

SECTION-A

Question number 1 to 16 are Multiple Choice type questions, carrying 1 mark each.

16x1=16

1. Number of significant figures in 3.0×10^8 is/are :

(A) 1

(B) 2

(C) 3

(D) 8

2. Number of moles in 7.3 g of HCl is are :

(Molar mass $\text{H} = 1 \text{ g mol}^{-1}$, $\text{Cl} = 35.5 \text{ g mol}^{-1}$)

(A) 0.1 mole

(B) 0.2 mole

(C) 2.0 mole

(D) 6.022×10^{23} mole

3. Oxidation state of 'Mn' in K_2MnO_4 is :

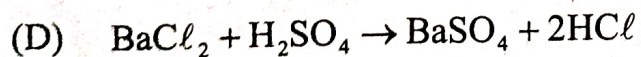
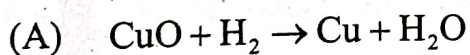
(A) +2

(B) +4

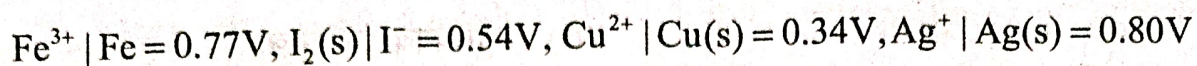
(C) +6

(D) +7

4. Which of the following is not an example of redox reaction?



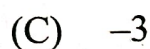
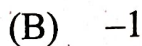
5. $E^\ominus$ values of redox couples are given below:



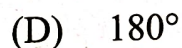
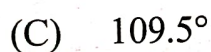
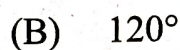
Which of these is strongest oxidising agent?



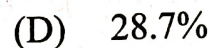
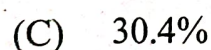
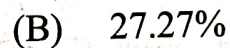
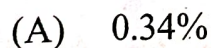
6. Formal charge on nitrogen atom in NH_4^+ ion is :



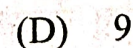
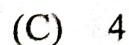
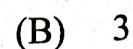
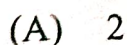
7. The angle which corresponds to sp^2 hybridisation is :



8. The mass percent of carbon in carbon dioxide is :



9. Number of orbitals associated with third shell will be :



10. Which quantum number describe shapes of orbitals?
- (A) Azimuthal quantum number (B) Principal quantum number
(C) Spin quantum number (D) Magnetic quantum number

11. Balmer series in H-spectrum lies in which region?

- (A) UV (B) Visible
(C) IR (D) X-ray

12. Element with atomic number 31 belongs to :

- (A) s-block (B) p-block
(C) d-block (D) f-block

For question number 13 to 16 two statements are given – one labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the order codes (a), (b), (c) and (d) as given below.

- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).
(c) Assertion (A) and is true, but Reason (R) is false.
(d) Assertion (A) and is false, but Reason (R) is true.

13. Assertion (A) : Electron gain enthalpy becomes less negative as we go down a group.

Reason (R): Size of the atom increases on going down the group and the added electron would be farther from nucleus.

14. Assertion (A): H_2O is liquid while H_2S is gas at room temperature.

Reason (R): H_2O involves in intermolecular H-bonding.

15. Assertion (A): If moving with same velocity, de Broglie wavelength of proton will be higher than electron.

Reason (R): According to de Broglie equation, wavelength is inversely proportional to mass of particle.

16. Assertion (A): All C–C bond lengths in benzene are same.

Reason (R): All carbon atoms in benzene are sp^2 hybridised.

SECTION-B

17. (i) State law of multiple proportion.

1

(ii) Calculate the mass of one atom of $^{16}_8\text{O}$ in gram.

1

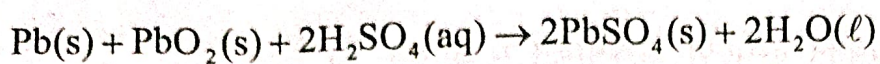
18. How many electrons in an atom may have following quantum numbers?

2x1

(i) $n = 4, m_s = -1/2$

(ii) $n = 3, l = 0$

19. Identify oxidising agent and reducing agent in following reaction: 2



OR

What are disproportionation reactions? Write an example. 2

20. (i) Write general electronic configuration of d-block elements. 1

- (ii) Write IUPAC name of element having $Z = 104$. 1

21. The frequency of a radiation is 6.0×10^{14} Hz. Calculate its wavelength. Which part of electromagnetic spectrum does it belong to? 2

SECTION-C

22. Write electronic configuration of the following: 3x1

- (i) Cr ($Z = 24$)

- (ii) Fe^{3+} ($Z = 26$)

- (iii) S^{2-} ($Z = 16$)

23. Describe the hybridisation in case of PCl_5 . Why are the axial bonds longer as compared to equatorial bonds? 3

24. Account for the following :

3x1

- (i) First ionization enthalpy of nitrogen is higher than oxygen.
- (ii) Atomic radius of Ga is smaller than Al.
- (iii) The first elements of s-block and p-block elements shows anomalous behaviour from rest elements of the group.

25. An organic compound on analysis found to contain 57.82% carbon, 3.6% hydrogen and the rest oxygen. If molecular mass of compound is 166u, then calculate empirical and molecular formula of organic compound.

3

(Atomic masses: H = 1u, C = 12u, O = 16u)

OR

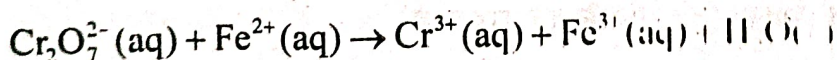
- (i) Define-mole fraction.
- (ii) The density of 3M solution of NaCl is 1.25 g mL^{-1} . Calculate molality of the solution. (Molar mass of NaCl = 58.5 g mol^{-1})

26. Calculate the wavenumber for the longest wavelength transition in the Balmer series atomic hydrogen. ($R_H = 1.1 \times 10^7 \text{ m}^{-1}$)

3

27. Balance following redox reaction in acidic medium:

3



28. Following are Period-2 elements:

Li, Be, B, C, N, O, F, Ne

Which element:?

(i) shows highest electronegativity?

1

(ii) is largest in size?

1

(iii) exhibits diagonal relationship with aluminium?

1

SECTION-D

The following questions are case based questions. Read the passage carefully and answer the questions that follow:

29. The word 'stoichiometry' is derived from two Greek words-stoicheion (meaning element) and metron (meaning measure). Stoichiometry thus deals with the calculation of masses (sometimes volumes also) of the reactants and products involved in a chemical reaction. Before understanding how to calculate the amounts of reactants required or the products produced in a chemical reaction, we need to consider balanced chemical equations.

(i) 1 mole of a gas occupies volume at STP.

1

(ii) $\text{N}_2(\text{g})$ and $\text{H}_2(\text{g})$ reacts to form $\text{NH}_3(\text{g})$ according to following chemical equation:

1



If 1.5 moles of $\text{N}_2(\text{g})$ reacts completely with $\text{H}_2(\text{g})$, how many moles of $\text{NH}_3(\text{g})$ will be produced. 1

- (iii) Calculate the amount of water (in grams) produced by the combustion of 24 g of methane. 2

OR

20g of CaCO_3 and 20g of H_2SO_4 react to give CaSO_4 along with water and CO_2 .

- (a) Determine the limiting reagent for above reaction.

- (b) How much CaSO_4 will be formed?

(Molar masses: $\text{CaCO}_3 = 100$ g, $\text{H}_2\text{SO}_4 = 98$ g, $\text{CaSO}_4 = 136$ g) 2

30. Molecular orbital theory (MOT) explains the bonding in molecules by considering atomic orbital combining to form molecular orbitals. These molecular orbitals are spread over the entire molecule and can be bonding, antibonding or non-bonding. Electrons fill these orbitals according to Aufbau principle, Hund's rule and Pauli's exclusion principle. The theory helps to explain magnetic properties and bond order of molecules like O_2 which cannot be fully understood using valence bond theory alone.

- (i) Define bond order. 1

- (ii) Using molecular orbital theory, explain why Be_2 molecule does not exist? 1

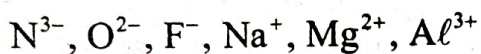
- (iii) O_2 is paramagnetic while N_2 is diamagnetic. Explain using molecular orbital theory. 2

OR

Compare bond order and magnetic behaviours of O_2^+ and O_2^{2-} ions using molecular orbital theory. 2

SECTION-E

31. (i) Consider the following species:



- (a) What is common in them?
- (b) Arrange them in increasing order of their ionic radii. 1+1
- (ii) What is electron gain enthalpy? Arrange F, Cl, Br, I in increasing order of electron gain enthalpy. 2
- (iii) Name the series of elements where 4f orbital is progressively filled. 1

OR

- (i) Enlist any two differences between electron gain enthalpy and electronegativity. 2

- (ii) Explain: The first ionisation enthalpy of sodium ($Z=11$) is lower than that of magnesium ($Z=12$) but its second ionisation enthalpy is higher than that of magnesium. 2
- (iii) Arrange B, Al, Mg, K in increasing order of their metallic character. 1
32. (i) Out of NH_3 and NF_3 , which has higher dipole moment and why? 2
- (ii) On the basis of VSEPR theory, explain of following molecules: 3x1
- (a) SF_4
- (b) BrF_3
- (c) XeF_4

OR

- (i) Arrange BeCl_2 , NH_3 , CH_4 , BF_3 in increasing order of bond angles. 1
- (ii) Enlist any two differences between sigma (σ) and pi (π) bonds. 2
- (iii) Both H_2O and CO_2 are triatomic molecules but H_2O is polar while CO_2 is non-polar. Explain with the help of their structures. 2
33. (i) State Heisenberg uncertainty principle. Calculate the uncertainty in the velocity of ball of mass 150g and uncertainty in its position is of the order of 0.1 nm. 1+2
- ($h = 6.626 \times 10^{-34} \text{ JS}$)
- (ii) Draw the surface boundary diagram of d_{xy} orbital. 1
- (iii) Calculate the number of radial nodes in 3p subshell. 1

OR

- (i) State Pauli's exclusion principle. 1
- (ii) The mass of an electron is 9.1×10^{-31} kg. If its kinetic energy is 3.0×10^{-25} J, calculate its wavelength. 3
- (iii) Mention a difference between orbit and orbital. 1