विद्या सर्वार्थ साधिका

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PERIODIC TEST - 2

Class: XI

Subject: Chemistry (043) MM : 70

Date : 10-09-2025 Time: 3 hours

General Instructions:

Read the following instructions carefully.

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

SECTION A

1. A waterdrop weighing 0.075 g, evaporates in half an hour. Calculate the number of molecules that evaporates per second. (1)
(A) 1.39×10^{18} (B) 2.78×10^{18} (C) 2.89×10^{17} (D) 3.89×10^{17}

2. The density of 3 M solutions of NaCl is $1.25 gmL^{-1}$. What is the molality of this solution? (Atomic mass of Na =23, Cl = 35.5) (1)
(A) 3.79 m (B) 2.79 m (C) 3.00 m (D) 3.2 m

3. Which of the following is the correct empirical formula for eplerenone, $C_{24}H_{30}O_6$? (1)
(A) $C_{12}H_{15}O_3$ (B) $C_8H_{10}O_2$ (C) C_4H_5O (D) $C_{24}H_{30}O_6$

4. Nitrogen reacts with hydrogen to produce ammonia: $N_2 + 3H_2 \rightarrow 2NH_3$ (1)
When 2 moles of nitrogen were reacted with excess hydrogen, 1.5 moles of ammonia were collected. What is the percent yield?
(A) 133% (B) 75.0% (C) 50.0% (D) 37.5%

5. Which of the following transitions in a Bohr Hydrogen atom would emit the shortest wavelength of light? (1)
(A) n=3→ n=2 (B) n= 2→ n=4 (C) n=5 → n = 1 (D) n=3 → n=1

6. The uncertainty in the momentum of an electron is 10^{-5} kg ms^{-1}. The uncertainty in its position will be _____. (1)
(A) 1.05×10^{-28} m (B) 5.25×10^{-28} m (C) 5.27×10^{-30} m (D) 1.05×10^{-26} m

7. Where would you expect the highest jump between successive ionisation energies of phosphorus (Z=15) to occur? (1)
(A) Between the 4th and 5th ionisation energies
(B) Between the 5th and 6th ionisation energies
(C) Between the 6th and 7th ionisation energies
(D) Between the 7th and 8th ionisation energies

8. Which of the following options does not represent ground state electronic configuration of an atom? (1)
(A) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$ (B) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9\ 4s^2$
(C) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$ (D) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8\ 4s^2$

9. Which of the following attain the linear structure? (1)
(A) $BeCl_2$ and CS_2 (B) $BeCl_2$ and NO_2 (C) CS_2 and IF_5 (D) $BeCl_2$ and PCl_5

10. Correct statements for an element with atomic number 9 are: (1)
(i) There can be 5 electrons for which $m_s = + ½$ and 4 electrons for which $m_s = - ½$.
(ii) There is only one electron in the p_z orbital.
(iii) The last electron goes to orbital with n=2 and l=1.
(iv) The sum of angular nodes of all the atomic orbitals is 1.
(A) (i) and (ii) only (B) (i), (iii) and (iv) only (C) (i) and (iii) only (D) (iii) and (iv) only

11. Consider the ground state of chromium atom (Z =24). How many electrons are with Azimuthal quantum number $l = 1$ and $l = 2$ respectively? (1)
(A) 16 and 5 (B) 12 and 5 (C) 12 and 4 (D) 16 and 4

12. Which among the following molecules is (a) involved in hybridization, (b) has different bond lengths and (c) has one lone pair of electrons on the central atom? (1)
(A) XeF_4 (B) XeF_2 (C) PF_5 (D) SF_4

Select the most appropriate answer from the options given below for questions 13 to16.
(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) A is false but R is true.

13. A: Electron affinity refers to an isolated atom's attraction for an additional electron while electronegativity is the ability of an atom of an element to attract the shared electron pair(s) towards itself. (1)
R: Electron affinity is a relative number and electronegativity is experimentally measurable.

14. A: BF_3 molecule has zero dipole moment. (1)
R: F is electronegative and B–F bonds are polar in nature.

15. A: The metallic radius of Al is less than that of Ga (1)
R: The ionic radius of Al^{3+} is less than that of Ga^{+3}.

16. A: The radii of isoelectronic species increase in the order. $Mg^{2+} < Na^+ < F < O^{2-}$ (1)
R: The magnitude of electron gain enthalpy of halogen decreases in the order Cl > F > Br > I.

SECTION B

17. 0.50 mole of $BaCl_2$ is mixed with 0.20 mole of Na_3PO_4. What is the maximum number of moles of $Ba_3(PO_4)_2$ that can be formed? (2)

18. Explain the non-linear shape of H_2S and non-planar shape of PCl_3 using valence shell electron pair repulsion theory. (2)

19. A compound X contains 32 % of A, 20 % of B and remaining percentage of C. What is the empirical formula X (Given atomic masses of A=64; B=40; C=32 u) (2)

20. Calculate the number of photons emitted per second by a 10 W sodium vapor lamp, assuming 60% of the energy is converted into light, and the wavelength of sodium light is 590 nm. (2)

OR

The work function of a substance is 4.0 eV. Find the longest wavelength of light that can cause photoelectron emission from this substance.1 eV= 1.6021 x 10^{-19} J

21. Electromagnetic radiation of wavelength 663 nm is just sufficient to ionise the atom of metal A. What is the ionization energy of metal A in kJ mol^{-1}? (2)

SECTION C

22. 1 gram of sodium hydroxide was treated with 25 mL of 0.75 M HCl solution. What is the mass of sodium hydroxide left unreacted? (3)

23. Calculate the wavelength, frequency and wavenumber of a light wave whose period is 2.0×10^{-10} s. (3)

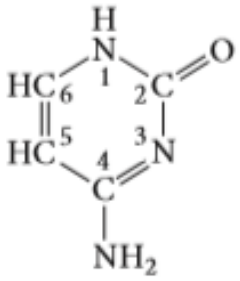
24. (a) Why does fluorine have a lower electron gain enthalpy (less negative) than chlorine, even though it is more electronegative? (3)
(b) Why does metallic character increase down a group but decrease across a period?

25. (a) What is the basic difference between the terms electron gain enthalpy an electronegativity? (3)
(b) The first ionization enthalpy values (in kJ mol^{-1}) of group 13 elements are given below.

B	Al	Ga	In	Tl
801	577	579	558	589

Explain the deviation from the general trend.

26. Assign a geometry to each interior atom from 1 to 6 in the molecule given below. (3)



27. Write the resonance structure of $CH_2 = CH - CHO$. Indicate the relative stability of the contributing structure. (3)

28. Electrons are emitted with zero velocity from a metal surface when it is exposed to radiation of wavelength 6800 Å. Calculate threshold frequency (ν_0) and work function (W_0) of the metal. (3)

SECTION D

29. A student performs three different reactions in the laboratory. In each case, one reactant is taken in excess while the other is limited.
Reaction A: $2H_2 + O_2 \rightarrow 2H_2O$
Reaction B: $N_2 + 3H_2 \rightarrow 2NH_3$
Reaction C**:** $C + O_2 \rightarrow CO_2$
In Reaction A, the student uses 4 moles of H_2
In Reaction B, the student uses 5 moles of N2
In Reaction C, the student uses 5 moles of carbon and 2 moles of oxygen.
Answer the following questions based on conversion of units?

(a) For Reaction A, identify the limiting reagent and calculate how many moles of water are formed. (1)

(b) For Reaction B, which reactant is in excess? Calculate the moles of ammonia produced. (1)

(c) (i) For Reaction C, which reactant is limiting? Calculate the moles and amount of CO_2 formed? (2)

OR

(c) (ii) (A) Out of the three reactions, in which one is the ratio of reactants exactly stoichiometric?
(B) If in Reaction A all H_2 reacts, how many moles of O_2 are formed?

30. Read the passage and answer the questions that follow: The attractive force which holds the two atoms together is called a chemical bond. A covalent bond is formed by an equal sharing of electrons. A coordinate bond is formed by unequal sharing of electrons. An ionic bond is formed by the transfer of electrons from one atom to another. Octet rule, although very useful but is not universally applicable. According to valence bond theory, a covalent bond is formed by overlapping of half-filled atomic orbitals resulting in a lowering of energy and more stability. Bond order is the number of bonds between atoms in a molecule. The higher the bond order more will be stability and bond dissociation enthalpy but the smaller the bond length. The polarity of a covalent bond depends upon the difference in electronegativity. The covalent character of a bond depends upon polarising power, smaller cation and bigger anions have higher polarising power. VSEPR theory helps to predict the shapes of molecules.
Answer the following questions:

(a) Write the electron dot structure of N_2O. (1)

(b) What are the ions present in CsI_3? (1)

(c) (i) Draw the structure of $XeOF_4$ on the basis of VSEPR theory (2)

OR

(c) (ii) Explain the difference between electron geometry and molecular geometry. Under what circumstances are they not the same?

SECTION E

31. Consider these elements: N, Mg, O, F, Al. (5)
(a) Write the electron configuration for each element.
(b) Arrange the elements in order of decreasing atomic radius.
(c) Arrange the elements in order of increasing ionization energy.
(d) Use the electron configurations in part (a) to explain the differences between your answers to parts (b) and (c).

32. List the correct electron and molecular geometries that correspond to each set of electron groups around the central atom of a molecule. (5)
(a) four electron groups overall; three bonding groups and one lone pair
(b) four electron groups overall; two bonding groups and two lone pairs
(c) five electron groups overall; four bonding groups and one lone pair
(d) five electron groups overall; three bonding groups and two lone pairs
(e) five electron groups overall; two bonding groups and three lone pairs

OR

(a) Apply valence bond theory to write a hybridization and bonding scheme for ethyne.
(b) What is the hybridisation in PCl_5. Why are the axial bonds longer as compared to equatorial bonds?

33. Titanium metal requires a photon with a minimum energy of 6.94×10^{-19} J to emit electrons. (5)
(a) What is the minimum frequency of light necessary to emit electrons from titanium via the photoelectric effect?
(b) What is the wavelength of this light?
(c) Is it possible to eject electrons from titanium metal using visible light?
(d) If titanium is irradiated with light of wavelength 233 nm, what is the maximum possible kinetic energy of the emitted electrons?

OR

Einstein's 1905 paper on the photoelectric effect was the first important application of Planck's quantum hypothesis. Describe Planck's original hypothesis, and explain how Einstein made use of it in his theory of the photoelectric effect.