

CLASS XI
CHEMISTRY THEORY (043)

M M:70

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.
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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. The significant figures in 0.00051 are :
 - a) 5
 - b) 3
 - c) 2
 - d) 6

2. Which statement regarding photoelectric effect is **false**?
 - a) The kinetic energy of photoelectrons is independent of intensity of incident light.
 - b) Electrons can be ejected only if the incident light is greater than a certain frequency.
 - c) The wavelength of the incident radiation required for ejection of electrons is the same for all the metals.
 - d) The number of photoelectrons ejected increases with increasing intensity of light.

3. The first ionisation energy (in KJ/mol) of Na, Mg, Al and Si respectively are
 - a) 496, 577, 737, 786
 - b) 786, 737, 577, 496
 - c) 496, 577, 786, 737
 - d) 496, 737, 577, 786

4. Which of the following arrangements of molecules is correct on the basis of their dipole moment?
- $\text{BF}_3 > \text{NH}_3 > \text{NF}_3$
 - $\text{BF}_3 > \text{NF}_3 > \text{NH}_3$
 - $\text{NF}_3 > \text{NH}_3 > \text{BF}_3$
 - $\text{NH}_3 > \text{NF}_3 > \text{BF}_3$
5. A reaction will be non spontaneous if
- Both ΔH and ΔS are negative
 - Both ΔH and ΔS are positive
 - ΔH is negative and ΔS is positive
 - ΔH positive and ΔS is negative
6. In the reaction $\text{I}_2 + \text{I}^- \rightarrow \text{I}_3^-$, which is the Lewis base?
- I_2
 - I^-
 - I_3^-
 - Both b and c
7. What is the correct representation for the solubility product of SnS_2 ?
- $[\text{Sn}^{2+}] [\text{S}^{2-}]^2$
 - $[\text{Sn}^{4+}] [\text{S}^{2-}]^2$
 - $[\text{Sn}^{2+}] [2\text{S}^{2-}]^2$
 - $[\text{Sn}^{4+}] [2\text{S}^{2-}]^2$
8. Which of the following species undergoes a disproportionation reaction?
- ClO_4^-
 - F_2
 - NO_3^{2-}
 - P_4
9. Identify the alkene that produces Ethanal and Methanal on Ozonolysis
- But-2-ene
 - Propene
 - 2-Methylpropene
 - But-1-ene
10. The heat of combustion of carbon to CO_2 is -393.5 KJ/mol . The heat released upon formation of 35.2 g of CO_2 from carbon and oxygen gas is
- $+31.5 \text{ KJ}$
 - -630 KJ
 - -3.15 KJ
 - -315 KJ

11. How many hyperconjugative structures for propene are possible ?
- 5
 - 4
 - 3
 - 2
12. Select correct method to separate steam volatile and immiscible organic substances.
- Distillation
 - Steam Distillation
 - Fractional Distillation
 - Distillation under reduced pressure

Question number 13 to 16 are assertion reason types.

Given below are two statements labelled as Assertion (A) and Reason (R)

select the most appropriate answer from the options given below:

- Both A and R are true and R is the correct explanation of A**
- Both A and R are true but R is not the correct explanation of A.**
- A is true but R is false.**
- A is false but R is true.**

13. Assertion (A): The stabilising effect arises when two or more electrons with the same spin are present in the degenerate orbitals of a subshell ,

Reason (R): The number of exchanges that can take place is maximum when the subshell is either half filled or completely filled.

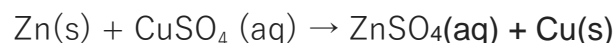
14. Assertion (A): The heat of combustion found by using bomb calorimeter gives the value of internal energy change ΔU and not enthalpy change ΔH

Reason(R): In a closed vessel, no work is done as $\Delta V=0$

15. Assertion (A): One molecule of water adds to alkynes only on warming with mercuric sulphate and dilute sulphuric acid at 333 K to form carbonyl compounds

Reason(R) : Alkynes are water immiscible and do not react with water easily.

16. Assertion (A): In the following reaction:



Cu is a reductant but itself gets oxidised.

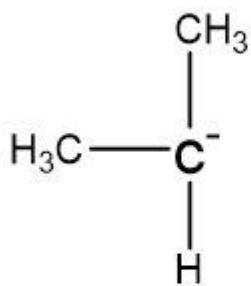
Reason(R): In a redox reaction, oxidant is reduced by accepting electrons and reductant is oxidised by losing electrons.

SECTION B

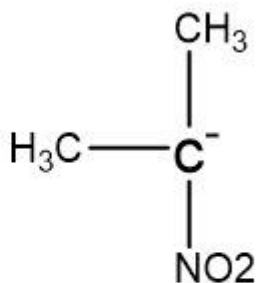
This section contains 5 questions with internal choice in one question.

The following questions are very short answer type and carry 2 marks each.

17. If the velocity of the electron in Bohr's first orbit is 2.19×10^6 m/s, Calculate the de Broglie wavelength associated with it.
18. Select an element from each of the following pairs which would have more negative first electron gain enthalpy. Give reasons also.
(a) O or S. (b) C or Si
19. (a) Why the Be_2 molecule does not exist. Give reason on the basis of molecular orbital theory.
(b) Out of ortho - nitrophenol and para-nitrophenol which one is not steam volatile. Give reason also.
20. Balance the following redox reaction :
 $\text{XeO}_6^{4-} + \text{F}^- \rightarrow \text{XeO}_3 + \text{F}_2$ (Acidic medium)
OR
 $\text{Cl}_2 \rightarrow \text{ClO}^- + \text{Cl}^-$ (Alkaline medium)
21. Out of the following carbocations, identify the one which is more stable. Give reason for your answer.



A



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.

22. (a) Identify the limiting reagent if the reaction mixture contains 16 volume of dihydrogen gas and 6 volume of dioxygen gas which reacts to produce a certain volume of water vapour . Also, determine the volume of water vapour that would be produced. (2)

(b) The elements nitrogen and oxygen combine to produce the following oxides

N_2O , NO_2 , N_2O_3 , N_2O_4 and N_2O_5

Which law is illustrated by the above example. (1)

23. (i) Arrange the following ions in order of their increasing radii:

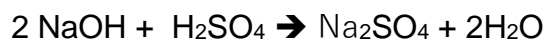
Li^+ , Mg^{2+} , K^+ , Al^{3+} .

(ii) Explain why the formation of Cl^- is exothermic but formation of O^{2-} is endothermic?

24. $\text{Na(s)} + \frac{1}{2} \text{Br}_2 \text{(l)} \rightarrow \text{NaBr (s)} \quad \Delta H_f$

Construct the Born-Haber cycle for NaBr(s) . Give all the reactions involved.

25. What volume of 0.1 M NaOH solution is required to neutralise 100 ml of conc. Aq. H_2SO_4 which contains 98% H_2SO_4 by mass .The density of conc. H_2SO_4 solution is 1.84 g /ml . NaOH reacts with H_2SO_4 according to the following equation:



26. The bond energies of C-C, $\text{C}\equiv\text{C}$, H-H and C-H linkages are 350, 600,400 and 410 KJ/ mol respectively. Calculate the heat of hydrogenation of ethyne to form ethane.

OR

Work done in the isothermal expansion of an ideal gas from 4 dm^3 to 6 dm^3 against a constant external pressure of 2.5 atm was used to heat up 1 mole of water at 20°C . Calculate the final temperature of water. Given that the specific heat of water = $4.2 \text{J g}^{-1}\text{K}^{-1}$

27. In Lassaigne's test for an element 'X' in an organic compound violet colouration is obtained on adding a few drops of sodium nitroprusside . Identify the element 'X' present in the compound. Estimate the percentage of 'X' in 0.16 g of the organic compound, which on oxidation and subsequent reaction with barium chloride gave 0.5 g of white ppt of a compound having molar mass 233 g per mole.

28. Complete the following reactions :



SECTION D

The following questions are case -based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

29. There are two different approaches that have been put forward to explain the shapes of molecules. These are valence shell electron pair repulsion theory and hybridisation. VSEPR theory is based on the repulsions among the electron pairs (bond pairs and lone pairs) present around the central atom so that they take up the directions. Where there are minimum repulsions between them. Hybridisation is based on mixing atomic orbitals of an atom (empty, half filled or fully filled)of comparable energy forming new equivalent orbitals of the same shape and energy, called hybrid orbitals. These hybrid orbitals then overlap with the orbitals of other atoms. Overlapping may take place between two half filled orbitals or one empty and one fully filled orbital. The direction of overlap gives the direction of bonds formed and hence the shape of molecule or ion.

Based on the above paragraph, answer the following questions.

1. On the basis of VSEPR theory, explain the shape of ammonium ion.
2. Briefly explain the shape of the SF₄ molecule.

3. On the basis of hybridisation, predict the shape of PCl_5 . Why does it easily dissociate into PCl_3 ?

OR

Give reason for the following :

(i) Although NH_3 involves sp^3 hybridisation, the bond angle H-N-H is not equal to $109^\circ 28''$

(ii) Bond angle in PH_3 is less than that in NH_3

30. Students were analyzing the physical and chemical properties of a compound with the formula C_4H_8 . They observed that the compound exists in two different forms, which they have labelled as "Alpha" and "Beta". The students have provided the following information about the two forms:

Alpha:

- Melting point: -105.5°C
- Solubility in water: Insoluble

Beta:

- Melting point: -138.9°C
- Solubility in water: Soluble

Answer the following questions :

1. Write the IUPAC name of Alpha form.
2. Identify the type of isomerism exhibited by Alpha and Beta
3. Draw the structural formula for each form (Alpha and Beta) of the compound C_4H_8 .

OR

3. Give reasons for the difference in melting and boiling points of the two forms.

SECTION E

The following questions are long answer types and carry 5 marks

each. All questions have an internal choice.

31. Attempt any **FIVE** of the following :

- a) An electron is in $4d_{z^2}$ orbital . Give the possible values of l and m quantum numbers for this electron .
- b) What is the maximum no. of emission lines when the excited electron of a hydrogen atom in $n=5$ drops to the second shell ?
- c) Write the mathematical expression for Heisenberg's uncertainty principle.
- d) State Hund's rule of maximum multiplicity.
- e) Write the electronic configuration of the element with atomic no. 29
- f) Draw the boundary surface diagram for dx^2-y^2 orbital.
- g) Which orbital in each of the following pairs is lower in energy in a multi electron atom
 - i) 5f and 4d
 - ii) 6s and 4f

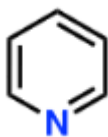
32. a) Derive the relationship between K_P and K_C .

- b) Calculate the pH of the mixture 0.1M, 100ml H_2SO_4 solution + 0.1 M, 100 ml NaOH solution.
- c) Define Common ion effect.

OR

- a) Define Buffer solution
- b) Hydrolysis of sucrose gives, equilibrium constant K_C for the reaction is 2×10^{13} at 300 K. Calculate ΔG^0 . ($R=8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)
- c) Arrange the following in increasing order of pH. Also write the appropriate reason.
 HF , H_2O , NH_3

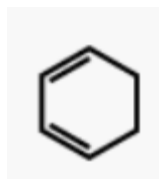
33. a) Assess the given structures and identify the aromatic compounds giving reasons :



(a)



(b)



(c)



(d)

b) Write 3-step mechanism for the reaction of benzene with acetic anhydride in the presence of anhydrous AlCl_3

OR

- Compare nitrobenzene and aniline on the basis of the fact that electrophilic substitution reaction for nitrobenzene produces meta product and that of aniline produces ortho,para products.
- Write stepwise mechanism for the reaction of But-1-ene with HBr in the presence of Benzoyl peroxide.