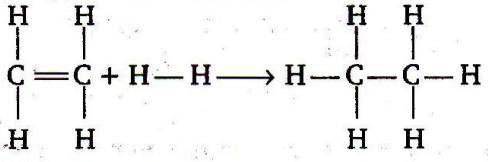
1. Which of the following molecules acts as a Lewis acid ?
   (a) $(CH_3)_3B$ (b) $(CH_3)_2O$
   (c) $(CH_3)_3P$ (d) $(CH_3)_3N$

2. Which of the following reactions is an example of nucleophilic substitution reaction ?
   (a) $RX + KOH \longrightarrow ROH + KX$
   (b) $2RX + 2Na \longrightarrow R-R + 2NaX$
   (c) $RX + H_2 \longrightarrow RH + HX$
   (d) $RX + Mg \longrightarrow RMgX$

3. From the following bond energies :
   H — H bond energy : 431.37 kJ mol^{-1}
   C = C bond energy : 606.10 kJ mol^{-1}
   C — C bond energy : 336.49 kJ mol^{-1}
   C — H bond energy : 410.50 kJ mol^{-1}
   Enthalpy for the reaction,



   will be
   (a) 1523.6 kJ mol^{-1}
   (b) – 243.6 kJ mol^{-1}
   (c) – 120.0 kJ mol^{-1}
   (d) 553.0 kJ mol^{-1}

4. Which one of the elements with the following outer orbital configurations may exhibit the largest number of oxidation states ?
   (a) $3d^3, 4s^2$ (b) $3d^5, 4s^1$
   (c) $3d^5, 4s^2$ (d) $3d^2, 4s^2$

5. The ionisation constant of ammonium hydroxide is 1.77×10^{-5} at 298 K. Hydrolysis constant of ammonium chloride is
   (a) 5.65×10^{-10}
   (b) 6.50×10^{-12}
   (c) 5.65×10^{-13}
   (d) 5.65×10^{-12}

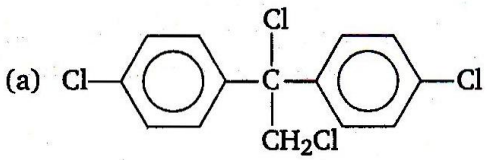
6. Which of the following oxides is not expected to react with sodium hydroxide ?
   (a) B_2O_3 (b) CaO
   (c) SiO_2 (d) BeO

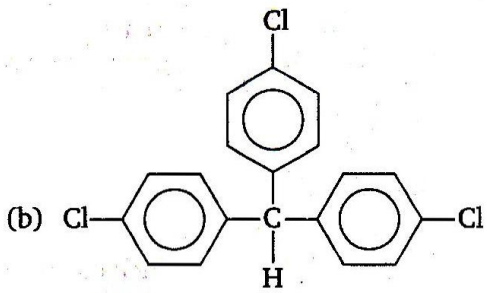
7. Which of the following does not show optical isomerism ? (en = ethylenediamine)
   (a) $[Co(en)_2Cl_2]^+$
   (b) $[Co(NH_3)_3Cl_3]^0$
   (c) $[Co(en)Cl_2(NH_3)_2]^+$
   (d) $[Co(en)_3]^{3+}$

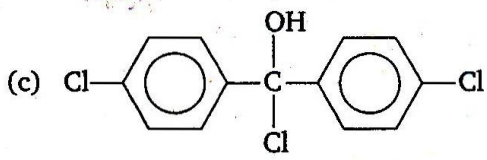
8. Which one of the following is employed as a tranquilizer ?
   (a) Equanil
   (b) Naproxen
   (c) Tetracycline
   (d) Chlorpheninamine

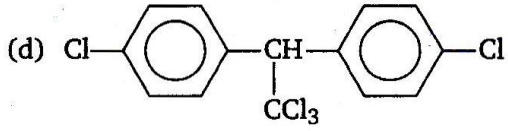
9. Al_2O_3 is reduced by electrolysis at low potentials and high currents. If 4.5×10^4 A of current is passed through molten Al_2O_3 for 6 h, what mass of aluminium is produced ? (Assume 100% current efficiency, at. mass of Al = 27 g mol^{-1})
   (a) 9.0×10^3 g (b) 8.1×10^4 g
   (c) 2.4×10^5 g (d) 1.3×10^4 g

10. Trichloroacetaldehyde, CCl_3CHO reacts with chlorobenzene in presence of sulphuric acid and produces

(a) 

(b) 

(c) 

(d) 

11. Which of the following complex ions is expected to absorb visible light ?
(At. no. Zn = 30, Sc = 21, Ti = 22, Cr = 24)
(a) $[Sc(H_2O)_3(NH_3)_3]^{3+}$
(b) $[Ti(en)_2(NH_3)_2]^{4+}$
(c) $[Cr(NH_3)_6]^{3+}$
(d) $[Zn(NH_3)_6]^{2+}$

12. Half-life period of a first order reaction is 1386 s. The specific rate constant of the reaction is
(a) $5.0 \times 10^{-3}\ s^{-1}$ (b) $0.5 \times 10^{-2}\ s^{-1}$
(c) $0.5 \times 10^{-3}\ s^{-1}$ (d) $5.0 \times 10^{-2}\ s^{-1}$

13. Consider the following reaction,

$$\text{Phenol} \xrightarrow{\text{Zn dust}} X \xrightarrow[\text{Anhydrous } AlCl_3]{CH_3Cl} Y \xrightarrow[KMnO_4]{\text{Alkaline}} Z,$$

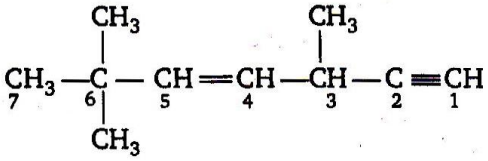
the product, Z, is
(a) toluene (b) benzaldehyde
(c) benzoic acid (d) benzene

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 ?
(a) 128 (b) 157
(c) 181 (d) 108

15. For the reaction, $A + B \rightarrow$ products, it is observed that
(1) On doubling the initial concentration of A only, the rate of reaction is also doubled and
(2) 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
(a) rate $= k[A]^2[B]$
(b) rate $= k[A][B]^2$
(c) rate $= k[A]^2[B]^2$
(d) rate $= k[A][B]$

16. According to MO theory which of the following lists ranks the nitrogen species in terms of increasing bond order ?
(a) $N_2^- < N_2 < N_2^{2-}$
(b) $N_2^{2-} < N_2^- < N_2$
(c) $N_2 < N_2^{2-} < N_2^-$
(d) $N_2^- < N_2^{2-} < N_2$

17. The state of hybridisation of C_2, C_3, C_5 and C_6 of the hydrocarbon,

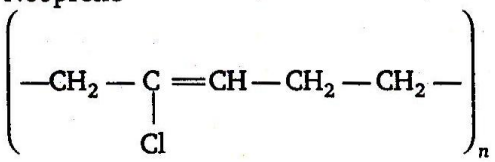


is in the following sequence
(a) sp, sp^3, sp^2 and sp^3
(b) sp^3, sp^2, sp^2 and sp
(c) sp, sp^2, sp^2 and sp^3
(d) sp, sp^2, sp^3 and sp^2

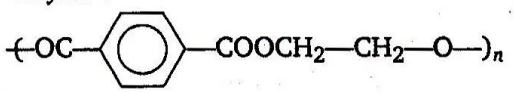
18. Among the following which is the strongest oxidising agent ?
(a) F_2 (b) Br_2
(c) I_2 (d) Cl_2

19. The equivalent conductance of $\frac{M}{32}$ solution of a weak monobasic acid is 8.0 mho cm^2 and at infinite dilution is 400 mho cm^2. The dissociation constant of this acid is
(a) 1.25×10^{-5} (b) 1.25×10^{-6}
(c) 6.25×10^{-4} (d) 1.25×10^{-4}

20. Structures of some common polymers are given. Which one is not correctly presented ?
(a) Teflon
$+CF_2-CF_2+_n$
(b) Neoprene



(c) Terylene



(d) Nylon 66
$+NH(CH_2)_6NHCO(CH_2)_4-CO-]_n$

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,
(a) +5, +6 and +6 (b) +3, +6 and +5
(c) +5, +3 and +6 (d) –3, +6 and +6

22. The IUPAC name of the compound having the formula $CH \equiv C - CH = CH_2$ is
(a) 3-butene-1-yne (b) 1-butyn-3-ene
(c) but-1-yne-3-ene (d) 1-butene-3-yne

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

(a) $MCl > MI > MBr > MF$

(b) $MF > MCl > MBr > MI$

(c) $MF > MCl > MI > MBr$

(d) $MI > MBr > MCl > MF$

24. Given,

(i) $Cu^{2+} + 2e^- \longrightarrow Cu$, $E° = 0.337$ V

(ii) $Cu^{2+} + e^- \longrightarrow Cu^+$, $E° = 0.153$ V

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

(a) 0.52 V (b) 0.90 V

(c) 0.30 V (d) 0.38 V

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

(a) 3×10^{-4} mol L^{-1} s^{-1}

(b) 4×10^{-4} mol L^{-1} s^{-1}

(c) 6×10^{-4} mol L^{-1} s^{-1}

(d) 1×10^{-4} mol L^{-1} s^{-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 $Ba(OH)_2$?

(a) 0.10 M (b) 0.40 M

(c) 0.0050 M (d) 0.12 M

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

(a) TiF_6^{2-} and CoF_6^{3-}

(b) Cu_2Cl_2 and $NiCl_4^{2-}$

(c) TiF_6^{2-} and Cu_2Cl_2

(d) CoF_6^{3-} and $NiCl_4^{2-}$

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

(a) [Ne] $3s^2$ $3p^3$ (b) [Ne] $3s^2$ $3p^2$

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

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

(a) $4l + 2$ (b) $2l + 1$

(c) $4l - 2$ (d) $2n^2$

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

(a) 240.8 pm (b) 151.8 pm

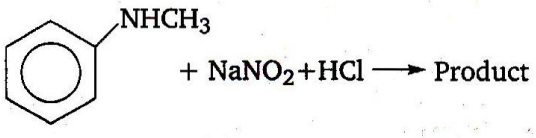
(c) 75.5 pm (d) 300.5 pm

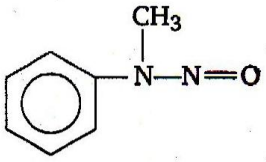
31. The segment of DNA, which acts as the instrumental manual for the synthesis of the protein is

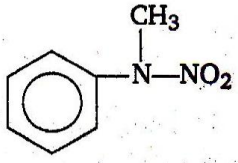
(a) nucleotide (b) ribose

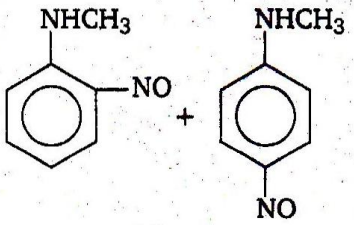
(c) gene (d) nucleoside

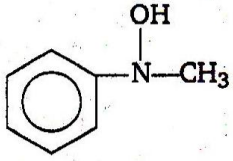
32. Predict the product,



(a) 

(b) 

(c) 

(d) 

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

(a) 2-butene (b) Butanol

(c) 2-butyne (d) 2-butenol

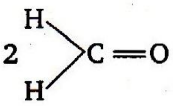
34. The values of ΔH and ΔS for the reaction, $C_{(graphite)} + CO_2(g) \longrightarrow 2CO(g)$ are 170 kJ and 170 JK^{-1}, respectively. This reaction will be spontaneous at

(a) 710 K (b) 910 K

(c) 1110 K (d) 510 K

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

(a) $2CO_2$ (b) 2 HCOOH

(c)  (d) 

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

$CN^- + CH_3COOH \quad HCN + CH_3COO^-$

would be

(a) 3.0×10^5 (b) 3.0×10^{-5}

(c) 3.0×10^{-4} (d) 3.0×10^4

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

(a) reducing agent (b) acid

(c) base (d) catalyst

38. In the reaction,

$$BrO_3^-(aq) + 5Br^-(aq) + 6H^+ \longrightarrow 3Br_2(l) + 3H_2O(l)$$

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

(a) $\frac{d[Br_2]}{dt} = -\frac{3}{5}\frac{d[Br^-]}{dt}$

(b) $\frac{d[Br_2]}{dt} = -\frac{5}{3}\frac{d[Br^-]}{dt}$

(c) $\frac{d[Br_2]}{dt} = \frac{5}{3}\frac{d[Br^-]}{dt}$

(d) $\frac{d[Br_2]}{dt} = \frac{3}{5}\frac{d[Br^-]}{dt}$

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

(a) NO_2^- and NH_2^-

(b) NH_2^- and H_2O

(c) NO_2^- and H_2O

(d) BF_3 and NO_2^-

40. Which of the following hormones contains iodine ?

(a) Insulin (b) Testosterone

(c) Adrenaline (d) Thyroxine

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

(a) 2 mol (b) 3 mol

(c) 4 mol (d) 1 mol

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

(a) 2.0×10^{-20} J (b) 2.2×10^{-19} J

(c) 2.0×10^{-19} J (d) 4.0×10^{-20} J

43. The straight chain polymer is formed by

(a) hydrolysis of $(CH_3)_3SiCl$ followed by condensation polymerisation

(b) hydrolysis of CH_3SiCl_3 followed by condensation polymerisation

(c) hydrolysis of $(CH_3)_4Si$ by addition polymerisation

(d) hydrolysis of $(CH_3)_2SiCl_2$ followed by condensation polymerisation

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

(a) Al < Ga < In < Tl

(b) Tl < In < Ga < Al

(c) In < Tl < Ga < Al

(d) Ga < In < Al < Tl

45. Consider the following reaction,

$$\text{ethanol} \xrightarrow{PBr_3} X \xrightarrow{\text{alc. KOH}} Y \xrightarrow[\text{(ii) } H_2O,\ \text{heat}]{\text{(i) } H_2SO_4,\ \text{room temperature}} Z;$$

the product Z, is

(a) $CH_2 = CH_2$

(b) $CH_3CH_2 - O - CH_2 - CH_3$

(c) $CH_3 - CH_2 - O - SO_3H$

(d) CH_3CH_2OH