






		1 1 2	1 1 2
	<p>electrons, yet phosphorus does not form a diatomic molecule like N₂. Also phosphorus shows pantavalency but nitrogen does not.</p> <p>(a) Out of CH₃NH₂ and HCN, in which molecule N-atom adopt sp³-hybrid state? Explain with</p> <p>(b) Out of NF₃, NF₅ and PF₅, which molecule does not exist?</p> <p>(c) What hybrid-state does P assume when it forms five P-Cl bonds around it? Explain with reference to PCl₅.</p>		
30.	<p>Arrange the following in decreasing order of bond angles BF₃, NH₃, PF₃ and I₂ Give a suitable reason</p> <p>A covalent bond can cleave either homolytically or heterolytically. Homolytic cleavage forms free radicals whereas heterolytic cleavage produces either carbocations or carbanions. In other words, during organic reactions the cleavage of bond results in the formation of above species known as intermediates which play an important role in the mechanism of the reaction. The formation of these inter-mediate depends on the dissociation energy of covalent bonds.</p> <p>(a) Out of the two structures, identify the one which has maximum stability</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  </div> <div style="text-align: center;"> $\text{C}_6\text{H}_5-\overset{\oplus}{\text{C}}(\text{CH}_3)-\text{CH}_3$ </div> </div> <p>(b) Predict the number of σ and π bonds in the following molecule:</p> <div style="text-align: center;">  </div> <p>(c) Draw bond line structure for: 2-Amino-2-cyclohexyl-1-propanol and Propanoic acid</p> <p>(d) Which is expected to be more stable O₂NCH₂CH₂O⁻ or CH₃CH₂O⁻ and why?</p>	1 1 2 2	1 1 2 2
SECTION: E			
The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.			
31.	<p>(a) For a gaseous reaction, 2A₂(g) + 5B₂(g) → 2A₂B₅(g) at 27°C the heat change at constant pressure is found to be - 50160 J. Calculate the value of internal energy change (ΔU). Given that R = 8.314 JK⁻¹ mol⁻¹.</p> <p>(b) Categorise the following into extensive/intensive properties: Temperature, internal energy, enthalpy, density</p>	5	(3)
32.	<p>(a) The uncertainty in the momentum of a particle is 6 × 10⁻² kg ms⁻¹. Calculate the uncertainty in its position.</p> <p>(b) The number of electrons, protons and neutrons in a monoatomic species are equal to 36, 35 and 45 respectively. Assign the proper symbol.</p> <p style="text-align: center;">OR</p> <p>(a) Calculate the momentum of a moving particle which has a de-Broglie wavelength of 200 pm.</p> <p>(b) Give the number of electrons in H₂⁺ and O₂⁺</p>	5	(3)
33.	<p>(a) What are the necessary conditions for any compound to show aromaticity?</p> <p>(b) Explain why the following systems are not aromatic:</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(i)</p> </div> <div style="text-align: center;">  <p>(ii)</p> </div> <div style="text-align: center;">  <p>(iii)</p> </div> </div> <p style="text-align: center;">OR</p> <p>(a) An alkene 'A' on ozonolysis gives a mixture of ethanal and pentan-3-one. Write the structure and IUPAC name of 'A'.</p> <p>(b) Draw the 3 structures that are possible for dichloro substitution on iso-butane.</p>	5	(3)

TIME-3 hrs

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 very 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.

(h) Use of log tables and calculators is not allowed.

**SECTION-A**

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1.	Which branched chain isomer of the hydrocarbon with molecular mass 72u gives only one isomer of mono substituted alkyl halide (a) Tertiary butyl chloride (b) Neopentane (c) Isohexane (d) Neohexane	1
2.	Representative elements are those which belong to (a) p and d blocks (b) s and d blocks (c) p and s blocks (d) f and d blocks	1
3.	For which of the following reactions ΔH is equal to ΔU ? (a) $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$ (b) $2HI(g) \longrightarrow H_2(g) + I_2(g)$ (c) $2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$ (d) $2NO_2(g) \longrightarrow N_2O_4(g)$	1
4.	Which of the following molecule does not exist (a) C_2 (b) O_2 (c) He_2 (d) Li_2	1
5.	Identify the most stable conformation of n-butane from the following <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> (a) </div> <div style="text-align: center;"> (b) </div> <div style="text-align: center;"> (c) </div> <div style="text-align: center;"> (d) </div> </div>	1
6.	Which of the following is a dehydrohalogenation reaction? (a) $C_2H_5Cl + aq. KOH \rightarrow CH_2=CH_2 + KCl + H_2O$ ✓ (b) $BrCH_2-CH_2Br + Zn \rightarrow CH_2=CH_2 + ZnBr_2$ ✗ (c) $CH_3COOH + CH_3OH \rightarrow CH_3COOCH_3 + H_2O$ (d) Both (a) and (b).	

(Later)

7. In which of the following equilibria K_c and K_p are not equal?

- (a) $2\text{NO}(g) \rightleftharpoons \text{N}_2(g) + \text{O}_2(g)$
 (b) $\text{SO}_2(g) + \text{NO}_2(g) \rightleftharpoons \text{SO}_3(g) + \text{NO}(g)$
 (c) $\text{H}_2(g) + \text{I}_2(g) \rightleftharpoons 2\text{HI}(g)$
 (d) $2\text{C}(s) + \text{O}_2(g) \rightleftharpoons 2\text{CO}_2(g) + \text{O}_2(g)$ ✓

8. A gas is allowed to expand in a well insulated container against constant external pressure of 2.5 atm, from initial volume of 2.50 L to a final volume of 4.50 L. The change in internal energy ΔU of the gas in Joules will be

- (a) -500 J
 (b) -505 J
 (c) +505 J
 (d) 1136.25 J

9. The maximum number of electrons with clockwise spin that can be accommodated in a f-sub-shell is

- (a) 14
 (b) 7
 (c) 5
 (d) 10

10. In isoelectronic species Cl^- , Ar , Ca^{2+} sizes differ due to

(a) electron electron repulsion in valence shell
 (b) nuclear charge
 (c) principal quantum number
 (d) magnetic quantum number

11. A typhoid patient records a temperature of 104°F . What will this reading be on Celsius scale?

- (a) 40°C
 (b) 68°C
 (c) 37.7°C
 (d) 57.7°C

12. Which of the following has the maximum number of unpaired d-electrons?

- (a) Zn $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10} = 0$
 (b) Fe^{2+} $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^4$ ✓
 (c) Ni^{3+} $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5$ ✓
 (d) Cu^{+} $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}$ ✓
 (Atomic numbers: $\text{Fe}=26$, $\text{Ni}=28$, $\text{Cu}=29$, $\text{Zn}=30$)

These questions have two statements each:

Statement 1 (assertion) and Statement 2 (reason). Each question has choices A, B, C, D of which only one is correct. Choose the correct option.

- (A) Both assertion and reason are correct statements and reason is the correct explanation of the assertion.
 (B) Both assertion and reason are correct statements but the reason is not the correct explanation of the assertion.

- (C) Assertion is correct, but reason is wrong statement.
 (D) Assertion is wrong, but reason is correct statement.

$E_m = n M F \times \frac{E_m}{n F}$

13. Assertion A: The empirical mass is n times the molecular mass of a substance. ✓
 Reason R: The empirical formula represents the simplest whole number ratio of various atoms present in a compound. ✓

14. Assertion A: s-orbital cannot accommodate more than two electrons. ✓
 Reason R: s-orbitals are extremely poor shielders. ✓

15. Assertion A: Solubility of a gas in water increases with decrease in temperature. ✓
 Reason R: Dissolution of gases in water or any other liquid is accompanied by evolution of heat. ✓

16. Assertion A: Pent-1-ene and pent-2-ene are position isomers.
 Reason R: Position isomers differ in the position of functional group or a substituent A

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.

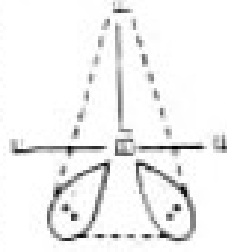
17. How many molecules of water of hydration are present in 252 mg of oxalic acid? ($\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$) 2

18. Account for the following:
 (a) NF_3 is pyramidal while BF_3 is triangular planar
 (b) Bond angle in H_2O is larger than the bond angle in H_2S 2

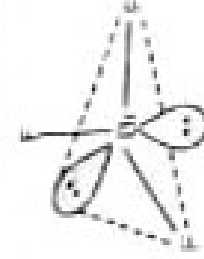
OR

Identify the correct geometrical arrangement of BrF_3 from the following:

(a)



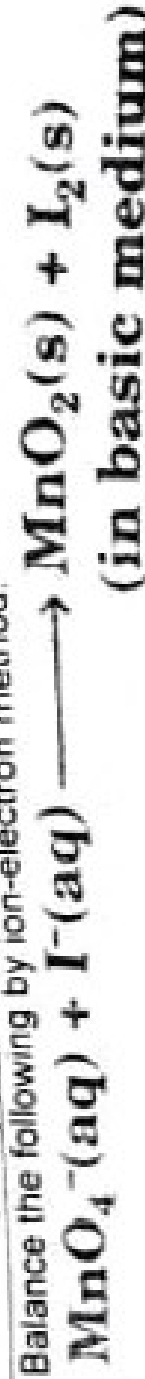
(b)



(c)

Justify your answer.

19. Balance the following by ion-electron method:



2

20. An alkene 'A' contains three C-C, eight C-H σ bonds and one C-C

π -bond. 'A' on ozonolysis gives two moles of an aldehyde of molar mass 44 a.m.u. Write the IUPAC name of 'A'

2

2

But-2-ene

OR

How can you convert benzene into:

(a) p-Nitrobromobenzene

(b) Acetophenone

2

1. Predict the structures of 'A' and 'B':



SECTION: C

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

2. In naturally occurring neon, the fractional abundance of various isotopes is as follows: $^{20}\text{Ne} =$ 0.9051; $^{21}\text{Ne} = 0.0027$; $^{22}\text{Ne} = 0.0922$. What is the atomic mass of neon?3. (a) The concentration of hydrogen ion in a sample of soft drink is $3.8 \times 10^{-3} \text{ M}$. What is its pH?(Given: $\log 3.8 = 0.5798$)

(b) Write the conjugate acid and base forms of HCO_3^- . CO_3^{2-} and OH^- $\text{pH} = 0.5$

4. (a) Write the IUPAC names of the products obtained by the ozonolysis of:

(i) Pent-2-ene

(ii) 2-Ethylbut-1-ene

(b) Why is Wurtz reaction not preferred for the preparation of alkanes containing odd number of carbon atoms?

5. Calculate the Gibbs energy change for the formation of propane, $\text{C}_3\text{H}_8(\text{g})$ at 298 K. Given that $\Delta_r H^\circ$ for propane = $-103.85 \times 10^3 \text{ J mol}^{-1}$ and ΔS for the reaction is -269.74 JK^{-1} .

6. Predict the mechanism for the following reaction:

Addition of HBr to propene to form the major product. 2-Bromopropane

If the velocity of the electron in Bohr's first orbit is $2.19 \times 10^6 \text{ m/s}$, calculate the de-Broglie wavelength associated with it. $\Delta E = h\nu$ $E_n = -\frac{R_e}{n^2}$, $\Delta E = h\nu$ $c = \nu\lambda$

Among the following pairs of orbitals which orbital will experience larger effective nuclear charge?

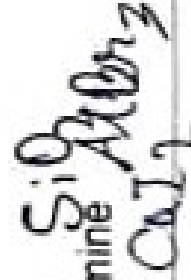
(a) 2s and 3s, (b) 4d and 4f, (c) 3d and 3p

Predict the formulas of the stable binary compounds that would be formed by the following pairs of elements:

(a) Silicon and oxygen

(b) Aluminium and bromine

(c) Calcium and iodine



SECTION: D

following questions are case-based questions. Each question has an internal choice and carries 4 + 2 marks each. Read the passage carefully and answer the questions that follow.

N atom can assume sp^2 , sp^3 as well as sp -hybrid state in different species. These hybrid states in fact represents different energy states of the atom at the time of bonding. When nitrogen atom is directly linked to H-atom it can also form H-bonds. N and P atoms both have same number of outer shell