

**Given Data:**

$$R=8.314 \text{ JK}^{-1}\text{mol}^{-1}$$

$$R =0.082 \text{ dm}^3\text{atmK}^{-1}\text{mol}^{-1}$$

$$R=0.08314 \text{ dm}^3\text{barK}^{-1}\text{mol}^{-1}$$

$$\text{E.N. of C}=2.6, \text{O}=3.4, \text{Ca}=1.0, \text{Li}=0.98, \text{Al}=1.61$$

**SECTION – I**

STRAIGHT OBJECTIVE TYPE

This section contains 6 multiple choice questions. Each question has four choices (a),(b), (c), (d), out of which **only one** is correct. **3 Marks** will be awarded for correct answer. **1 Mark** will be deducted for wrong answer.

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1. Reaction of  $\text{NaBH}_4$  with  $\text{BF}_3 \cdot \text{O}(\text{C}_2\text{H}_5)_2$  in diglyme at room temperature produces mainly
  - (a)  $\text{H}_2$
  - (b)  $\text{B}_2\text{H}_6$
  - (c)  $\text{B}_2\text{H}_3\text{F}_3$
  - (d)  $(\text{CH}_3\text{OCH}_2\text{CH}_2)_2\text{O}$
2. Which formula represents a molecular substance?
  - (a) CO
  - (b)  $\text{Li}_2\text{O}$
  - (c) CaO
  - (d)  $\text{Al}_2\text{O}_3$
3. Which of the following sulphate is insoluble in water?
  - (a)  $\text{CdSO}_4$
  - (b)  $\text{FeSO}_4$
  - (c)  $\text{SrSO}_4$
  - (d)  $\text{CuSO}_4$

4. Hemoglobin, a complex containing iron is a constituent of blood. The oxidation state of iron in the complex is
- (a) Zero
  - (b) +1
  - (c) +2
  - (d) +3
5.  $O_2 + PtF_6 \longrightarrow$
- (a)  $O_2^+PtF_6^-$
  - (b)  $O_2^-PtF_6^+$
  - (c)  $PtO_2 + OF_2$
  - (d)  $Pt_3O_4 + OF_2$
6. During the extraction of iron from hematite, limestone is added to the blast furnace to
- (a) To remove silica as slag
  - (b) To remove silica as gangue
  - (c) To reduce hematite
  - (d) To oxidize coke to carbon monoxide

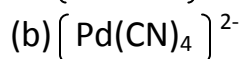
## SECTION II

### MULTIPLE CHOICE TYPE QUESTIONS

This section contains 4 multiple choice questions. Each question has 4 choices (a), (b), (c), (d), out of which **ONLY ONE** is correct. **NO NEGATIVE** marking.

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7. Which of the following chemical species can behave both as a Bronsted-Lowry acid and base?
- (a)  $NO_3^-$
  - (b)  $H_3O^+$
  - (c)  $HCO_3^-$
  - (d)  $SO_4^{2-}$
8. Which of the following compound has tetrahedral geometry?



9. In which of the following reaction new carbon-carbon bond is formed?

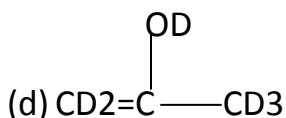
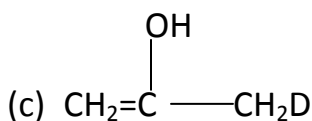
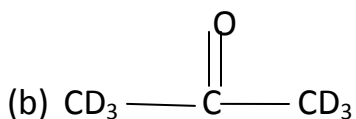
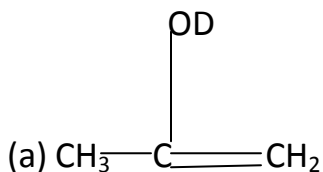
(a) Friedel-Craft alkylation

(b) Reimer-Tiemann Reaction

(c) Clemensen reduction

(d) Cannizzaro reaction

10. The enol form of acetone, after treatment with  $\text{D}_2\text{O}$ , gives



### SECTION III

#### ASSETION- REACTION TYPE

This section contains 4 Reasoning type questions. Each question has four choices (a),(b), (c), (d), out of which **only one** is correct. **3 Marks** will be awarded for correct answer. **1 Mark** will be deducted for wrong answer.

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11. **Assertion:** Aniline is always acetylated before nitration with acid mixture.

**Reason:** Aniline is very susceptible to oxidation, will be readily oxidized by nitric acid present in nitrating mixture.

- (a) Both A and R are individually true and R is the correct explanation of A
- (b) Both A and R are individually true and R is **not** the correct explanation of A
- (c) A is true but R is false
- (d) A is false but R is true

12. **Assertion:**  $\text{—}\overset{\text{O}}{\parallel}{\text{C}}\text{—}$  part of the  $\text{—}\overset{\text{O}}{\parallel}{\text{C}}\text{—OH}$  group doesn't react with hydroxylamine hydrochloride.

**Reason:** Both the compounds are acidic in nature.

- (a) Both A and R is individually true and R is the correct explanation of A
- (b) Both A and R is individually true and 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:** p-Dihalobenzenes have higher melting points and lower solubilities than that of their o- and m- isomers.

**Reason:** The p-isomer is more symmetrical and therefore fit better into a crystal lattice as a result the intermolecular forces are greater than that of o- and m-isomers.

- (a) Both A and R are individually true and R is the correct explanation of A
- (b) Both A and R are individually true and R is **not** the correct explanation of A
- (c) A is true but R is false
- (d) A is false but R is true

14. **Assertion:**  $\text{Mg}_3\text{N}_2$  when reacted with water gives off  $\text{NH}_3$  but HCl is not obtained from  $\text{MgCl}_2$  on reaction with water at room temperature.

**Reason:**  $Mg_3N_2$  is a salt of strong base  $Mg(OH)_2$  and weak base  $NH_3$ , hence undergoes hydrolysis. While  $MgCl_2$  is a salt of strong base and strong acid hence doesn't undergo hydrolysis.

- (a) Both A and R are individually true and R is the correct explanation of A  
(b) Both A and R is individually true and R is **not** the correct explanation of A  
(c) A is true but R is false  
(d) A is false but R is true

#### SECTION IV

#### LINKED COMPREHENSTION TYPE

This section contains 2 paragraphs. Based upon each paragraph, 3 multiple choice questions have to be answered. Each question has four choices (a), (b), (c), (d), out of which **only one** is correct **4 marks** will awarded for corrected answer. **1 mark** will be deducted for wrong answer. **NO MARKS WILL BE GIVEN OR DEDUCTED IF A QUESTION IS NOT ANSWERED.**

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Paragraph for questions 15 to 17

Ideal gas is gas which obeys gas equation ( $PV=nRT$ ) is said to be ideal gas. The gas equation is called ideal gas equation. However, no gas is perfect gas i.e., ideal gas. All gases are real gases. They show deviations from the ideal gas equation; van der Waal gave an equation called van der Waal's equation which is obeyed by real gases over a wide range of temperatures and pressures.

Van der Waal's equation:  $(P + \frac{an^2}{V^2})(V - nb) = nRT$

This equation can written as 
$$p = \frac{RT}{(V_m - nb)} - \frac{a}{V_m^2}$$

The molecular volume ( $V_m$ ) =  $V/n$

The constants  $a$  and  $b$  are called van der Waals coefficients. They are characteristics of each gas but independent of temperature.

**Boyle's temperature:** The temperature at which a real gas obeys Boyle's law is known as Boyle's temperature ( $T_B$ ), at this temperature

$$\lim_{V_m \rightarrow \infty} \frac{dZ}{d(1/V_m)} \text{ vanishes. Where } Z = PV_m/RT$$

15. Estimate the molar volume of  $\text{CO}_2$  ( $a=3.610\text{dm}^6\text{mole}^{-1}$ ,  $b=4.29\text{dm}^3\text{mole}^{-1}$ ) at 500K and 100 atm by treating it as van der Waals gas.

- (a)  $.410\text{ dm}^3\text{ mol}^{-1}$
- (b)  $.298\text{ dm}^3\text{ mol}^{-1}$
- (c)  $.453\text{ dm}^3\text{ mol}^{-1}$
- (d)  $.366\text{ dm}^3\text{ mol}^{-1}$

16. Calculate the molar volume of the  $\text{CO}_2$  using the above values under the perfect gas conditions

- (a)  $0.410\text{ dm}^3\text{ mol}^{-1}$
- (b)  $0.298\text{ dm}^3\text{ mol}^{-1}$
- (c)  $0.453\text{ dm}^3\text{ mol}^{-1}$
- (d)  $0.366\text{ dm}^3\text{ mol}^{-1}$

17. Boyle's temperature in terms of van der Waal's constants:

- (a)  $T_B = 2a/Rb$
- (b)  $T_B = a/Rb$
- (c)  $T_B = 8a/27Rb$
- (d)  $T_B = 2a/3Rb$

**Paragraph for questions 18 to 20**

A scientist proposed the following equation of state:

$$PV_m = RT \left( 1 + \frac{B}{V_m} + \frac{C}{V_m^2} \right)$$

Using the above van der Waal's equation answer the following questions.  
Use any approximations if require.

18. The value of B in terms of van der Waals constants a and b is

(a)  $B = b + \frac{a}{RT}$

(b)  $B = b - \frac{a}{RT}$

(c)  $B = a - \frac{b}{RT}$

(d)  $B = a + \frac{b}{RT}$

19. The value of C in terms of van der Waals constants a and b is

(a)  $C = a^2$

(b)  $C = b^2$

(c)  $C = ab$

(d)  $C = a/b$

20. If the value of  $C = 1200 \text{ cm}^6 \text{ mol}^{-2}$  and  $B = -21.7 \text{ cm}^3 \text{ mol}^{-1}$  then the value of van der Waals constant a is ( $R = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$  and  $T = 273 \text{ K}$ )

(a)  $1.26 \text{ L}^2 \text{ atm mol}^{-2}$

(b)  $1.5 \text{ L}^2 \text{ atm mol}^{-2}$

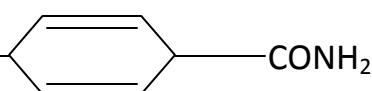
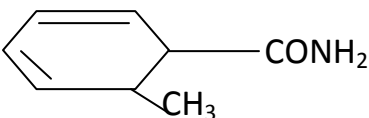
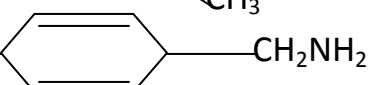
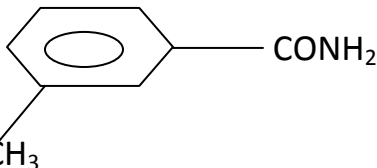
(c)  $1.9 \text{ L}^2 \text{ atm mol}^{-2}$

(d)  $0.12 \text{ L}^2 \text{ atm mol}^{-2}$

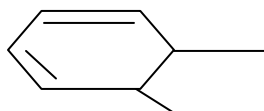
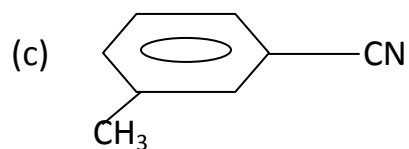
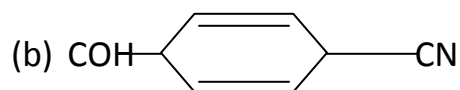
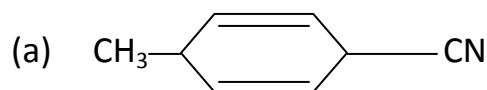
**Paragraph for questions 21-23**

Compound (A)  $C_8H_9NO$  is insoluble in dilute acid and base. (A) When treated with acidic  $KMnO_4$  gives nitrogen free compound (B) only. (B) is soluble in aqueous  $NaHCO_3$  solution and gives only one mononitro substitution product. When (A) treated with  $P_2O_5$  gives compound (C).

21. Identify the compound (A)

- (a) 
- (b) 
- (c) 
- (d) 

22. Identify the compound (C)



(d)

CN

CH<sub>3</sub>

23. Identify the compound (B)

