CHEMISTRY

BOOKS - CHHAYA CHEMISTRY (BENGALI ENGLISH)

MODEL QUESTIONS PAPER

Set I Section I

1. The correct set of four quantum numbers of the outermost electron of rubidium (Z = 37) is-

A. $5, 1, 1, +\frac{1}{2}$

B. $6, 0, 0, -\frac{1}{2}$

C. $5, 0, 0, +\frac{1}{2}$

D. $5, 1, 0, +\frac{1}{2}$

Answer: C

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2. Which of the two orbitals cannot form a $\pi -$ bond

A. two s-orbitals

B. s- and p-orbitals

C. two p-orbitals

D. none of the above

Answer: A

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3. State of hybridisation and number of lone pair of electrons of the central element of $POCl_3$ are -

A. sp^3 , 0

B. sp^2, 0

C. sp, 0

D. sp^3d, 0

Answer: A

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4. Compressibility factor of an ideal gas is -

A. 1

B. 2

C. 3

D. 4

Answer: A

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5. Which of the following statements regarding spontaneous reaction is correct -

A. for a spontaneous reaction in an isolated system , the change of entropy is positive

B. if ΔH = positive then the reaction cannot be spontaneous

C. if ΔH = negative , then the reaction is always positive

D. none of the above

Answer: A

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6. $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$, in this chemical reaction -

A. $\Delta H = \Delta E$

B. $\Delta H > \Delta E$

C. $\Delta H < \Delta E$

D. none of the above

Answer: B

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7. Equilibrium constants of a reaction at $20^{\circ}C$ and at $50^{\circ}C$ are 2.5×10^{5} and 2×10^{6} respectively. For this reaction -

A. ΔH= positive

B. ΔH = negative

C. $\Delta H = 0$

D. ΔU = negative

Answer: A

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8. Which of the following does not react with NaOH -

A. B_2O_3

B. BeO

C. CaO

D. SiO_2

Answer: C

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9. Which is added to table salt to keep it dry and free flowing -

A. KCl

B. $Ca_3(PO_4)_2$

C. KI

D. Na_3PO_4

Answer: B

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10. In $C^1H_3C^2 \equiv C^3 - C^4H_2 - C^5H = C^6H_2$, hybridisation state of carbon number 1 , 3 and 5 are respectively -

A. sp^3, sp and sp^2

B. sp^2, sp and sp^2

C. sp, sp and sp^3

D. sp^2, sp^2 and sp

Answer: A

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11. An alkene on ozonolysis gives two molecules of acetaldehyde . The alkene is -

A. but-2-ene

B. but-1-ene

C. 2 - methylpropene

D. ethylene

Answer: A

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12. Which of the following is the most active towards electrophilic nitration -

A. benzene

B. toluene

C. benzoic acid

D. nitrobenzene

Answer: B

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13. Smog is a combination of -

A. O_2 and O_3

B. O_2 and N_2

C. SO_x and NO_x

D. O_3 and N_2

Answer: C

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14. The most stable carbocation is -

A. $CH_3\overset{\oplus}{C}H_2$

B. $CH_2 = CH - \overset{\oplus}{C}H_2$

C. $Me_2\overset{\oplus}{C}H$

D. $Me_3\overset{\oplus}{C}$

Answer: B

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Set I Section Ii Group A

1. How many molecules are there in 1 millimol NH_3 gas ?

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2. Arrange the following in increasing order of basicity- $MgO, SrO, K_2O, Na_2O, Cs_2O$

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3. Arrange the following in increasing order of ionisation potential (IP)- B , C , N, O.

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4. Write down the third law of thermodynamics .

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5. $CH_3C \equiv CCH_3 \xrightarrow{H_2 \text{ Lindlar catalyst}}$ A , Identify A .

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6. Write down the number of σ and π - bonds in the given compound : $CH_3CH = CHC \equiv CH$

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Set I Section Ii Group B

1. Vapour density of a metal chloride is 54 . Metal content of the compound is 34.32 % . Calculate the atomic weight of the metal .

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2. CO but not CO_2 forms addition compounds - Explain .

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3. Write down the electronic configuration of $_{29}Cu$.

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4. Write down the set of four quantum numbers of the valence shell electron of $_3Li$.

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5. Give the IUPAC name of $CH_3CHBrCH_2COOC_2H_5$

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6. Give the structural formula of 2-methyl-2-methoxypropane .

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7. Many spray-bottles from which a perfume is sprayed contain a very harmful substance . By what name is it commonly known and why is it harmful ?

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Set I Section Ii Group C

1. Write down the relation between wavelength and momentum of a moving tiny particle .

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2. The ionisation potential of H-atom is 13.6 eV. Calculate the ionisation potential of He^+ and Li^{2+} ions.

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3. Electron affinity of chlorine is greater than that of fluorine . Explain .

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4. Arrange the following species in increasing order of acidic strength : $Al_2O_3, ClO_2, NO_2, SiO_2$.

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5. 1st ionisation potential of Al is less than that of Mg- explain

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6. State the position of $_{33}Q$ in the periodic table.

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7. KHF_2 exists but $KHCl_2$ does not - explain .

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8. Arrange the bonds in increasing order of bond polarity : $Br-Cl, B-Cl, Be-Cl, Ba-Cl$

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9. A 15 L container containing 5.6 g of N_2 is fitted with another container of same capacity containing 8.0 g of O_2 at 27°C . If the valve is opened and if there occurs no change in temperature , then determine the partial pressure of N_2 in the gas mixture .

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10. At Boyle temperature , what is the value of compressibility factor of a real gas ?

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11. Write down the kinetic gas equation .

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12. Define surface tension of liquids . What is its unit in SI system ?

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13. 3 mol ideal gas expands isothermally & reversibly to 100 L at STP . Find the work done by the gas ?

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14. Calculate the bond strength of O-H bond in $O-H$ bond in $H_2O(g)$ from the following data :

$H_2(g) \rightarrow 2H(g), \Delta H^0 = 436kJ \cdot \text{mol}^{-1}$

$\frac{1}{2}O_2(g) \rightarrow O(g), \Delta H^0 = 249kJ \cdot mol^{-1}$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g), \Delta H^0 = -241kJ \cdot mol^{-1}$

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15. Balance the chemical equation by ion-electron method :

$Cr_2O_7^{2-} + Fe^{2+} + H^+ \rightarrow Cr^3 + Fe^{3+} + H_2O$

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16. What is the oxidation number of Fe in $Na_2\left[Fe(CN)_5NO\right]$?

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17. What is permutit ? What is degree of hardness of water ? What is the unit of degree of hardness of water ?

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18. Which alkali metal is used in photoelectric cells ?

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19. How will you prepare : $NaCl \rightarrow Na_2CO_3$

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20. Arrange cis-but-2-ene , trans-but-2-ene and but-1-ene in increasing order of their stability and give reasons .

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21. What are electrophiles and nucleophiles ? Give examples

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Set I Section Ii Group D

1. $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g), \Delta H^0 = +124kJ \cdot mol^{-1}$

Applying Le Chatelier's principle , discuss the effect of increase in pressure , temperature and addition of inert gas at constant volume on the equilibrium of this reaction .

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2. $2Cl(g) \Leftrightarrow I_2(g) + Cl_2(g),$ for this reaction $K_c = 0.14$. If the initial concentration of Icl be 0.78 (M) , then calculate equilibrium concentration of all species in the reaction mixture .

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3. Write the law of mass reaction .

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4. Solubility of $ZnSO_4$ in water is x $mol \cdot L^{-1}$. Give the mathematical expression of solubility product of the compound .

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5. 25 mL of 0.1 (N) NaOH is mixed with 50 mL of 0.1 (N) CH_3COOH . Calculate the pH of the resulting mixture $[pK_a$ of CH_3COOH is 4.74]

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6. Complete the reaction : $B_2H_6 + 3O_2 \rightarrow$

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7. $[SiF_6]_2$ exists but $[SiCl_6]^{2-}$ does not explain .

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8. Identify A , B , C and D .

$$A \xrightarrow[\text{conc } HNO_3]{\text{conc. } H_2SO_4} B \xrightarrow[HCl]{Sn} C \xrightarrow[0-5^\circ C]{NaNO_2, HCl} D \xrightarrow{H_3PO_2} A$$

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9. How will you isolate CH_4, C_2H_4 and C_2H_2 from their mixtures ?

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10. Transform : $HC \equiv CH \rightarrow CH_3CH_2OH, HC \equiv CH \rightarrow$ But-2-yne

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11. Identify but-1-yne and but-2-yne by one chemical reaction .

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Set Ii Section I

1. Which species among the following has the greatest paramagnetic moment -

A. Mn^{2+}

B. Fe

C. Fe^{2+}

D. Cr^{3+}

Answer:

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2. In the formation of N_2^+ from N_2 molecule the electron is removed from a

A. σ-orbital

B. π- orbital

C. σ^* - orbital

D. π^*-orbital

Answer: A

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3. The unit of van der Waals constant 'a' is

A. atm $\cdot L \cdot mol^{-2}$

B. atm $\cdot L^2 \cdot mol^{-2}$

C. atm $\cdot L^2 \cdot mol^{-1}$

D. atm $\cdot L$

Answer:

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4. The lithium compound which is soluble in water is -

A. Li_2CO_3

B. $LiNO_3$

C. LiF

D. Li_3PO_4

Answer:

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5. Which of the following relations regarding the reaction : $Br_2(l) + Cl_2(g) \rightarrow 2BrCl(g)$ is correct -

A. $q_P = q_V$

B. $q_P > q_V$

C. $q_P < q_V$

D. none of the above

Answer:

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6. Which of the following cannot be prepared by Wurtz reaction-

A. CH_4

B. C_2H_6

C. C_3H_8

D. C_4H_{10}

Answer:

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7. The correct formula of PAN is -

A. $CH_2 = O$

B. $CH_2 = CH - CH = O$

C. $CH_3(CO) - O - O - NO_2$

D. $Et - O - N = O$

Answer:

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8. Which of the following possesses the least hydration energy-

A. Li^+

B. K^+

C. Ca^{2+}

D. Al^{3+}

Answer:

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9. The correct attitude towards electrophile substitution reaction of the following species are-

benzene (I) , toluene (II) ,

chlorobenzene (III) , nitrobenzene (IV)

A. $I > II > III > IV$

B. $IV > III > II > I$

C. $II > I > III > IV$

D. $II > III > I > IV$

Answer:

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10. When ice melts into water , the entropy -

A. becomes zero

B. decreases

C. increases

D. remains the same

Answer:

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11. The value of pH of 10^{-8} (M) HCl is -

A. 0.96

B. 8

C. 7

D. 6

Answer:

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Set Ii Section Ii Group A

1. Calculate the number of neutrons in 46 ng of $^{14}CO_2$.

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2. Calculate the mass of 1 nanomol of ammonia .

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3. $CH_3CH_2I \xrightarrow{\text{Zn-Cu couple/ EtOH}} A$. Identify A.

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4. Give an example of a chemical reaction where $\Delta H = \Delta U$.

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5. Fill in the blanks : The element having highest ionisation potential is .....

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6. What is the unit of electron affinity ?

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Set Ii Section Ii Group B

1. How many photons of wavelength , 50Å are required to produce 0.2 J of energy ? ($h = 6.626 \times 10^{-34} J \cdot s$)

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2. Write the names of two gases responsible for acid rain .

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3. A gaseous hydrocarbon contains 75% carbon by weight . 1 L of this gas weight 0.72 g . What is the molecular formula of the compound ? (1 L of hydrogen weighs 0.090 g at STP)

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4. 20 g of certain metal reacts with dilute sulphuric acid to produce 0.504 g of hydrogen gas . What amount of metal oxide will be formed by 2.0 of that metal ?

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5. 2-chloroethanoic acid is a stronger acid than ethanoic acid . Why ?

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6. Write the IUPAC names and chain isomers of C_4H_{10}

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7. Why PbI_4 has no existence ?

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Set Ii Section Ii Group C

1. Differentiate between orbit and orbital

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2. Why does 2d-orbital not exits ?

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3. Write the postulates of Bohr's atomic model .

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4. Why is the 1st ionisation potential of B less than that of Be ?

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5. Arrange the following in increasing order of radius :

$Mg^{2+}, Al^{3+}, O^{2-}, F^{-}$

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6. What is lanthanide contraction ? Write the causes of this phenomenon .

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7. In spite of having the same molecular mass , boiling point of ethanol is lesser than that of formic acid. Explain

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8. Write down the hybridisation states of the central atoms of CO_2 and NH_3.

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9. 4 g of He gas at $27^\circ C$ is expanded isothermally and reversibly to 1 atm from 10 atm . Calculate the work done in calorie unit

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10. Calculate the enthalpy of combustion of ethylene .

Given :

$$C_2H_6(g) + \frac{7}{2}O_2(g) \to 2CO_2 + 3H_2O(l), \Delta H = = 1562kJ \cdot mol^{-1}$$

$$H_2(g) + \frac{1}{2}O_2(g) \to H_2O(l), \Delta H = -286kJ \cdot mol^{-1}$$

$$C_2H_4(g) + H_2(g) \to C_2H_6(g), \Delta H = -32kJ \cdot mol^{-1}$$

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11. Write the significance of the gas contain 'a' and 'b'.

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12. Define coefficient of viscosity ?

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13. Balance the equation by ion-electron method : $MnO_4^- + Fe^{2+} \rightarrow Mn^{2+} + Fe^{3+} + H_2O$ (in acid medium)

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14. Balance the chemical equation by ion-electron method :

$CuO + NH_3 \rightarrow Cu + N_2 + H_2O$

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15. Determine the volume strength of 1.5 (N) H_2O_2.

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16. Why is hard water not used in boilers ?

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17. Why the alkali metals cannot be extracted by chemical reduction method ?

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18. Which alkali metal is the most abundant in earth's crust ?

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19. Why is the aqueous solution of $BeCl_2$ acidic ?

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20. Which is Gr.-II metal plays an important role in coagulation of blood and contraction of muscles ?

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21. Write the IUPAC name of $CH_3 - CH_2 - CH(CH_3) - COOH$

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22. Point out the electrophilic centre of CH_3CHO and CH_3CN

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Set Ii Section Ii Group D

1. Write and explain Ostwald's dilution law .

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2. What is common ion effect ?

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3. A 0.1 (M) solution of acetic acid at $25^{\circ}C$ is 1.34 % ionised . Calculate the ionisation constant of the acid .

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4. What is 'chemical equilibrium'? Chemical equilibrium is a dynamic equilibrium -explain. Give examples of homogeneous and heterogeneous equilibrium.

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5. At 300 K , the equilibrium partial pressures of $N_2O_4(g)$ and $NO_2(g)$ of the reaction $N_2O_4(g) \Leftrightarrow 2NO_2(g)$ and 0.28 and 1.1 atm respectively . If the volume of the container is doubled keeping the temperature constant , then calculate the partial pressures of $N_2O_4(g)$ and $NO_2(g)$ in the new equilibrium .

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6. $PbCl_4$ is less stable than $SnCl_4$ but $PbCl_2$ is more stable than $SnCl_2$ - Explain .

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7. BF_3 acts as Lewis acid - Explain .

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8. The atomic radius of Ga is less than that of Al - Why ?

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9. Identify A and B in the reaction

$$CH_3CH_2CH_2Br \xrightarrow{\text{aqueous KOH}} A \xrightarrow{\text{conc. } H_2SO_4/170^\circ C} B$$

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10. Identify A and B in the reaction

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11. Identify A and B in the reaction

$$(CH_3C \equiv CH + O_3) \xrightarrow{Zn/H_2O} A$$

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12. Give the structure of P and T in the reaction .

$$CH_3CH_2OH \xrightarrow{\text{conc. } H_2SO_4/170^\circ C} P \xrightarrow{Br_2} Q$$

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13. Give the structure of P and T in the reaction .

$$R \xrightarrow{O_3Zn/H_2O} o - C_6H_4(CHO)_2 + (CHO)_2$$

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14. Give the structure of P and T in the reaction .

$$C_6H_6 + Me_2CHCH_2Cl \xrightarrow{\text{anhyd. } AlCl_3} S$$

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15. Give the structure of P and T in the reaction .

$$o - C_6H_4(CH_3)_2 \xrightarrow{\text{alkaline } KMnO_4/\,\Delta\,, H_3O^+} T$$

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Set Iii Section I

1. The correct set of quantum numbers of $3d^1$ electron is -

A. $n = 3, l = 1, m = 1, s = +1/2$

B. $n = 3, l = 2, m = +3, s = +1/2$

C. $n = 3, l = 2, m = +2, s = +1/2$

D. $n = 3, l = 0, m = +2, s = +1/2$

Answer:

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2. Which of the following compounds is least polar -

A. BF_3

B. NF_3

C. NH_3

D. CCl_2H_2

Answer:

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3. The correct order of bond angles of the following molecules and ions is -

A. $H_2O < H_2S < NH_3 < BF_4^-$

B. $H_2S < H_2O < NH_3 < BF_4^-$

C. $H_2S < NH_3 < H_2O < BF_4^-$

D. $H_2S < NH_3 < BF_4^- < H_2O$

Answer:

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4. At the same temperature and pressure , the ratio of rate of diffusion of helium and methane is -

A. 0.5

B. 1

C. 2

D. 4

Answer:

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5. Which of the following thermodynamic relations is correct -

A. d E = PdV + Td S

B. dH = - V dP + Td S

C. dG = Vd P + SdT

D. dG = VdP - SdT

Answer:

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6. ΔU° for combustion of a gaseous hydrocarbon is $-xcal \cdot mol^{-1}$, The value of ΔH^{0} is -

A. $= \Delta U^{0}$

B. $> \Delta U^{0}$

C. $< \Delta U^0$

D. 0

Answer:

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7. If solubility of $Ca(OH)_2$ be $\sqrt{3}$, then solubility product is -

A. 3

B. 27

C. $\sqrt{3}$

D. $12\sqrt{3}$

Answer: D

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8. Identify the major product P in the given reactions :

$$CH_3CH = CH_2 \xrightarrow{\text{HI / peroxide}} P$$

A. $CH_3CH_2CH_3$

B. $CH_3 - C \equiv CH$

C. $CH_3CH_2CH_2I$

D. $CH_3CH(I)CH_3$

Answer:

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9. Which of the following shows tautomerism-

A. lactic acid

B. phenol

C. pentan-2-one

D. but-2-ene

Answer:

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Set Iii Section Ii Group A

1. Mention a group which strongly deactivates benzene ring .

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2. Which one has the highest acidity ? SO_3, P_2O_5, ZnO, Na_2O

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3. Which one possesses lowest electron affinity ? B , C , N , O

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4. Vapour density of a gas is 11.2 . What is the volume of 10 g of that gas at STP ?

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5. Give an example of isomorphous crystal of $MgSO_4, 7H_2O$.

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6. Calculate the molar entropy of vaporisation of water , (Given : $H_2O(l) \Leftrightarrow H_2O(g), \Delta H = 40.8kJ \cdot mol^{-1}$)

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Set Iii Section Ii Group B

1. Calculate the magnetic moment of Cu^{3+} ion .

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2. What is the difference in angular momentum of a 3p and a 4p electron ?

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3. Carbon dioxide is a gas but silicon dioxide is a solid explain .

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4. Boric acid behaves as a strong acid in presence of glycerol - explain .

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5. Write the IUPAC name of $CH_3CH_2COCH_2COOCH_3$.

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6. Give the structures of two compounds which are metamers and position isomers of each other .

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7. Write the mechanism of absorption of UV-rays by atmospheric ozone layer .

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8. Which one is greater , BOD or COD ? Give reasons .

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9. A metallic chloride contains 20.2 % of metal (M) . The atomic weight of the metal is 27 . What is the formula of the metallic chloride ?

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Set Iii Section Ii Group C

1. Write van der Waals equation for 1 mol real gas and deduce the equation for the gas containing n molecules from it.

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2. What happens when chlorine gas is passed over $Ca(OH)_2$ at $40^\circ C$? Write with equation .

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3. Arrange in increasing order of basicity : BeO , MgO , BaO , CaO

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4. Alkali metals (except Li) exhibit photoelectric effect- explain

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5. Alkaline earth metal like Be does not respond to flame test - explain

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6. The internuclear distance of H-F molecule is 0.92Å and dipole moment is 2 debye . Calculate the percentage of ionic character of the molecule .

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7. Draw the resonating structures of carbonate ion .

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8. Although H_2SO_4 and H_3PO_4 have same molecular mass , H_3PO_4 has higher boiling point and viscosity - explain .

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9. Which anion is isostructural with BF_3.

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10. Write one difference between reversible and irreversible processes.

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11. Mention the application of the first law of thermodynamics in adiabatic process .

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12. An ideal gas of volume 21 L is enclosed in a cylinder fitted with a piston . At constant temperature and against external pressure of 3 atm , the gas is compressed to one -third of its original volume . Calculate q , w and ΔU in the process.

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13. Find the number of unpaired electrons in the atom of the element having atomic number 16 .

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14. Which rule is followed in determining the arrangement of unpaired electrons in P-atom ? State the rule .

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15. 2nd ionisation potential of Be is greater than the 1st ionisation potential of B but less than 2nd ionisation potential of B - explain .

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16. Ionisation potential of O is less than that of N - explain

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17. Writes the names of two elements that show diagonal relationship.

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18. Balance the equation by ion-electron method :

$$Zn + NaNO_3 + NaOH \rightarrow Na_2ZnO_2 + NH_3 + H_2O$$

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19. Give an example of disproportionation reaction .

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20. Why during preparation of H_2O_2 , a paste of hydrated barium peroxide is added to ice cold H_2SO_4 but the reverse process is not done ?

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21. Give examples of two interstitial hydrides.

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22. $CH_3 - NH_2$ is more basic than ammonia . Why ?

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23. Arrange the free radicals according to their stability : $Me\dot{C}H_2, \dot{C}H_3, Me_2\dot{C}H, Me_3\dot{C}$

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Set Iii Section Ii Group D

1. At 25° C , the solubility product of CaF_2 is 4×10^{-11} . At that temperature , calculate the solubility in its saturated solution and molar concentration of the ions produced.

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2. What is buffer solution ? Give example of each type of buffer solution .

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3. At $25^{\circ}C$, the following equilibrium is established in a closed vessel : $SO_2Cl_2(g) \Leftrightarrow SO_2(g) + Cl_2(g)$. How the equilibrium will be affected if (a) He gas is added and (b) pressure is increased ?

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4. Calculate the amount of HCOONa that is to be added to 0.05 (M) 1 L HCOOH to make the overall pH of the solution 4.00 (Given : K_a of HCOOH = 2.4×10^{-4}).

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5. Unlike diamond , graphite is a good conductor of electricity - explain .

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6. Silicon in elemental form does not form a graphite like structure - explain .

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7. Why does aniline not respond to Friedel Crafts reaction ?

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8. Differentiate by only one chemical reaction : acetylene and ethylene .

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9. What is Lindlar's catalyst?

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10. Identify A , B , C and D :

$$CHB_2 = CH_2 \xrightarrow{Br_2} A \xrightarrow[KOH]{EtOH} B \xrightarrow[1\%\, Hg^{2+}, 80^\circ C]{20\%\, H_2SO_4} C \xrightarrow[\text{conc. } HCl]{Zn/Hg} D$$

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11. An alkene on ozonolysis gives 1 molecule glyoxal , 1 molecule acetone and 1 molecule acetaldehyde . Identify the alkene .

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12. Identify the reagents and conditions of the following reactions :

$$C_6H_6 \overset{A}{C}_6H_5CH_3 \xrightarrow{B} C_6H_5COOH$$

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