2025- Chemistry Revision

Paper 4

1. The correct quantum numbers for the electron in 3p orbital is

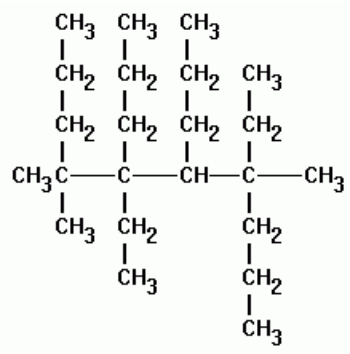
Answer	*n*	*l*	m_l	m_s
1	*4*	*2*	*-1*	*0*
2	*3*	*1*	*-1*	$+\frac{1}{2}$
3	*2*	*2*	*-2*	*-1*
4	*3*	*1*	*-2*	$-\frac{1}{2}$
5	*3*	*1*	*-2*	$-\frac{1}{2}$

2. The electron pair geometry around Xe in XeF_4.
   1. Tetrahedral 2. Square planer 3. Octahedral 4. Trigonal pyramid
   1. See saw

3. Oxidation states of the more electronegative atoms of the product obtained by the reaction of BaO_2 and H_2SO_4 followed by heating.

   1. 0 and -1 2. -1 and -2 3. -2 and 0 4. -2 and +1 5. +2 and -1

4. IUPAC name of the following compound is



1. 4,6,7-trimethylocta-2,5-diene
2. 2,5 dimethylocta-2,5-diene
3. 5,7-diethyl-4,4,7-trimethyl-5,6-dipropyldecane
4. 1,2,4-trimethylocta-2,5-diene
5. None of the above

5. Out of the following species which, has the lowest bond angel?

   1. BF_4^- 2. H_3O^+ 3. $^+CH_3$ 4. $^-NH_2$ 5. H_2O

6. The correct answer when the following are arranged in the increasing order of their boiling points.
   1. $CH_3F < CH_3Cl < CH_3Br < CH_3I$
   2. $CH_3Cl < CH_3Br < CH_3I < CH_3F$
   3. $CH_3I < CH_3Br < CH_3Cl < CH_3F$
   4. $CH_3Cl < CH_3Br < CH_3F < CH_3I$
   5. $CH_3F < CH_3I < CH_3Br < CH_3Cl$

7. A sample contains a mixture of NaBr (103 g mol^{-1}) and CsBr (213 $gmol^{-1}$). 1.00 g of this mixture contains 0.49 g of Br. Calculate the mass percentage of NaBr. (Na- 23, Cs- 133, Br-80)

1. 82.3% 2. 51.8% 3. 43.9 % 4. 29 % 5. 18.4%

8. If the root mean square speed of H_2 is $\sqrt{7}$ times that of N_2, identify the expression that shows the correct relationship.

1. $T_{H_2} = T_{N_2}$ 2. $T_{H_2} > T_{N_2}$ 3. $T_{H_2} = \sqrt{7}T_{N_2}$ 4. $\sqrt{7}\ T_{H_2} = T_{N_2}$ 5. $T_{H_2} < T_{N_2}$

9. 17.6 g of a mixture of $CaCO_3$ and $MgCO_3$ was heated strongly to produce 8.8 g of CO_2 after complete dissociation. The molar percentages of $CaCO_3$ and $MgCO_3$ in the mixture.

1. 50% & 50% 2. 60% & 40% 3. 40 % & 60 % 4. 25 % & 75% 5. 75% & 25 %

10. What are the species having the same number of lone pairs in the central atom?

A. NH_3 B. BCl_3 C. PCl_3 D. ClF_3 E. H_3O^+

1. A & C 2. C & D 3. A, B & D 4. A, C & E 5. B & D

11. Arrange Li, Na, Mg and Al in the increasing order of the covalent radius.

1. Li< Al< Mg< Na 2. Al< Li< Mg< Na 3. Al< Mg< Li< Na 4. Li< Na< Mg<Al
5. Al<Mg<Li<Na

12. Identify the option where all species are isoelectronic.

1. Na^+, Ne, Mg 2. F^-, Ne, Al 3. Na^+, Ne, F 4. Na^+, Ne, Mg^{2+}
5. O^{2-}, Ne, F

13. Consider the following enthalpy data

$\Delta H^{\circ}_{f(A2O)(g)}$= -348 kJ mol^{-1}

$\Delta H^{\circ}_{c(B)(s)}$= -452 kJ mol^{-1}

$\Delta H^{\circ}_{c(BA4)(g)}$= + 678 kJ mol^{-1}

Using the data given above, Calculate the standard enthalpy of formation of BA_4. (Standard form of A is A_2(g) and the standard from of B is B(s)

1. 1826 kJ mol^{-1} 2. 1478 kJ mol^{-1}. 3. -1478 kJ mol^{-1} 4. -1826 kJ mol^{-1} 5. 1148 kJ mol^{-1}

14. A certain HCl solution has a density of 1.15 g cm^{-3} and its percentage purity is 36.5%. Calculate the mass of Li_2O required to react with 2 dm^3 of this HCl solution. (Li = 7, O =16, Cl =35.5, H =1)

1. 38.4 g 2. 345 g 3. 464 g 4. 498.2 g 498.8 g

15. The pressure inside a glass-blub containing Ar gas at 22 ℃ is 1.2×10^5 Pa. The temperature inside changes to 87 ℃ when the bulb is lit. Calculate the pressure inside the container.

1. $1 \times 10^5\ Pa$ 2. $1.2 \times 10^5\ Pa$ 3. $1.46 \times 10^5\ Pa$ 4. $1.46 \times 10^6\ Pa$ 5. $1.2 \times 10^6\ Pa$

16. The percentage of H_2O by mass in $MSO_4.xH_2O$ 25.3%. (M = 63. S =32, O =16, H=1). Calculate the value of x.

1. 6 2. 2 3. 3 4. 4 5. 5

17. The size of the atomic nucleus was first determined by,
    1. making use of ∝ particles scattering.
    2. making use of β- particles scattering.
    3. using high-speed electrons.
    4. using neutron beams
    5. making use of alpha-particle absorption.

18. Combustion of a hydrocarbon produced CO_2 and H_2O in the mass ratio of 17.6 : 9. What is the empirical formula of the hydrocarbon.

1. CH_3 2. C_3H_7 3. C_4H_{10} 4. C_2H_5 5. C_4H_9

19. Identify the van der Waals equation.

1. PV= nRT 2. $\left(P + \frac{na^2}{V^2}\right)(V + nb) = nRT$ 3. $\left(P - \frac{a^2n^2}{V^2}\right)(V - nb) = nRT$
4. $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$ 5. $\left(P + \frac{a}{V^2}\right)(V - nb) = nRT$

20. Which statement is the more accurate statement out of the following for an ionic compound?

1. There are London dispersion forces among ionic bonds.
2. There are no mobile ions in the solid form.
3. Both solid and the molten forms can conduct electricity.
4. When they are dissolved in water, the compound conducts electricity due to the presence of mobile electrons.
5. All ionic compounds are completely soluble in water.

21. Calculate the root mean square speed of the N_2 at 77 ℃. (N =14)

1. 1.77×10^1 ms^{-1} 2. 3.12×10^2 ms^{-1} 3. 5.58×10^2 ms^{-1} 4. 7.89×10^2 ms^{-1}
5. 3.12×10^2 ms^{-1}

22. Which of the following g reactions cannot evolve $NH_3(g)$ when heated with aqueous NaOH?

1. Urea 2. $(NH_4)_2CO_3$ 3. $NaNO_3$+Zn dust 4. $[Cu(NH_3)_4]SO_4$ 5. $NaNO_3$ + Fe dust

23. An iron nail has undergone partial rusting process and there is a 10 % mass increase. If the chemical formula of rust is Fe_2O_3 what is the mass percentage of remaining Fe in the rusted nail. (Fe = 56, O =16)

1. 10% 2. 20% 3. 82% 4. 77% 5. None of the above.

24. Which out of the following are similar in colours?

a. MnS, CuS b. $CdS, As_2\ S_3$

$c.\ Cu_2I_2, ZnS$ d. Sb_2S_3, Bi_2S_3

25. What is the correct statement regarding BiOCl?

a. Oxidation number of Cl is +1 b. Oxidation number of Cl is -1

c. There is a lone pair in the central atom. d. It is soluble in water.

01. A. (i) Arrange in the increasing order of bond energy NO_2^+, NO_2^-, NO_3^-

_____<_____<_____

(ii) Arrange the increasing order of the bond angle SO_3, O_3, ICl_3

_____<_____<_____

(iii) Arrange the following in the increasing order of the frequency of the radiation emitted by the atom. K, Na, Li, Cu.

_____<_____<_____<_____

(iv) Arrange the following in the increasing order of the ionic radius. Na^+, Mg^{2+}, O^{2-}, Cl^-.

_____<_____<_____<_____

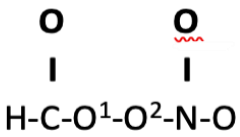
(v) Arrange the following in the increasing order of thermal stability: K_2CO_3, $CaCO_3$, $BaCO_3$, $SrCO_3$.

_____<_____<_____<_____

(vi) Arrange the following in the increasing order of the electronegative character of the S atom. SO_2, SO_3, H_2S.

_____<_____<_____

B. The skeletal formula of $HCNO_5$ is shown below.



1. Draw the most acceptable Lewis structure for the compound above.

2. Draw 4 different resonance structures for the compound.

3. Complete the following the table on the structure you drew in 1 above.

	C	**O^1**	**O^2**	**N**
Electron pair geometry				
Shape				
Hybridization				
Bond angle				

4. Identify the atomic or hybrid orbitals that are responsible for the following bond formations.

$C\text{-}O^1$ = C_____ O^1_____

$O^1\text{-}O^2$ = O^1_____ O^2_____

$O^2\text{-}N$ = O^2_____ N_____

c. Identify the nature of bonds and intermolecular forces in the following compounds.

Compound	**Nature of the bond (Ionic, polar covalent, non-polar covalent)**	**Intermolecular forces (Dipole-dipole, H-bonds, London forces, Electrostatic forces)**
Paraffin(*s*)		
Bromine (*l*)		
$CHCl_3$(*l*)		
CH_3OH(*l*)		
Potassium hydride (*s*)		

2.

a) **M** is a s-block element. **M** does not contain electrons having *l*=2 in its electron configuration at all.

- **M** forms oxides with atmospheric O_2
- **M** forms a stable nitride with N_2 at high temperature.
- **M** forms a strongly alkaline solution by rapidly reacting with cold water.

i) Identify element **M**.

……

ii) Write the electron configuration of **M**.

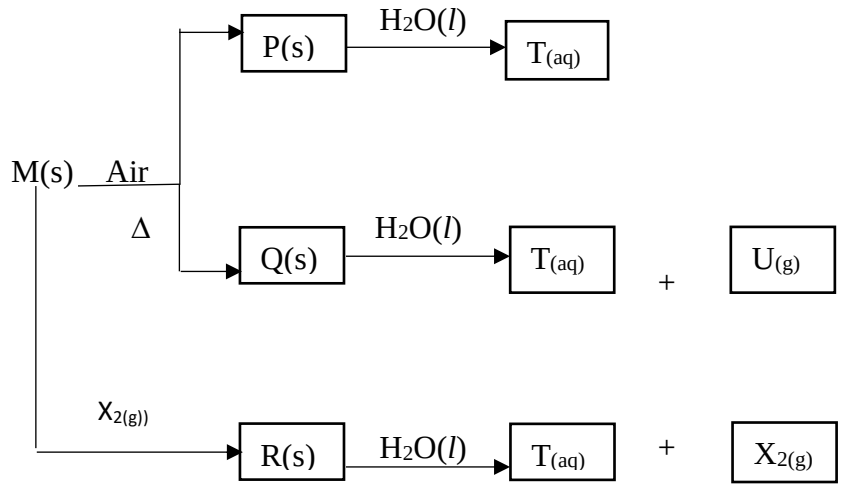
……

iii) Write down the observation of flame test carried out with a slat of **M**.

……

……

iv) Consider the following reaction sequence of **M**.



I. Identify the gas X_2.

……

II. Identify **P, Q, R, T, U, X**

P ……. T …….

Q ……. U …….

R ……. X …….

III. Write the balanced chemical equation for the reaction between X_2 and **M**.

……

……

IV. Write down an identification test for gas **U**.

……

……

……

b) **A** is a blue colour solid ionic compound consisting of three elements. **A** gives a green colour flame, when subjected to flame test. **A** dissolve in water to form a blue colour solution, **B**. When few drops of ammonia solution are added to it, a light blue colour precipitate, **C** is formed and upon addition of ammonia in excess, a dark blue colour solution, **D** is formed.

Upon heating solid **A**, a black colour solid compound **E**, a reddish-brown colour gas **F** and a colourless, diatomic gas **G** are formed. Solution **H** which is yellow in colour is formed, upon addition of concentrated HCl in excess to **E**.

i) Identify **A, B, C, D, E, F, G** and **H**.

A ……. E …….

B ……. F …….

C ……. G …….

D ……. H …….

ii) Write the balanced chemical equation for the following reaction, giving the formulae.

$A(s) \longrightarrow E(s) + F(g) + G(g)$

……

iii) To an aqueous solution of **A**, an equal volume of a freshly prepared aqueous solution of $FeSO_4$ was added and then concentrated H_2SO_4 was added in dropwise.

I. Write down the colour change that takes place here.

……

II. Write down the balanced chemical equation for the reaction take place here.

……

……

c) **A** is a *p*-block element. It forms an oxyanion in the form of $A_xO_y^{2-}$. When a dilute acid is added to **B**, a precipitate of **A** is formed along with a gaseous oxide of **A**.

i) Identify the oxyanion **B**.

……..

ii) Write down the balanced chemical equation for the reaction between dilute HNO_3 and the oxyanion **B**.

……

……

iii) Considering the reaction between the gaseous product formed in the reaction in part (ii) above and acidified $K_2Cr_2O_7$ solution, write down.

I. The balanced chemical equation

……

……

II. Colour change of the solution.

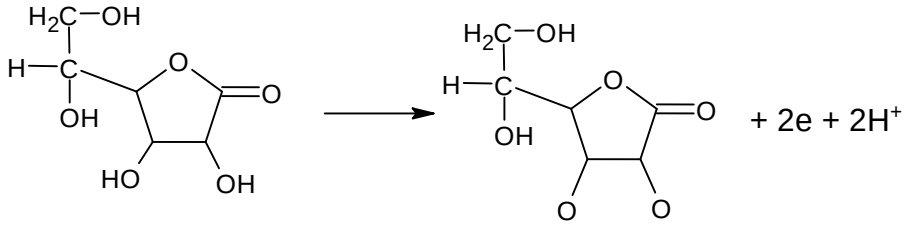
……

……

3. A.

Vitamin C is an essential nutrient. The molecular formula of the active compound it contains is ascorbic acid, which is $C_6H_8O_6$. A method followed to find the mass percentage of ascorbic acid in a vitamin tablet is given below.

A **vitamin C** tablet of mass 100 mg was dissolved in a sulfuric acid solution of concentration 0.20 mol dm^{-3} to form a solution of volume 70.0 cm^3. It was treated with excess KI(s). KIO_3 with a concentration of 0.01 mol dm^{-3} 50.0 cm^3 of a solution was added. KI and KIO_3 release I_2 in acidic medium. When I_2 is reduced, the ascorbic acid in **vitamin C** is oxidized according to the balanced half ionic reaction below.



A volume of 25.00 cm^3 of $Na_2S_2O_3$ solution of 0.08 mol dm^{-3} is consumed to titrated with liberated I_2 in the reaction.

(i) Write balanced chemical equations for the following reactions.

I. Between KI and KIO_3
II. Between I_2 and ascorbic acid
III. Between I_2 and $Na_2S_2O_3$

(ii) Calculate the mass percentage of ascorbic acid in a **vitamin C** tablet. (C – 12, O = 16, H = 1)

(B)

Derive Dalton's law of partial pressure using PV=nRT Equation. A certain rigid container contains 12 g of He gas at 27 °C and its volume is 16.628 dm^3.

(i) Calculate the pressure of the gas in the container. In the calculation, state the assumptions made clearly. (He=4)

(ii) If 2 mol of O_2 gas is introduced into the above container while the temperature is constant, then calculate the partial pressure of He gas inside the container.

(iii) What is the total pressure in the vessel after the O_2 gas is introduced?

(iv) If another rigid evacuated vessel (equal volume to the previous vessel) is connected, and the temperature is maintained at 27 °C calculate the total pressure in the new system.

(v) If the temperature of the above combined vessel increased from 27 °C to 127 °C, what will be the new pressure in the vessel?

(vi) Now x moles of $NO_{(g)}$ is added to the above combined vessel and the temperature is maintained at 127 °C. The total pressure at the end is 6.5×10^5 Pa. Here NO and O_2 gases react in the following way,

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

But since there was not enough NO to react with all O_2, some O_2 remains in the system. Calculate the value of x.

4. (a)

5 cm^3 of a gaseous hydrocarbon is mixed with 60 cm^3 of O_2 gas and was allowed to undergo combustion. When the resulting air mixture reached room temperature and pressure, its volume was 45 cm^3. This mixture was passed through a concentrated KOH solution, the final volume of the gaseous mixture was 20 cm^3 at room temperature and pressure. Find the molecular formula of the hydrocarbon. What is the gas law used for this calculation? Draw the structures isomers, write their IUPAC names. Arrange them in the increasing order of the melting point.

b) Consider the following enthalpy values. Thus calculate the standard enthalpy of formation of CuO(s) using a Born Haber cycle.

Enthalpy of sublimation of Cu(s)	+340 kJ mol^{-1}
Enthalpy of first ionization of Cu(g)	+750 kJ mol^{-1}
Enthalpy of second ionization of Cu(g)	+2000 kJ mol^{-1}
Enthalpy of bond dissociation of O_2(g)	+500 kJ mol^{-1}
Enthalpy of first electron gain of O(g)	-141 kJ mol^{-1}
Enthalpy of second electron gain of O(g)	+790 kJ mol^{-1}
Lattice enthalpy CuO(s)	-4143 kJ mol^{-1}

(c) You are provided with the following data.

(i)

Standard enthalpy of combustion of CH_3-CH_3(g)	-1560 kJ mol^{-1}
Standard enthalpy of combustion of CH_3-CH_2-CH_3 (g)	-2220 kJ mol^{-1}
Standard enthalpy of formation of CO_2(g)	-395 kJ mol^{-1}
Standard enthalpy of combustion of H_2(g)	-286 kJ mol^{-1}
Standard enthalpy of combustion of CH_3-CH=CH_2(g)	-2060 kJ mol^{-1}

Using the above data, calculate the standard enthalpy of formation of CH_3-CH_3(g) and CH_3-CH_2-CH_3(g) using an enthalpy cycle.

(ii) Using the data obtained from the calculation in (i) above and the data given below, Calculate the C−C and C−H bond strengths of C= C present in $CH_3CH=CH_2(g)$ and C−C and C−H present in $CH_3CH_3(g)$ and $CH_3CH_2CH_3(g)$.

Standard sublimation enthalpy of carbon = +717 kJ mol^{-1}

Standard bond dissociation enthalpy of $H_2(g)$ = 436 kJ mol^{-1}

b) ΔG^{θ} of formation of species $MgSO_4(s)$, $BaSO_4(s)$, $Mg^{2+}(aq)$, $Ba^{2+}(aq)$ and $SO_4^{2-}(aq)$ is -1174 kJ mol^{-1} , -1353 kJ mol^{-1}, -456 kJ mol^{-1}, -561 kJ mol^{-1} and -742 kJ mol^{-1}. Prove the use of ΔG^{θ} that $MgSO_4(s)$ is more soluble in water than $BaSO_4(s)$.