Time allowed: 2:35 Hours

Total Marks: 68

Note: Answer all parts from Section 'B' and all questions from Section 'C' on the separately provided E-Sheet. Write your answers neatly and legibly. No extra E-Sheet will be provided.

SECTION – B (Marks 42)

Q.2: Attempt all parts from the following. All parts carry equal marks. $(14 \times 3 = 42)$

i.   Calculate the theoretical yield of MgO, when 2.52 g of Mg was treated in excess of Oxygen. $2Mg + O_2 \longrightarrow 2MgO$

OR

What will be the wave number $(\bar{v})$ of the spectral line of an electron when it jumps from $n_2=4$ to $n_1=2$?

ii. Apply Hund's rule to write an electronic configuration for atom A with atomic number 7 and atom B with atomic number 15. $(1.5+1.5)$

OR

Analyze the behaviour of each of the following salts in their aqueous solution NaCl, NH_4Cl, KNO_3.

iii. Apply VSEPR theory to predict the shape of NH_3. $(1+2)$

OR

How can we predict the extent of completion of a chemical reaction.

iv. Compare Amorphous and Crystalline solids in terms of their structure, arrangement of atoms and melting point. $(1+1+1)$
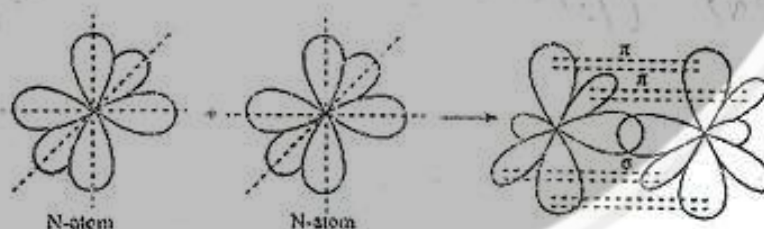
OR

Calculate the radius of 3rd and 4th orbits of the hydrogen atom.

v.   Justify with reason:
a. Size and energy of 2s orbital is larger than 1s.
b. The d-orbitals of different shells are similar in shape but differ in energies.

OR

What information are you getting from the diagram about the formation of N_2 molecules? $(0.5+2.5)$

vi. What properties are exhibited by liquid molecules due to cohesion forces between their molecules?   (3)

OR

Classify each of the following as Bronsted acid or base. $(1+1+1)$
a. HCO_3^{-1} b. HBr   c. CH_3COO^-

vii. With respect to physical state of reactants and products how can we classify chemical equilibrium.

OR

Why water (H_2O) has high boiling point than HF, although fluorine is more electronegative than Oxygen.

viii. Give reason:
   a. Why only Balanced chemical equations are used in stoichiometric problems?
   b. Why is the concept of "gram atom" used in chemistry?

OR

Give reason why all collisions between reactant molecules do not lead to a reaction.

ix. VBT predicts that O_2 molecule would be diamagnetic, but it is paramagnetic in nature. Why?

(1.5+1.5)

OR

How is the strength of intermolecular forces in a liquid molecule related to its vapour pressure?

x. What features of the water molecule cause its behavior to be irregular?

OR

State the significance of the rate-determining step on the overall rate of a multi-step reaction.

xi. Use your knowledge of gases to determine why lighter gases diffuse more quickly than heavier ones.

OR

Prove that K_a is inversely proportional to K_b at a given temperature.

xii. A sample of oxygen gas has volume of 225 ml when its pressure is 1.12 atm. what will the volume of the gas be at a pressure of 0.98 atm if the temperature remains constant?

OR

Calculate the concentration of Pb^{+2} ions when solid $PbSO_4$ is added to water. The solubility product of $PbSO_4$ is 1.6×10^{-8}.

$$PbSO_4 \rightleftharpoons Pb^{+2} + SO_4^{-2}$$

xiii. Consider two gases A and B in a container at room temperature. What effect would the changes have on the rate of reactions between these gases?
   a. The number of molecules of gas A is added.
   b. The temperature is decreased by 10°C.
   c. The pressure is doubled.

(1x3)

OR

Calculate the numerical value of "R" if one mole of gas is taken at S.T.P.

xiv. Briefly discuss why the conjugate base of a strong acid is a weak base and conjugate acid of a strong base is a weak acid. Give one example of each case to support your answer.

(1.5+1.5)

OR

Give reason why all known gases can't behave ideally.

H	¹								He	²
Li	³	Be	⁴	B	⁵	C	⁶	N	⁷	O	⁸	F	⁹	Ne	¹⁰
Na	¹¹	Mg	¹²	Al	¹³	Si	¹⁴	P	¹⁵	S	¹⁶	Cl	¹⁷	Ar	¹⁸
K	¹⁹	Ca	²⁰											

Note: Attempt all questions. Marks of each question are given within brackets.
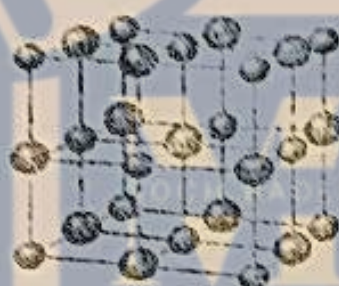
Q.3: The application of a theory is shown in the energy level diagrams below. Identify and explain it in detail with reference to the formation of molecules given (O_2 and H_2). (1+3+3)
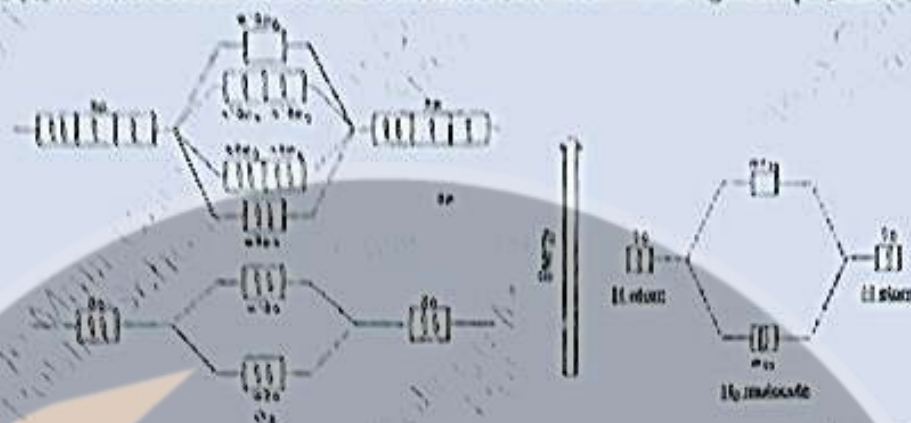
OR

Derive ideal gas equation using Boyle's Law, Charle's Law and Avagadro's Law. (7)

Q.4: Identify and differentiate between two types of crystals given below. (any six differences) (1+6)

A   B

OR

Sate the law of mass action. Apply your knowledge about the law to complete the table below for the reaction given: (2+5)

$$Aa_{(g)} + bB_{(g)} \rightleftharpoons cC_{(g)} + dD_{(g)}$$

Equilibrium constant representation	expressed in terms of	expressed as
K_c		$[C]^c [D]^d / [A]^a [B]^b$
K_p		
K_x		

Q.5: How are the various forms of buffer solutions made? Justify that Buffer solution resists change in pH when a small amount of acid or base is added, support your answer with a suitable example. (2+2+2)

OR

Apply your knowledge of Le Chatelier's principle to suggest three ways to get the maximum yield of Ammonia. (2x3)

Q.6: How can you derive a relationship for the conclusion: "The Kelvin temperature of a gas is actually the measure of average translational K.E of its molecules". (6)

OR

How can you differentiate liquid crystals from pure liquids and crystalline soilds. Discuss any four applications of liquid crystals. (4+2)