

**Chemistry**

1. Which of the following molecules acts as a Lewis acid ?

- (1)  $(CH_3)_3B$                       (2)  $(CH_3)_2O$                       (3)  $(CH_3)_3P$                       (4)  $(CH_3)_3N$

Sol. (1)

2. Which of the following reactions is an example of nucleophilic substitution reaction ?

- (1)  $RX + KOH \rightarrow ROH + KX$                       (2)  $2RX + 2Na \rightarrow R-R + 2NaX$   
 (3)  $RX + H_2 \rightarrow RH + HX$                       (4)  $RX + Mg \rightarrow RMgX$

Sol. (1)

3. From the following bond energies :

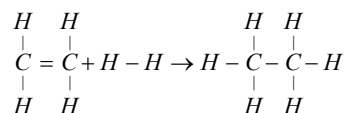
H-H bond energy :  $431.37 \text{ kJ mol}^{-1}$

C=C bond energy :  $606.10 \text{ kJ mol}^{-1}$

C-C bond energy :  $336.49 \text{ kJ mol}^{-1}$

C-H bond energy :  $410.50 \text{ kJ mol}^{-1}$

Enthalpy for the reaction,



will be

- (1)  $1523.6 \text{ kJ mol}^{-1}$                       (2)  $-243.6 \text{ kJ mol}^{-1}$                       (3)  $-120.0 \text{ kJ mol}^{-1}$                       (4)  $553.0 \text{ kJ mol}^{-1}$

Sol. (3)

4. Which one of the elements with the following outer orbital configurations may exhibit the largest number of oxidation states ?

- (1)  $3d^3 4s^2$                       (2)  $3d^5 4s^1$                       (3)  $3d^5 4s^2$                       (4)  $3d^2 4s^2$

Sol. (3)

5. The ionization constant of ammonium hydroxide is  $1.77 \times 10^{-5}$  at  $298 \text{ K}$ . Hydrolysis constant of ammonium chloride is

- (1)  $5.65 \times 10^{-10}$                       (2)  $6.50 \times 10^{-12}$                       (3)  $5.65 \times 10^{-13}$                       (4)  $5.65 \times 10^{-12}$

Sol. (1)

6. Which of the following oxides is *not* expected to react with sodium hydroxide

- (1)  $B_2O_3$                       (2)  $CaO$                       (3)  $SiO_2$                       (4)  $BeO$

Sol. (2)

7. Which of the following *does not* show optical isomerism ?

- (1)  $[CO(en)_2Cl_2]^+$                       (2)  $[CO(NH_3)_3Cl_3]^0$   
 (3)  $[CO(en)Cl_2(NH_3)_2]^+$                       (4)  $[CO(en)_3]^{3+}$  (*en* = ethylenediamine)

Sol. (2)

8. Which one of the following is employed as a tranquilizer ?

- (1) Equanil                      (2) Naproxen                      (3) Tetracycline                      (4) Chlorpheninamine

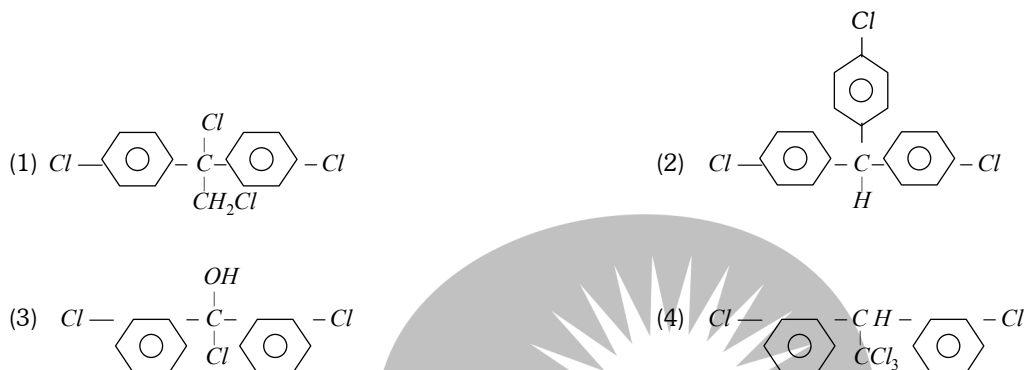
Sol. (1)

9.  $Al_2O_3$  is reduced by electrolysis at low potentials and high currents. If  $4.0 \times 10^4$  amperes of current is passed through molten  $Al_2O_3$  for 6 hours, what mass of aluminium is produced ? (Assume 100% current efficiency, At. mass of *Al* =  $27 \text{ g mol}^{-1}$ )

- (1)  $9.0 \times 10^3 \text{ g}$                       (2)  $8.1 \times 10^4 \text{ g}$                       (3)  $2.4 \times 10^5 \text{ g}$                       (4)  $1.3 \times 10^4 \text{ g}$

Sol. (2)

10. Trichloroacetaldehyde,  $\text{CCl}_3\text{CHO}$  reacts with chlorobenzene in presence of sulphuric acid and produces :



Sol. (4)

11. Which of the following complex ions is expected to absorb visible light

- (1)  $[\text{Sc}(\text{H}_2\text{O})_3(\text{NH}_3)_3]^{3+}$       (2)  $[\text{Ti}(\text{en})_2(\text{NH}_3)_2]^{4+}$       (c)  $[\text{Cr}(\text{NH}_3)_6]^{3+}$       (4)  $[\text{Zn}(\text{NH}_3)_6]^{2+}$   
 (At. no.  $\text{Zn} = 30$ ,  $\text{Sc} = 21$ ,  $\text{Ti} = 22$ ,  $\text{Cr} = 24$ )

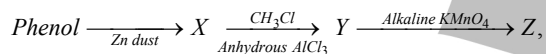
Sol. (3)

12. Half life period of a first-order reaction is 1386 seconds. The specific rate constant of the reaction is

- (1)  $5.0 \times 10^{-3} \text{ s}^{-1}$                       (2)  $0.5 \times 10^{-2} \text{ s}^{-1}$                       (3)  $0.5 \times 10^{-3} \text{ s}^{-1}$                       (4)  $5.0 \times 10^{-2} \text{ s}^{-1}$

Sol. (3)

13. Consider the following reaction :



The product Z is

- (1) Toluene                      (2) Benzaldehyde                      (3) Benzoic acid                      (4) Benzene

Sol. (3)

14. Copper crystallises in a face-centred cubic lattice with a unit cell length of 361 pm. What is the radius of copper atom in pm

- (1) 128                      (2) 157                      (3) 181                      (4) 108

Sol. (1)

15. For the reaction  $A + B \rightarrow \text{products}$ , it is observed that :

- (a) On doubling the initial concentration of A only, the rate of reaction is also doubled and  
 (b) On doubling the initial concentrations of both A and B, there is a change by a factor of 8 in the rate of the reaction

The rate of this reaction is given by

- (1)  $\text{rate} = k[A]^2[B]$                       (2)  $\text{rate} = k[A][B]^2$                       (3)  $\text{rate} = k[A]^2[B]^2$                       (4)  $\text{rate} = k[A][B]$

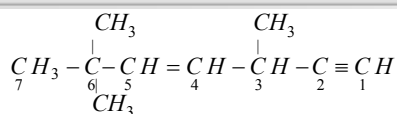
Sol. (2)

16. According to MO theory which of the following lists ranks the nitrogen species in terms of increasing bond order

- (1)  $\text{N}_2^- < \text{N}_2 < \text{N}_2^{2-}$                       (2)  $\text{N}_2^{2-} < \text{N}_2^- < \text{N}_2$                       (3)  $\text{N}_2 < \text{N}_2^{2-} < \text{N}_2^-$                       (4)  $\text{N}_2^- < \text{N}_2^{2-} < \text{N}_2$

Sol. (2)

17. The state of hybridization of  $\text{C}_2$ ,  $\text{C}_3$ ,  $\text{C}_5$  and  $\text{C}_6$  of the hydrocarbon



is in the following sequence

- (1)  $sp, sp^3, sp^2$  and  $sp^3$     (2)  $sp^3, sp^2, sp^2$  and  $sp$     (3)  $sp, sp^2, sp^2$  and  $sp^3$     (4)  $sp, sp^2, sp^3$  and  $sp^2$

Sol. (1)

18. Among the following which is the strongest oxidising agent

- (1)  $F_2$     (2)  $Br_2$     (3)  $I_2$     (4)  $Cl_2$

Sol. (1)

19. The equivalent conductance of  $\frac{M}{32}$  solution of a weak monobasic acid is  $8.0 \text{ mhos cm}^2$  and at infinite dilution is  $400 \text{ mhos cm}^2$ . The dissociation constant of this acid is

- (1)  $1.25 \times 10^{-5}$     (2)  $1.25 \times 10^{-6}$     (3)  $6.25 \times 10^{-4}$     (4)  $1.25 \times 10^{-4}$

Sol. (1)

20. Structures of some common polymers are given. Which one is not correctly presented

- (1) Teflon  $(CF_2 - CF_2)_n$     (2) Neoprene  $\left( -CH_2 - \underset{\underset{Cl}{|}}{C} = CH - CH_2 - CH_2 - \right)_n$   
 (3) Terylene  $(OC - \text{C}_6\text{H}_4 - COOCH_2 - CH_2 - O)_n$     (4) Nylon 66  $[NH(CH_2)_6NHCO(CH_2)_4 - CO]_2$

Sol. (2)

21. Oxidation numbers of P in  $PO_4^{3-}$ , of S in  $SO_4^{2-}$  and that of Cr in  $Cr_2O_7^{2-}$  are respectively

- (1) +5, +6 and +6    (2) +3, +6 and +5    (3) +5, +3 and +6    (4) -3, +6 and +6

Sol. (1)

22. The IUPAC name of the compound having the formula  $CH \equiv C - CH = CH_2$  is

- (1) 3-butene-1-yne    (2) 1-butyn-3-ene    (3) but-1-yne-3-ene    (4) 1-butene-3-yne

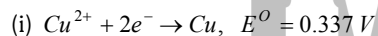
Sol. (4)

23. In the case of alkali metals, the covalent character decreases in the order

- (1)  $MCl > MI > MBr > MF$     (2)  $MF > MCl > MBr > MI$     (3)  $MF > MCl > MI > MBr$     (4)  $MI > MBr > MCl > MF$

Sol. (4)

24. Given :



Electrode potential,  $E^0$  for the reaction,  $Cu^+ + e^- \rightarrow Cu$ , will be

- (1) 0.52 V    (2) 0.90 V    (3) 0.30 V    (4) 0.38 V

Sol. (1)

25. For the reaction,  $N_2 + 3H_2 \rightarrow 2NH_3$ , if  $\frac{d[NH_3]}{dt} = 2 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$ , the value of  $\frac{-d[H_2]}{dt}$  would be

- (1)  $3 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$     (2)  $4 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$     (3)  $6 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$     (4)  $1 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$

Sol. (1)

26. What is the  $[OH^-]$  in the final solution prepared by mixing 20.0 mL of 0.050 M HCl with 30.0 mL of 0.10 M  $Ba(OH)_2$

- (1) 0.10 M (2) 0.40 M (3) 0.0050 M (4) 0.12 M

Sol. (1)

27. Out of  $TiF_6^{2-}$ ,  $COF_6^{3-}$ ,  $Cu_2Cl_2$  and  $NiCl_4^{2-}$  ( $Z$  of  $Ti = 22$ ,  $CO = 27$ ,  $Cu = 29$ ,  $Ni = 28$ ) the colourless species are

- (1)  $TiF_6^{2-}$  and  $COF_6^{3-}$  (2)  $Cu_2Cl_2$  and  $NiCl_4^{2-}$  (3)  $TiF_6^{2-}$  and  $Cu_2Cl_2$  (4)  $COF_6^{3-}$  and  $NiCl_4^{2-}$

Sol. (3)

28. Amongst the elements with following electronic configurations, which one of them may have the highest ionization energy

- (1)  $Ne[3s^2 3p^3]$  (2)  $Ne[3s^2 3p^2]$  (3)  $Ar[3d^{10} 4s^2 4p^3]$  (4)  $Ne[3s^2 3p^1]$

Sol. (1)

29. Maximum number of electrons in a subshell of an atom is determined by the following

- (1)  $4l + 2$  (2)  $2l + 1$  (3)  $4l - 2$  (4)  $2n^2$

Sol. (1)

30. Lithium metal crystallises in a body centred cubic crystal. If the length of the side of the unit cell of lithium is 351 pm, the atomic radius of the lithium will be

- (1) 240.8 pm (2) 151.8 pm (3) 75.5 pm (4) 300.5 pm

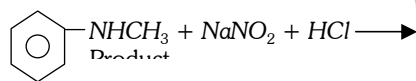
Sol. (2)

31. The segment of DNA which acts as the instrumental manual for the synthesis of the protein is

- (1) nucleotide (2) ribose (3) gene (4) nucleoside

Sol. (3)

32. Predict the product



- (1) CN(C)N=O (2) CN(C)[N+](=O)[O-] (3) CN(C)c1ccc([N+](=O)[O-])cc1 + CN(C)c1ccc([N+](=O)[O-])cc1 (4) CN(C)O

Sol. (1)

33. Which of the following compounds will exhibit *cis-trans* (geometrical) isomerism

- (1) 2-Butene (2) Butanol (3) 2-Butyne (4) 2-Butenol

Sol. (1)

34. The values of  $\Delta H$  and  $\Delta S$  for the reaction,  $C_{(graphite)} + CO_{2(g)} \rightarrow 2CO_{(g)}$  are 170 kJ and 170 JK<sup>-1</sup>, respectively. This reaction will be spontaneous at

- (1) 710 K (2) 910 K (3) 1110 K (4) 510 K

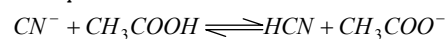
Sol. (3)

35.  $H_2COH.CH_2OH$  on heating with periodic acid gives

- (1) 2  $CO_2$  (2) 2  $HCOOH$  (3)  $\begin{matrix} CHO \\ | \\ CHO \end{matrix}$  (4) 2  $\begin{matrix} H > C = O \\ H > \end{matrix}$

Sol. (4)

36. The dissociation constants for acetic acid and HCN at 25°C are  $1.5 \times 10^{-5}$  and  $4.5 \times 10^{-10}$ , respectively. The equilibrium constant for the equilibrium



would be

- (1)  $3.0 \times 10^5$  (2)  $3.0 \times 10^{-5}$  (3)  $3.0 \times 10^{-4}$  (4)  $3.0 \times 10^4$

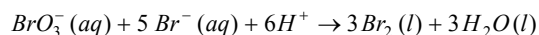
Sol. (4)

**37.** Nitrobenzene can be prepared from benzene by using a mixture of conc.  $HNO_3$  and conc.  $H_2SO_4$ . In the mixture, nitric acid acts as a/an

- (1) reducing agent                      (2) acid                                      (3) base                                      (4) catalyst

**Sol. (3)**

**38.** In the reaction



The rate of appearance of bromine ( $Br_2$ ) is related to rate of disappearance of bromide ions as following

- (1)  $\frac{d(Br_2)}{dt} = -\frac{3}{5} \frac{d(Br^-)}{dt}$       (2)  $\frac{d(Br_2)}{dt} = -\frac{5}{3} \frac{d(Br^-)}{dt}$       (3)  $\frac{d(Br_2)}{dt} = \frac{5}{3} \frac{d(Br^-)}{dt}$       (4)  $\frac{d(Br_2)}{dt} = \frac{3}{5} \frac{d(Br^-)}{dt}$

**Sol. (1)**

**39.** In which of the following molecules/ions  $BF_3$ ,  $NO_2^-$ ,  $NH_2^-$  and  $H_2O$ , the central atom is  $sp^2$  hybridized

- (1)  $NO_2^-$  and  $NH_2^-$                       (2)  $NH_2^-$  and  $H_2O$                       (3)  $NO_2^-$  and  $H_2O$                       (4)  $BF_3$  and  $NO_2^-$

**Sol. (4)**

**40.** Which of the following hormones contains iodine

- (1) insulin                                      (2) testosterone                                      (3) adrenaline                                      (4) thyroxine

**Sol. (4)**

**41.** 10 g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Amount of water produced in this reaction will be

- (1) 2 mol                                      (2) 3 mol                                      (3) 4 mol                                      (4) 1 mol

**Sol. (3)**

**42.** The energy absorbed by each molecule ( $A_2$ ) of a substance is  $4.4 \times 10^{-19} J$  and bond energy per molecule is  $4.0 \times 10^{-19} J$ . The kinetic energy of the molecule per atom will be

- (1)  $2.0 \times 10^{-20} J$                       (2)  $2.2 \times 10^{-19} J$                       (3)  $2.0 \times 10^{-19} J$                       (4)  $4.0 \times 10^{-20} J$

**Sol. (1)**

**43.** The straight chain polymer is formed by

- (1) hydrolysis of  $(CH_3)_3 SiCl$  followed by condensation polymerisation  
 (2) hydrolysis of  $CH_3 SiCl_3$  followed by condensation polymerisation  
 (3) hydrolysis of  $(CH_3)_4 Si$  by addition polymerisation  
 (4) hydrolysis of  $(CH_3)_2 SiCl_2$  followed by condensation polymerisation

**Sol. (4)**

**44.** The stability of + 1 oxidation state increases in the sequence

- (1)  $Al < Ga < In < Tl$                       (2)  $Tl < In < Ga < Al$                       (3)  $In < Tl < Ga < Al$                       (4)  $Ga < In < Al < Tl$

**Sol. (1)**

**45.** Consider the following reaction, ethanol  $\xrightarrow{PBr_3} X \xrightarrow{alc. KOH} Y \xrightarrow[\text{(ii) } H_2O, \text{ heat}]{\text{(i) } H_2SO_4 \text{ room temperature}} Z$ ; the product Z is

- (1)  $CH_2 = CH_2$                       (2)  $CH_3CH_2 - O - CH_2 - CH_3$       (3)  $CH_3 - CH_2 - O - SO_3H$                       (4)  $CH_3CH_2OH$

**Sol. (4)**

46. A 0.0020 m aqueous solution of an ionic compound  $\text{Co}(\text{NH}_3)_5(\text{NO}_2)\text{Cl}$  freezes at  $-0.00732^\circ\text{C}$ . Number of moles of ions which 1 mol of ionic compound produces on being dissolved in water will be ( $k_f = -1.86^\circ\text{C}/m$ )

- (1) 2                                      (2) 3                                      (3) 4                                      (4) 1

Sol. (1)

47. What is the dominant intermolecular force or bond that must be overcome in converting liquid  $\text{CH}_3\text{OH}$  to a gas

- (1) Hydrogen bonding              (2) Dipole-dipole interaction      (3) Covalent bonds                      (4) London dispersion force

Sol. (1)

48. Benzene reacts with  $\text{CH}_3\text{Cl}$  in the presence of anhydrous  $\text{AlCl}_3$  to form

- (1) Toluene                              (2) Chlorobenzene                      (3) Benzylchloride                      (4) Xylene

Sol. (1)

49. Which of the following is not permissible arrangement of electrons in an atom

- (1)  $n = 4, l = 0, m = 0, s = -\frac{1}{2}$                                       (2)  $n = 5, l = 3, m = 0, s = +\frac{1}{2}$   
 (3)  $n = 3, l = 2, m = -3, s = -\frac{1}{2}$                                       (4)  $n = 3, l = 2, m = -2, s = -\frac{1}{2}$

Sol. (3)

50. Propionic acid with  $\text{Br}_2/P$  yields a dibromo product. Its structure would be

- (1)  $\text{CH}_2\text{Br}-\text{CHBr}-\text{COOH}$                                       (2)  $\begin{array}{c} \text{Br} \\ | \\ \text{H}-\text{C}-\text{CH}_2\text{COOH} \\ | \\ \text{Br} \end{array}$   
 (3)  $\text{CH}_2\text{Br}-\text{CH}_2-\text{COBr}$                                       (4)  $\begin{array}{c} \text{Br} \\ | \\ \text{CH}_3-\text{C}-\text{COOH} \\ | \\ \text{Br} \end{array}$

Sol. (4)

