $NO_2^+ > NO_2 > NO_2^-$

iii. $NO_2 > NO_2^- > NO_2^+$ iv. $NO_2^- > NO_2^+ > NO_2$

v. $NO_2^+ > NO_2^- > NO_2$

15. The volume of the gas evolved when 164.6 g of Na amalgam was reacted with water is 2.24 dm^3 at S.T.P. Assume the gas behaves ideally. (Relative molar masses Na=23, Hg=200) molar fraction of Na in the amalgam is,

i. 0.1 ii. 0.2 iii. 0.4 iv. 0.6 v. 0.8

❖ Follow the instructions given below for the questions from 16 to 20.

(1)	(2)	(3)	(4)	(5)
if only (*a*) and (*b*) are correct.	if only (*b*) and (*c*) are correct.	if only (*c*) and (*d*) are correct.	if only (*d*) and (*a*) are correct.	if any other number or combination of response is correct.

16. Which of the following statement/s is/are false regarding gases?

a. In all real gases at low pressure, compressibility factor (Z) value is nearly 0.
b. At high pressures, there's no effect of intermolecular forces on the behavior of gases.
c. At high pressure, intermolecular forces among real gas molecules are weak.
d. At high pressures repulsive forces occur between real gas molecules.

17. An element may exist in two or more different forms called allotropes. White **Sn** and grey **Sn** are two such allotropes of Sn. These two allotropes……

a) have different melting points.
b) have different numbers of neutrons but the same number of protons in their nuclei.
c) have the same density.
d) have the same boiling point.

18. Which of the following molecules or ions have a tetrahedral electron pair geometry?

a. SO_2
b. NH_4^+
c ClO_4^-
d. ICl_4^-

19. Which of the following statement/s is/are correct regarding an ideal gas?

a. Repulsive forces never occur between gas molecules
b. Attractive forces never occur between gas molecules
c. Kinetic energy of gas molecules is directly proportional to the temperature.
d. Value of $^{PV}/_{nRT}$ does not change with pressure.

20. Correct statement/s regarding $SO_2(g)$ is/are,

a. H_2S can be oxidized using SO_2
b. $H^+/KMnO_4$ can be oxidized using SO_2
c. $SO_2(g)$ reacts with strong bases like Ba(OH)₂.
d. SO_2 gives SO_4^{2-} acting as a bleaching agent

❖ Follow the instructions given below for the questions from 21 to 25.

Response	First Statement	Second Statement
(1)	True	True, and correctly explains the first statement
(2)	True	True, but does not explain the first statement correctly
(3)	True	False
(4)	False	True
(5)	False	False

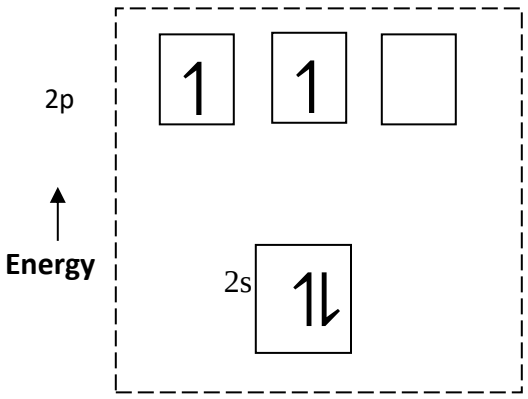
	First Statement	Second Statement
21	Bond angle of NO_2^+ ion is greater than that of NO_2^- ion.	Repulsive force exerted by a lone pair of electrons on a bond is greater than the repulsive force exerted by two bonds on each other.
22	Kinetic energy of an ideal gas molecule is a constant at constant temperature.	Volume of ideal gas molecules is negligible.
23	Standard neutralization enthalpy of HF is greater than that of HCl numerically.	HF is a stronger acid than HCl.
24	ICl_2^- and NO_2 are both linear in shape.	Molecules and ions that have the same number of atoms generally have the same shape.
25	Propanone has a higher boiling point than that of propan-2-ol.	The carbon-oxygen double bond in propanone is more polarized than the carbon-oxygen single bond in propan-2-ol.

Structured Essay

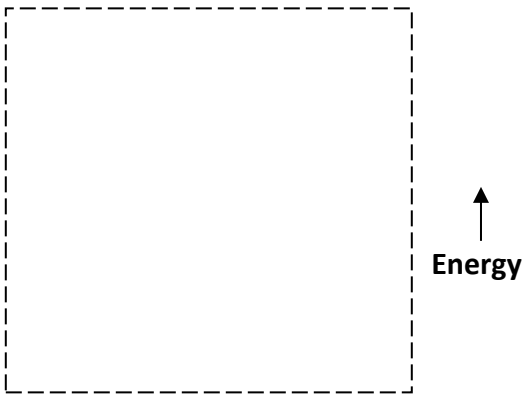
1.

a) Consider the state of hybridization of the carbon atoms in the ethene molecule C_2H_4. Given below in Cage **A** is the schematic representation of the electron distribution in the outer shell of the ground state carbon atom, where each box represents an orbital.

N.B: The vertical position of the boxes represents the relative energy levels of the orbitals.



Cage A: Ground State of carbon atom



Cage B: State of hybridization of a carbon atom in C_2H_4

i) Using boxes similar to those in Cage **A**, draw in Cage **B**, the outer orbitals of a hybridized carbon atom in ethene.

Label the boxes to indicate the types of orbitals represented by them. Indicate, as in Cage **A**. the electron distribution in the boxes in Cage **B**.

N.B. In drawing these boxes in Cage B. pay attention to their vertical position with respect to the boxes in Cage A.

ii) Complete the following sentences by filling in the blanks: -

I) The electron in the …….. orbital of carbon is involved information of the π bond in C_2H_4.

II) The electrons in the …… orbitals of carbon are involved in the formation of C–H bonds in C_2H_4.

c) Compounds **P**, **Q**, **R** all have the same molecular formula, C_7H_{14}. All three compounds do exhibit optical isomerism. However, none of them is a geometrical isomer or an optical isomer of any of the others. The three compounds **P**, **Q**, and **R** undergo catalytic hydrogenation to yield the same compound **S** with molecular formula, C_7H_{16}. **S** exhibits optical isomerism.

i) Write in the relevant box below, the possible 'structural formula for each of the compounds P, Q, R and S.

Compound	Structural formula
P	
Q	

R	
S	

ii) One out of the three compounds **P**, **Q**, **R** exhibits geometrical isomerism. Draw the structures of the two geometrical isomers of the compound in the cases below.

Geometrical Isomer I	**Geometrical Isomer II**

b) The following data are provided: -

Heat source	**relative molecular mass**	**standard boiling point/°C**	**standard molar enthalpy of combustion, ΔH^0/kJ mol^{-1}**
$C_3H_8(g)$	44	-40	-2,000
$C_8H_{18}(l)$	114	+125	-5,200

i) Under standard conditions, 5.0 kg each of propane and octane is separately subjected to complete combustion. Calculate, in each case,

I) the heat energy that is evolved.(C=12, H = 1)

II) the mass of gaseous CO_2 that is produced.

ii) Using your results from (i) above, deduce, giving two reasons, which of the two compounds would be more advantageous as a heat source.

02)

a) The element **M** belongs to the third period. It gives H_2 by reacting with dil. H_2SO_4. When **M** reacts with conc. H_2SO_4 it produced a gas which shows bleaching properties. The sulphate of **M** is used in purification of drinking water. When **M** is combusted in air, both oxide and the nitride are formed.

i) Identify the metal **M** ……

ii) Write the balance equation for the reaction of **M** and conc. H_2SO_4

……

iii) What is the oxidation state of **M** shown in the compounds?

……..

iv) Although N_2 is inert when **M** is combusted in air, N_2 reacts with it. Explain the reasons.

……

v) Write a use of the of **M**.

……..

b) The aqueous solution of the following compounds are provided in the vessels labelled from **A** to **E**

$BaCl_2$ (aq), $Na_2S_2O_3$(aq), $Pb(NO_2)_2$ (aq), $MnCl_2$(aq), $Al(NO_3)_3$ (aq) in an non ordered manner.

To distinguish the above compounds, carried out tests and their observations are given in the following table.

Solution	Addition of aqueous NaOH	Addition of aqueous H_2SO_4
A	A clear solution was formed	A gas is evolved, and the solution became turbid.
B	A clear solution	A white precipitate is obtained.
C	A white precipitate and dissolves when excess is added	A clear solution is obtained.
D	White precipitate is obtained, and it turns to black within a short period of time.	A clear solution is obtained.
E	A white precipitate is obtained.	A reddish-brown gas evolved

i) Identify the solution **A** to **E.**

A……. **B**……. **C**……. **D**……. **E**…….

ii) Write the balance equations for the reactions relevant to each of the precipitation observations.

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c) **X** and **Y** are two elements of the second period of the periodic table. The electron affinities of them are negative values. The first ionization energy of **X** is less than the first ionization energy of **Y**.

i) Identify the elements,

X = **Y** =

ii) Write the electron configuration of an atom of **X** in its ground state.

……

iii) When **X** is combusted in air it reacts with **Y**. Write the chemical equation for the reaction using the chemical symbols.

……

iv) Write the balanced chemical equations for the reactions taken place when the followings react with the oxide of **X**.

1. dil. HCl ……..
2. aqueous NaOH ……

i) Write the balance equation for a suitable reaction to prepare a sample of the element **Y** in the laboratory.

……

ii) Write two uses of the element **Y**.

……

……

2.

b) A. Write down balanced chemical equations for the following.

i) The thermal decomposition of $NaNO_3$

ii) The thermal decomposition of $Mg(NO_3)_2$

iii) The thermal decomposition of $AgNO_3$

iv) The thermal decomposition of NH_4NO_3

v) The oxidizing action of SO_2

vi) The reducing action of SO_2

vii) The oxidizing action of H_2S

viii) The reducing action of H_2S

b) An aqueous solution consists of Cu^{2+} (aq) and $C_2O_4^{2-}$ (aq). The following experiment is carried out to determine the molar ratio of Cu^{2+} (aq) and $C_2O_4^{2-}$ (aq) in the given solution.

First the aqueous solution is acidified by dil H_2SO_4. The volume of 22.6 cm^3 of 0.02 mol dm^{-3} $KMnO_4$ is required for complete oxidation of the $C_2O_4^{2-}$(aq) ions of the above solution. The resultant solution is neutralized by adding Na_2CO_3 (aq) solution.

Then the solution is acidified by the acetic acid and excess KI is added. To reduce liberated I_2 from it, 11.3 cm^3 of 0.05 mol dm^{-3} $Na_2S_2O_3$ (aq) is required.

i) Write balanced equations for all reactions could be taken place here.

ii) Calculate the molar ratio of the ions Cu^{2+}: $C_2O_4^{2-}$(aq) consisting in the solution.

c) Write the balanced equations for the reactions taking place with the followings.

i) $Cl_{2(g)}$ with excess $NH_{3\,(g)}$

ii) $S_{(S)}$ with aqueous NaOH

iii) Excess $H_2S_{(g)}$ with aqueous NaOH

iv) MgH_2 and water