CLASS XI

SAMPLE PAPER

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.**

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.One mole of P_4 molecules contain:

A. 4 molecules of P
B. 4 atoms of P
C. ¼ X 6.022 X10 ^{23} phosphorus atoms
D. 24.088 X 10 ^{23} phosphorus atoms

2. The wavelength of light emitted when an electron in a hydrogen atom falls from n = 3 to n= 2 is in ____ region:

A. Ultraviolet
B. Visible
C. Infrared
D. X-ray.

3. Identify the second organic compound synthesized from an inorganic compound after urea

A.Ethanol
B.Methane
C.Methanol
D.Acetic acid

4. Recognize the intermediate formed in the mechanism involving Markovnikov's rule
A.free radical
B.carbocation
C.carbanion
D.carbene

5. When carbon forms CO and CO_2 the masses of oxygen combining with a fixed carbon mass are in a simple whole number ratio. The observation is in accordance with:
A. Law of conservation of mass
B. Law of definite proportion
C. Law of multiple proportion
D. Avogadro's Law

6. Analyse the following redox reaction to identify the coefficients (a,b,c,d,e,f) to balance it in acidic medium :
a MnO_4^-(aq.) + bSO_2 (g) +cH_2O + dH^+ → eMn^{2+}(aq.) + fHSO_4^- (aq.)

A. 2,5,2,1,2,5
B. 1,3,5,3,5,2
C. 2,2,5,1,2,3
D. 1,5,2,1,2,3

7. Identify the compound in which nitrogen cannot be estimated by Kjeldahl's method
A. Azo compounds
B. Aniline
C. Hydrazine
D. Benzamide

8. Choose the compound that cannot be prepared by Wurtz reaction:

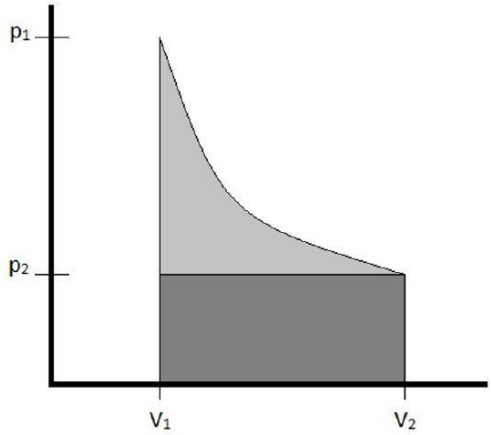
A.Ethane

B.Butane

C.Methane

D.Hexane

9. Area under the P-V isotherm represents the total work done. Which of the following is true for the reversible (W_{rev}) and irreversible (W_{irrev}) work done when an ideal gas is expanded reversibly or irreversibly from the volume V_1 to V_2 ,.



A.$W_{rev} = W_{irrev}$

B. $W_{rev} < W_{irrev}$

C. $W_{rev} > W_{irrev}$

D. $W_{rev} = W_{irrev} + P_{ext}\,\Delta V$

10. A 0.01 M solution of weak acid HA has an acid dissociation constant $K_a = 2 \text{ X } 10^{-6}$. What is the approximate percentage ionization of HA in this solution?

A. 1.4 %

B. 10%

C. 14%

D. 5%

11. Fe_2O_3 may be represented as $Fe_2(III)O_3$.This notation is termed as :

A. Redox notation

B. Oxidant notation

C. Stock notation

D. Reductant notation

12. A gas decolourises Bayer's reagent and reacts with sodium to give hydrogen gas . Use the given information to identify the gas .

A. Ethane

B. Ethyne

C. Ethene

D. Benzene

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:

(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. **Assertion (A):** Heisenberg's Uncertainty Principle is significant only for subatomic particles like electrons.

Reason (R): For macroscopic objects, the product of uncertainty in position and momentum is negligibly small.

14. **Assertion (A):** The first ionization enthalpy of nitrogen is higher than that of oxygen.

Reason(R): Nitrogen has a half filled p-subshell configuration which is extra stable.

15. **Assertion (A) :**pH of water increases with increase in temperature.
Reason(R) : k_w of water increases with increase in temperature.

16. **Assertion(A):** In heterolytic fission, one atom gets both the electrons of the bond.
Reason. (R): Heterolytic fission produces free radicals.

SECTION B

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

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

17. 10 g of Urea was dissolved in water to obtain 210 g of an aqueous solution. Calculate the molality of the solution? (Mol. Wt. of urea = 60)

18. Why is a molecule of ammonia (NH_3) pyramidal in shape instead of trigonal?

19. Define a redox couple. Write the redox couple involved in Daniel cell .

OR

Name a reagent that can act as self indicator in redox titrations to produce a visible colour change at the end point. How are the equivalence point and end point different for a titration.

20. (a) The heat evolved in combustion of methane is given by the equation

$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2\,(g)} + H_2O_{\,(l)}$ $\Delta_rH = -890.3$ kJ mol^{-1} (1)

Calculate the amount of methane in grams that would be required to produce 445.15 kJ of heat of combustion.

(b) Calculate the enthalpy of formation of HCl

$H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{\,(g)}$ $\Delta_rH = -184.0$ kJ mol^{-1} (1)

21. Consider the following reactions with respect to the conditions given against them and predict the direction in which the equilibrium will shift

(a) $CaCO_{3\,(s)} + \text{Heat} \rightleftharpoons CaO_{\,(s)} + CO_{2\,(g)}$ (Temperature is increased)

(b) $N_2\,(g) + O_2\,(g) \rightleftarrows 2NO\,(g)$ $\Delta_rH = +180.7$ kJ (Pressure is increased and temperature is decreased)

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. Calculate the de-Broglie wavelength of a proton moving with a kinetic energy of 500 eV.

(Mass of proton = 1.67×10^{-27} kg, 1 eV = 1.6×10^{-19} J, h= 6.626×10^{-34} Js)

23. 150 ml. of 0.100 M $Pb(NO_3)_2$ on reaction with 200 ml of 0.150 M NaCl forms insoluble lead (II) chloride. The reaction involved is

$Pb(NO_3)_2\,(aq.) + 2\,NaCl(aq.) \rightarrow PbCl_2(s) + 2\,NaNO_3(aq.)$

(i) Which reactant is the limiting reagent in this reaction ?

(ii) Calculate the mass (in grams) of $PbCl_2$ precipitate formed.(atomic mass of Pb = 207 g/mol)

24. The following reaction was carried out at 310K by taking 1 mol of each of the reactants.

$CH_3COOH_{(l)} + C_2H_5OH_{(l)} \rightleftarrows CH_3COOC_2H_{5\ (l)} + H_2O_{\ (l)}$

Reaction reached equilibrium when 3/4th of reactants were consumed. Calculate Gibbs energy change for the reaction.(Given $\log_{10} 9 = 0.954$, $R = 8.314\ J\ K^{-1}mol^{-1}$)

25. A saturated solution of a sparingly soluble salt A_xB_y has a solubility product $K_{sp} = 4.0 \times 10^{-12}$ at 25°C.

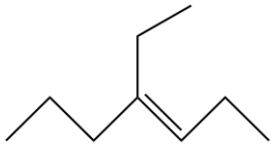
(a) Write the equation for the dissolution of salt and give the expression for K_{sp} in terms of molar solubility S.
(b) Derive an expression for the molar solubility S in pure water in terms of K_{sp}, x and y.
(c) Explain how you would predict whether a precipitate will form if another soluble salt containing either A or B ions is added to the solution. Name the principle involved.

OR

Explain how a mixture of $NaHCO_3$ and Na_2CO_3 resists pH changes when:
(a) A small amount of HCl is added.
(b) A small amount of NaOH is added.
Give its one application in the biological system.

26.(a) Formulate the metamer of N-Ethyl ethanamine ($C_2H_5NHC_2H_5$).

(b) Write the IUPAC name of the following organic compound



(c) Identify the electrophiles among the following molecules/ions:

BF_3, Cl^+, $CH_3CH_2O^-$, NH_3

27.

(a) State the conditions under which you expect the following reaction to occur spontaneously.

$$O_{2(g)} + \text{Heat} \rightarrow 2O_{(g)}$$

(b) Classify the following variables as Intensive and Extensive properties
Pressure , Temperature , Entropy , Volume

28. Describe stepwise mechanism of the reaction between benzene and isopropyl chloride in the presence of $AlCl_3$.

SECTION D

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

29. Quantum numbers are a set of four numbers that describe the position and properties of an electron in an atom. They give information about the energy level, shape, orientation, and spin of the orbital in which the electron is present.

An electron is represented by the following set of quantum numbers:
n = 3, l =2 , m = 0, s = +½

(a) Can another electron have the same set of quantum numbers? Justify
(b) Identify the subshell in which the electron is present and the orbital it occupies.
(c) How many orbitals are possible in this subshell?

OR

(c) Which rule helps to place one electron in each orbital before pairing begins?

30. An organic compound (X) decolourises bromine water and undergoes ozonolysis to produce 2 moles of compound (Y) with molecular formula C_2H_4O.

Compound (X) exists in 2 geometrical isomeric forms which have comparable boiling points but melting point of one of the isomers is higher than the other.

(a) Write IUPAC name and structural formula for compound (X) .

(b) Name the isomer with higher melting point .

(c) Draw structure of an isomer of (X) that does not show geometrical isomerism .

OR

(c). Name the product formed when compound (X) reacts with $KMnO_4$ in acidic medium.

SECTION E

The following questions are long answer type and carry 5 marks each. All questions have an internal choice.

31. (A) (a) Draw the resonating structures of benzaldehyde (C_6H_5CHO).

(b) Classify the following reactions according to the reaction type:

(i) $(CH_3)_3CCl + OH^- \rightarrow (CH_3)_2C=CH_2 + H_2O + Cl^-$

(ii) $CH_3CH_2Br + OH^- \rightarrow CH_3CH_2OH + Br^-$

(c) State the principle of distillation. Give an example of mixture that can be purified using this method.

OR

31. (B) (a) In the qualitative analysis of an organic compound, name the test used to detect the presence of nitrogen, sulphur and halogen.

(b) Describe how nitrogen is detected using this test.

(c) Write the chemical reactions involved in the Sodium nitroprusside test for Sulphur. Mention the colour of the final product obtained in the test.

32.A. (a). Explain how the molecular orbital theory accounts for the stability of Li_2 molecule and instability of Be_2 molecule.

(b) Intramolecular hydrogen bonding reduces the boiling point of a substance." Justify with an example.

OR

B (a) Explain how MOT can be used to predict which among F_2^-,F_2 or F_2^+ has a stronger bond.

(b) A compound X has –OH and $–NO_2$ groups on adjacent carbon atoms. Another compound Y has –OH and $–NO_2$ on opposite sides of the benzene ring. Which one will show higher solubility in water and why?

33. (A) Predict the best choice in the following :

(i) Smallest ionic size : Mg^{2+}, Ca^{2+}, Ba^{2+}

(ii) Highest ionization enthalpy : Li, Mg, Be, B

(iii) Lowest electron gain enthalpy : O, S, F, Cl

(B) An element X has atomic number 117

(i) Name the block of periodic table to which 'X' belongs.

(ii) Write the IUPAC name of the element 'X'.

OR

(A) An element belongs to group 1 and period 2. Predict its:

(i) Nature of oxide (acidic or basic)

(ii) Ionization enthalpy compared to other elements in the same group

(B) First member of each group of representative elements (i.e., s-and p-block elements) shows anomalous behaviour when compared with the other elements of the group. Justify the statement by giving two examples with reasons.