

TIME ALLOWED: 3 HOURS

GENERAL INSTRUCTIONS

- (a) There are 33 questions in this question paper with internal choice.
(b) SECTION A consists of 16 multiple choice questions carrying 1 mark each.
(c) SECTION B consists of 5 short answer questions carrying 2 marks each.
(d) SECTION C consists of 7 short answer questions carrying 3 marks each.
(e) SECTION D consists of 2 case - based questions carrying 4 marks each.
(f) SECTION E consists of 3 long answer questions carrying 5 marks each.

(g) All questions are compulsory.

SECTION A

1. Which of the following is iso-electronic with helium

- (A) O_2^{2-} (B) F^+ (C) Li^+ (D) Na
(A) 1 and 2 (B) 2 and +1 (C) 3 and -1 (D) 1 and -1
(A) 0.034% (B) 27.27% (C) 3.4% (D) 72.72%

2. The value of l and m for the last electron in the Cl^- ion are -

- (A) 1 and 2 (B) 2 and +1 (C) 3 and -1 (D) 1 and -1

3. What is the mass percent of oxygen in carbon dioxide?

- (A) 0.034% (B) 27.27% (C) 3.4% (D) 72.72%

4. Which of the following statements about a compound is incorrect?

- (A) A molecule of a compound has atoms of different elements.
(B) A compound cannot be separated into its constituent elements by physical methods of separation.
(C) A compound retains the physical properties of its constituent elements.
(D) A compound retains the physical properties of its constituent elements in a compound is fixed.

5. Which of the following molecules do not follow the octet rule?
(A) PCl_5 (B) H_2O (C) CO_2 (D) NO_2
6. Which of the following set of quantum numbers is not possible?
(A) $n = 3, l = 0, m = 0$ (B) $n = 3, l = 1, m = -1$ (C) $n = 2, l = 0, m = -1$ (D) $n = 2, l = 1, m = 0$

7. The empirical formula of a compound of molecular mass 120 is CH_2O . The molecular formula of the compound is:
(A) $\text{C}_2\text{H}_4\text{O}_2$ (B) $\text{C}_4\text{H}_8\text{O}_4$ (C) $\text{C}_3\text{H}_6\text{O}_3$ (D) all of these

8. Which of the following compound has highest covalent character
(A) LiCl (B) LiBr (C) LiF (D) LiI

9. Which of the following rule out the existence of definite path or trajectories of electrons
(A) Pauli's exclusion principle (B) Heisenberg's uncertainty principle
(C) Hund's rule of maximum multiplicity (D) Aufbau's principle



The reason for the negative value of E is

- (A) endothermic reaction (B) exothermic reaction
(C) both 1 and 2 (D) All of the above are wrong
11. The number of water molecules is maximum in
(A) 18 gram of water (B) 18 moles of water
(C) 18 molecules of water (D) 1.8 gram of water

12. Find the molecule with the maximum dipole moment
(A) CH_4 (B) NH_3 (C) CO_2 (D) NF_3

ASSERTION AND REASON TYPE QUESTIONS (1 MARK)

In the following questions, a statement of Assertion followed by a statement of Reason is given. Choose the correct option out of the choices given below.

- (A) Both A and R are true, and R is the correct explanation of A.
(B) Both A and R are true, but R is not the correct explanation of A.

- (C) A is true but R is false.
(D) Both A and R are false.

13. Assertion: Equal moles of different substances contain same number of constituent particles.

Reason: Equal weights of different substances contain the same number of constituents particles.

14. Assertion: Generally, ionization enthalpy increases from left to right in a period.

Reason: When successive electrons are added to the orbitals in the same principal quantum level, the shielding effect of inner core of electrons does not increase very much to compensate for the increased attraction of the electron to the nucleus.

15. Assertion: Energy of resonance hybrid is equal to the average of energies of all canonical forms.

Reason: Resonance hybrid cannot be presented by a single structure. Select the most appropriate

16. Assertion: Significant figures for 0.400 is 3 whereas for 400 it is 1.

Reason: Zero at the end or right of a number are significant provided they are not on the right side of the decimal point.

SECTION B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17. Explain why CO_2 molecule has zero dipole moment?

18. What were the reasons for the failure of Thomson's model?

19. Explain why ozone molecule cannot be represented by a single Lewis structure. How can it be best represented?

20. With two suitable examples explain the difference between an ionic and covalent bond?

21. On the basis of quantum numbers, justify that the fifth period of the periodic table should have 18 elements.

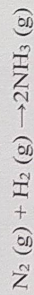
OR

What is screening or shielding effect? How does it influence electron gain enthalpy?

SECTION C

This section contains 7 questions with internal choice in one question. The following questions are short answer types and carry 3 marks each.

22. Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation:



(i) Calculate the mass of ammonia produced if 4.00×10^3 g dinitrogen reacts with 1.00×10^3 g of dihydrogen.

(ii) Will any of the two reactants remain unreacted?

(iii) If yes, which one and what would be its mass?

23. (i) Out of F or Cl which element would have a more negative electron gain enthalpy and why?

(ii) How would you explain the fact that the first ionization enthalpy of sodium is lower than that of magnesium but its second ionization enthalpy is higher than that of magnesium.

24. Draw the resonating structure of nitrobenzene.

25. Does Li_2 molecule exist? Explain

26. (i) Draw the resonance structures of phenol. Show the electron shift using curved arrow notation.

(ii) Why the bond angle in water is less than methane molecule?

27. Hydrogen gas is prepared in the laboratory by reacting dilute HCl with granulated zinc.

Following reaction takes place.



Calculate the volume of hydrogen gas liberated at STP when 32.65 g of zinc reacts with HCl.

1 mol of a gas occupies 22.7 L volume at STP; atomic mass of Zn = 65.3 u.

28. In the reaction $2\text{A} + 4\text{B} \rightarrow 3\text{C} + 4\text{D}$, when 5 moles of A react with 6 moles of B, then

(i) which is the limiting reagent?

(ii) calculate the amount of C formed?

OR

- (i) Why BeH_2 molecule has zero dipole moment although the BeH_2 bonds are polar?
(ii) Write one difference between sigma bond and π bond.
(iii) What type of hydrogen bonding is observed in o-nitrophenol molecule and alcohol molecules?

SECTION D

The following questions are case-based questions. Each question has an internal choice and carries 4 marks each. Read the passage carefully and answer the questions that follow.

29. Study the following tables related to electronegativity values along the periods 2 and 3, Group 1 and 17 and answer the questions that follow based on these.
Electronegativity Values (on Pauling scale) Across the Periods

Atom (Period II)	Li	Be	B	C	N	O	F
Electronegativity	1.0	1.5	2.0	2.5	3.0	3.5	3.0
Atom (period III)	Na	Mg	Al	Si	P	S	Cl
Electronegativity	0.9	1.2	1.5	1.8	2.1	2.5	3.0

Electronegativity Values (on Pauling scale) Down a Family

Atom (Group I)	Electronegativity Value	Atom (Group XVII)	Electronegativity Value
Li	1.0	F	4.0
Na	0.9	Cl	3.0
K	0.8	Br	2.8
Rb	0.8	I	2.5
Cs	0.7	At	2.2

(i) How does electronegativity vary along a period and why?

(ii) Why does electronegativity decrease down the group?

(i) Why is CsF most ionic?

(ii) Why is H⁺ ion bigger than F⁻ ion?

OR

(iv) Why is Cl₂O₇ more acidic than Cl₂O₆?

30. The identity of a substance is defined not only by the types of atoms or ions it contains, but by the quantity of each type of atom or ion. The experimental approach required the introduction of a new unit for amount of substances, the mole, which remains indispensable in modern chemical science. The mole is an amount unit similar to familiar units like pair, dozen, gross, etc. It provides a specific measure of the number of atoms or molecules in a bulk sample of matter. A mole is defined as the amount of substance containing the same number of discrete entities (atoms, molecules, ions, etc.) as the number of atoms in a sample of pure ¹²C weighing exactly 12g. One Latin connotation for the word "mole" is "large mass" or "bulk," which is consistent with its use as the name for this unit. The mole provides a link between an easily measured macroscopic property, bulk mass, and an extremely important fundamental property, number of atoms, molecules and so forth. The number of entities composing a mole has been experimentally determined to be $6.02214179 \times 10^{23}$

(i) How many moles of magnesium phosphate, Mg₃(PO)₄ will contain 0.25 mole of oxygen atoms?

(a) 1.25×10^{-2} (b) 2.5×10^{-2} (c) 0.02 (d) 3.125×10^{-2}

(ii) What is the mass of one molecule of yellow phosphorus? (At. mass of phosphorus = 30)

(a) 1.993×10^{-22} mg (b) 1.993×10^{-19} mg

(c) 4.983×10^{-20} mg (d) 4.983×10^{-23} mg

(iii). The number of moles of oxygen in 1L of air containing 21% oxygen by volume, in standard conditions is

(a) 0.186 mol (b) 0.21 mol (c) 2.10 mol (d) 0.0093 mol

(iv). The number of moles present in 6 gm of carbon is:



(a) 2

(b) 0.5

(c) 5

(d) 1

SECTION E

The following questions are long answer type and carry 5 marks each.

31. (i) Write the electronic configurations of Cu^{2+}
 (ii) Explain the rule in writing the electronic configuration of Cu(29)
 (iii) Explain the hybridization in case of Sulphur hexa fluoride. sp^3d^2
- (i) Explain hybridisation and its characteristics.
 (ii) Describe the hybridisation in the case of BeCl_2 .
 (iii) Why are the axial bonds longer compared to equatorial bonds in PCl_5 ?

OR

32. (i) A flask P contains 0.5 mole of oxygen gas. Another flask Q contains 0.4 mole of ozone gas. Which of the two flasks contains the greater number of oxygen atoms?
 (ii) Calculate no. of carbon and oxygen atoms present in 44.8 litres of CO_2 at N.T.P.
 (iii) Define the law of constant proportions. Explain it with two examples.
33. (i) Briefly explain the postulates of Bohr's model and give its drawbacks.
 (ii) What are the major drawbacks of Rutherford's model of atom?
 (iii) An atomic orbital has $n = 4$. What are the possible values of l and m ?
 (iv) Why 5s-orbital is filled before 4d-orbital?
 (v) Which of the following orbitals are not possible? 1p, 2s, 2p and 3f

OR

- (i) How many electrons in an atom may have the following quantum numbers?
 (a) $n = 4, m_s = -\frac{1}{2}$ (b) $n = 3, l = 0$
- (ii) Explain why cations are smaller and anions larger in radii than their parent atoms?
- (iii) Elements A, B, C and D have atomic numbers 12, 19, 29, and 36 respectively. On the basis of electronic configuration, write to which group and period of the periodic table each