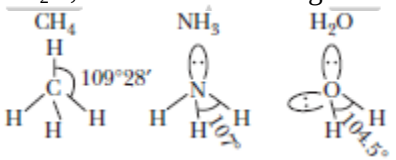
NEET 2016
CHEMISTRY

This paper contains 45 multiple choice questions and there is only one correct response for each question.

1. Consider the molecules CH_4, NH_3 and H_2O. Which of the given statements is false?
(1) The H – C – H bond angle in CH_4, the H – N – H bond angle in NH_3, and the H – O – H bond angle in H_2O are all greater than 90°.
(2) The H – O – H bond angle in H_2O is larger than the H – C – H bond angle in CH_4.
(3) The H – O – H bond angle in H_2O is smaller than the H – N – H bond angle in NH_3.
(4) The H – C – H bond angle in CH_4 is larger than the H – N – H bond angle is NH_3.
Solution:
All the molecules are sp^3 hybridized and bond angle of H_2O is smaller than CH_4 and NH_3, because more is the number of lone pairs lesser in eth bond angle.
In CH_4, H – C – H bond angle is 109°28′ (no lone pair)
In NH_3, H – N – H bond angle is 107°16′ (one lone pair)
In H_2O, H – O – H bond angle is 104°29′ (two lone pairs)

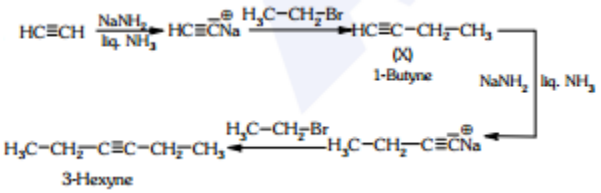


Hence, the correct option is (2).

2. In the reaction

$$H-C\equiv H \xrightarrow[2.\ CH_3CH_2Br]{1.\ NaNH_2/liq.NH_3} X \xrightarrow[2.\ CH_3CH_2Br]{1.\ NaNH_2/liq.NH_3} Y,$$ X and Y are:

(1) X = 1-Butyne; Y = 3-Hexyne
(2) X = 2-Butyne; Y = 3-Hexyne
(3) X = 2-Butyne; Y = 2-Hexyne
(4) X = 1-Butyne; Y = 2-Hexyne
Solution:



Hence, the correct option is (1).

3. Among the following, the correct order of acidity is:
(1) $HClO_3 < HClO_4 < HClO_2 < HClO$
(2) $HClO < HClO_2 < HClO_3 < HClO_4$
(3) $HClO_2 < HClO < HClO_3 < HClO_4$

(4) $HClO_4 < HClO_2 < HClO < HClO_3$

Solution:

Acidic strength of compound is directly proportional to the electronegativity of chlorine. And electronegativity of chlorine in turn is directly proportional to the oxidation state of chlorine.

Thus, the order of acidic strength is

$HClO < HClO_2 < HClO_3 < HClO_4$

As the number of oxygen atoms attached to chlorine increases, acid strength increase.

Hence, the correct option is (2).

4. The rate of a first-order reaction is 0.04 mol L^{-1} s^{-1} at 10 seconds and 0.03 mol L^{-1} s^{-1} at 20 seconds after initiation of the reaction. The half-life period of the reaction is:

(1) 24.1 s

(2) 34.1 s

(3) 44.1 s

(4) 54.1 s

Solution:

For first order reaction, rate of reaction is directly proportional to concertation of reactant.

Thus,

$$k = \frac{2.303}{(t_2 - t_1)} \log \frac{C_1}{C_2}$$

$$= \frac{2.303}{(20-10)} \log \frac{(0.04)}{(0.03)}$$

$$= \frac{2.303 \times 0.1249}{10} \quad \text{.....(i)}$$

As, $k = \frac{0.693}{t_{1/2}}$ ....(ii)

Therefore, from Eqs (i) and (ii), we have

$$\frac{0.693}{t_{1/2}} = \frac{2.303 \times 0.1249}{10}$$

$$t_{1/2} = \frac{0.3010 \times 10}{0.1249} = 24.1\text{s}$$

Hence, the correct option is (1).

5. Which one of the following characteristics is associated with adsorption?

(1) ΔG is negative, but ΔH and ΔS are positive

(2) ΔG, ΔH and ΔS all are negative

(3) ΔG and ΔH are negative, but ΔS is positive

(4) ΔG and ΔS are negative, but ΔH is positive

Solution:

Adsorption is a spontaneous process, so ΔG is negative.

Energy is released in adsorption, thus it is an exothermic process, so ΔH is negative.

In adsorption, randomness of adsorbed substances decreases, thus entropy decreases, so ΔS is negative

Thus, ΔG, ΔH and ΔS all are negative

Hence, the correct option is (2).

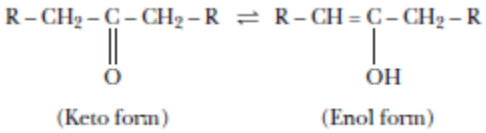
6. In which of the following options, the order of arrangements does not agree with the variation of property indicated against it?
(1) $Al^{3+} < Mg^{2+} < Na^{+} < F^{-}$ (increasing ionic size)
(2) B < C < N < O (increasing first ionization enthalpy)
(3) I < Br < Cl < F (increasing electron gain enthalpy)
(4) Li < Na < K < Rb (increasing metallic radius)
Solution:
Given, order for first ionization enthalpy is B < C < N < O, while the correct order is B < C < O < N. As, N has $ns^2\ np^3$ configuration (which is half-filled), hence its first ionization enthalpy is greater than that of O whose electronic configuration is $ns^2\ np^4$.
Given order for magnitude of electron gain enthalpy is I < Br < Cl < F, while the correct I < Br < F < Cl, because of the smaller size of fluorine atom, its electron gain enthalpy is less than that of Cl.
The increasing order of ionic size in option (1) is correct as on formation of position ion, the effective nuclear charge exceeds number of electrons, so it is smaller. More is the number of electrons removed smaller is the ion.
The order of metallic radius in option (4) is correct, because on moving down the group, metallic radius increases due to successive use of orbitals with quantum number one higher than the last.
Hence, the correct options are both (2) and (3).

7. Which of the following statements is false?
(1) Mg^{2+} ions form a complex with ATP.
(2) Ca^{2+} ions are important in blood clotting.
(3) Ca^{2+} ions are not important in maintaining the regular beating of the heart.
(4) Mg^{2+} ions are important in the green parts of plants.
Solution:
Monovalent ions of sodium and potassium ion and divalent ions of magnesium and calcium play significant roles in biological fluids. These ions perform vital biological functions such as maintenance of heart beat and nerve impulse. Calcium ions are involved in neuromuscular function, interneuronal transmissions, maintaining cell membrane integrity and in blood coagulation**.**
Hence, the correct option is (3).

8. Which of the following statements about hydrogen is incorrect?
(1) Hydrogen has three isotopes of which tritium are the most common.
(2) Hydrogen never acts as cation in ionic salts.
(3) Hydronium ion, H_3O^{+} exists freely in solution.
(4) Dihydrogen does not act as a reducing agent.
Solution:
Hydrogen has three isotopes protium $\left({}_{1}^{1}\mathrm{H}\right)$, deuterium $\left({}_{1}^{2}\mathrm{H}\right)$ and tritium $\left({}_{1}^{3}\mathrm{H}\right)$. The most common form is protium. Tritium, which is radioactive is very rare to occur. Dihydrogen reduces some metal ions in aqueous solution and oxides of metals into their corresponding metals.
Hence, the correct options are (1) and (4).

9. The correct statement regarding a carbonyl compound with a hydrogen atom on its alpha-carbon, is:
(1) a carbonyl compound with a hydrogen atom on its alpha-carbon never equilibrates with its corresponding enol.
(2) a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as aldehyde-ketone equilibration.
(3) a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as carbonylation.
(4) a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism.

Solution:
A carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism.



Hence, the correct option is (4).

10. MY and NY_3, two nearly insoluble salts, have the same K_{sp} values of 6.2×10^{-13} at room temperature. Which statement would be true in regard to MY and NY_3?
(1) The molar solubilities of MY and NY_3 in water are identical.
(2) The molar solubility of MY in water is less than that of NY_3.
(3) The salts MY and NY_3 are more soluble in 0.5 M KY than in pure water.
(4) The addition of the salt of KY to solution of MY and NY_3 will have no effect on their solubilities.

Solution:
For MY

$$MY(s) \rightleftharpoons M^{+}(aq) + Y^{-}(aq)$$

$$K_{sp} = s^2$$

$$\therefore s = \sqrt{(6.2 \times 10^{-13})} = 7.8 \times 10^{-7}\ \text{mol L}^{-1}$$

For NY_3

$$NY_3(s) \rightleftharpoons M^{3+}(aq) + 3Y^{-}(aq)$$

$$K_{sp} = 27s^4$$

$$\therefore s = \sqrt[4]{\frac{(6.2 \times 10^{-13})}{27}} = 3.89 \times 10^{-4}\ \text{mol L}^{-1}$$

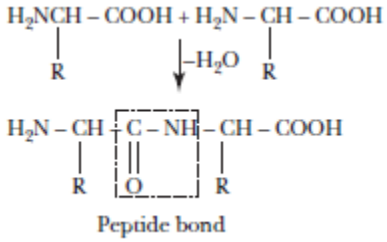
Thus, solubility of NY_3 is greater than that of MY.

Hence, the correct option is (2).

11. In a protein molecule various amino acids are linked together by:
(1) α-glycosidic bond
(2) β-glycosidic bond
(3) peptide bond
(4) dative bond

Solution:

In biopolymer proteins, monomers amino acids are joined to each other by peptide bonds. This bond is formed when the carboxyl group of one amino acid reacts with the amino group of the other, and releases a molecule of water (H_2O).



Hence, the correct option is (3).

12. Natural rubber has

(1) all *cis*-configuration

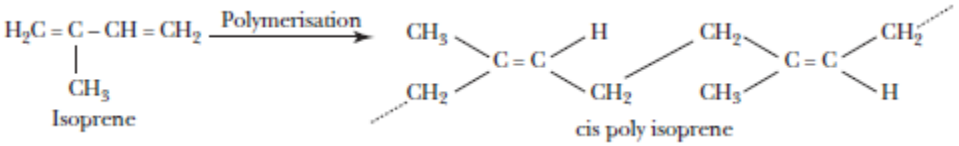
(2) all *trans*-configuration

(3) alternate *cis* – and *trans*-configuration

(4) random *cis* – and *trans*-configuration

Solution:

Natural rubber is *cis* polyisoprene.



Hence, the correct option is (1).

13. Match items of Column I with the items of Column II and assign the correct code:

Column I		Column II	
(a)	Cyanide process	(i)	Ultrapure Ge
(b)	Froth floatation process	(ii)	Dressing of ZnS
(c)	Electrolytic reduction	(iii)	Extraction of Al
(d)	Zone refining	(iv)	Extraction of Au
		(v)	Purification of Ni

Code:

	(a)	(b)	(c)	(d)
(1)	(iv)	(ii)	(iii)	(i)
(2)	(ii)	(iii)	(i)	(v)
(3)	(i)	(ii)	(iii)	(iv)
(4)	(iii)	(iv)	(v)	(i)

Solution:

(a) Cyanide process is used for the extraction of Au in hydrometallurgy.

(b) Froth flotation process is used for the dressing of sulfide ores of Zn.

(c) Electrolytic reduction is used for the extraction of Al.

(d) Zone refining process is used for obtaining ultrapure Ge.

Hence, the correct option is (1).

14. Which one of the following statements is correct when SO_2 is passed through acidified $K_2Cr_2O_7$ solution?

(1) The solution turns blue.

(2) The solution is decolorized.

(3) SO_2 is reduced.

(4) Green $Cr_2(SO_4)_3$ is formed.

Solution:

When SO_2 is passed through acidified $K_2Cr_2O_7$, the following reaction takes place

$$K_2Cr_2O_7 + 3SO_2 + H_2SO_4 \rightarrow K_2SO_4 + \underset{\text{(green)}}{Cr_2(SO_4)_3} + 3H_2O$$

Hence, the correct option is (4).

15. The electronic configurations of Eu (Atomic No. 63), Gd (Atomic No. 64) and Tb (Atomic No. 65) are:

(1) $[Xe]4f^7 6s^2$, $[Xe]4f^8 6s^2$ and $[Xe]4f^8 5d^1 6s^2$

(2) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 6s^2$

(3) $[Xe]4f^6 5d^1 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^8 5d^1 6s^2$

(4) $[Xe]4f^7 6s^2$, $[Xe]4f^7 5d^1 6s^2$ and $[Xe]4f^9 6s^2$

Solution:

Eu (Z=63): $[Xe]4f^7 6s^2$

Gd (Z=64): $[Xe]4f^7 5d^1 6s^2$

Tb (Z=65): $[Xe]4f^9 6s^2$

Hence, the correct option is (4).

16. Two electrons occupying the same orbital are distinguished by:

(1) Principal quantum number

(2) Magnetic quantum number

(3) Azimuthal quantum number

(4) Spin quantum number

Solution:

Electrons present in the same orbital differ by their spin quantum number value.

Hence, the correct option is (4).

17. When copper is heated with conc. HNO_3 it produces:

(1) $Cu(NO_3)$ and NO_2

(2) $Cu(NO_3)_2$ and NO

(3) $Cu(NO_3)_2$, NO and NO_2

(4) $Cu(NO_3)_2$ and N_2O

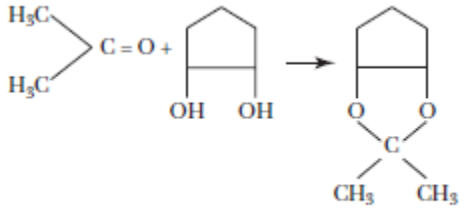
Solution:

When copper reacts with conc. nitric acid, the metal ion coordinates with nitrate ions. The complex gives green color to the solution. The brown gas so produced in the reaction is nitrogen dioxide

$$Cu + 4HNO_3(conc.) \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$$

Hence, the correct option is (1).

18. Which of the following reagents would distinguish *cis*-cyclopenta-1,2-diol from the *trans*-isomer?
(1) Acetone
(2) Ozone
(3) MnO_2
(4) Aluminum isopropoxide
Solution:
Acetone usually condenses with the *cis* hydroxyl groups on the adjacent carbon atoms.



Ketal formation

Hence, the correct option is (1).

19. The correct thermodynamic conditions for the spontaneous reaction at all temperatures is:
(1) $\Delta H < 0$ and $\Delta S > 0$
(2) $\Delta H < 0$ and $\Delta S < 0$
(3) $\Delta H < 0$ and $\Delta S = 0$
(4) $\Delta H > 0$ and $\Delta S < 0$
Solution:
$\Delta G = \Delta H - T\Delta S$
Using this, we can say that ΔG will always be negative, when $\Delta H < 0$ and ΔS is > 0.
Thus, the reaction will be spontaneous.
Hence, the correct option is (3).

20. Lithium has a bcc structure. Its density is 520 kg m^{-3} and its atomic mass is 6.94 g mol^{-1}. Calculate the edge length of a unit cell of Lithium metal. ($N_A = 6.02 \times 10^{23}$ mol^{-1})
(1) 154 pm
(2) 352 pm
(3) 527 pm
(4) 264 pm
Solution:
The density of bcc unit cell is given by

$$d = \frac{Z \times M}{a^3 \times N_A}$$

For bcc structure, $Z = 2$, given, $d = 520$ kg m^{-3}
Therefore, edge length can be determined as:

$$a^3 = \frac{2 \times 6.94}{0.53 \times 6.02 \times 10^{23}} = 43.5 \times 10^{-24}\ \text{cm}^3$$

$$a = \sqrt[3]{43.5 \times 10^{-24}} = 3.52 \times 10^{-8}\ \text{cm} = 352\ \text{pm}$$

Hence, the correct option is (2).

21. Which one of the following orders is correct for the bond dissociation enthalpy of halogen molecules?
(1) $I_2 > Br_2 > Cl_2 > F_2$
(2) $Cl_2 > Br_2 > F_2 > I_2$
(3) $Br_2 > I_2 > F_2 > Cl_2$
(4) $F_2 > Cl_2 > Br_2 > I_2$
Solution:
The correct order of bond dissociation enthalpy of halogens is $Cl_2 > Br_2 > F_2 > I_2$. It is expected that the bond energy of X_2 molecules (where X is a halogen) would decrease as the atoms become larger, since increased size results in less eefctibve overlap of orbitals Cl_2, Br_2, I_2 show the expected trend, but bond energy of F_2 is abnormally low because large electron – electron repulsion between the lone pairs of electrons on two fluorine atoms weaken its bond.
Hence, the correct option is (2).

22. Which of the following is an analgesic?
(1) Novalgin
(2) Penicillin
(3) Streptomycin
(4) Chloromycetin
Solution:
Novalgin is an analgesic. It is used for the treatment of pain.
Penicillin and streptomycin are antibiotics.
Chloromycetin is used for the treat of various infections.
Hence, the correct option is (1).

23. Equal moles of hydrogen and oxygen gases are placed in a container with a pin-hole through which both can escape. What fraction of the oxygen escapes in the time required for one-half of the hydrogen to escape?
(1) 1/8
(2) 1/4
(3) 3/8
(4) 1/2
Solution:
Given: $n_{O_2} = n_{H_2}$

Let us assume that rate of escape of O_2 molecule = r_{O_2}

Rate of escape of H_2 molecule = r_{H_2}

According to Graham's law

$$\frac{r_{O_2}}{r_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}} = \sqrt{\frac{1}{16}} = \frac{1}{4} \qquad \text{...(i)}$$

Fraction of H_2 molecules escaped in time $t = 1/2$

Fraction of O_2 molecules escaped in time $t = x$

Putting in (i) we get:

$$\frac{r_{O_2}}{r_{H_2}} = \frac{1/2t}{1/x} = \frac{1}{4}$$

$$\frac{1}{x} = \frac{1}{8}$$

Hence, the correct option is (1).

24. Consider the nitration of benzene using mixed conc. H_2SO_4 and HNO_3. If a large amount of $KHSO_4$ is added to the mixture, the rate of nitration will be:

(1) faster

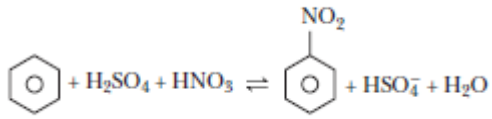
(2) slower

(3) unchanged

(4) doubled

Solution:

The nitration of benzene, proceeds through electrophilic aromatic substitution reaction.



Presence of excess of $KHSO_4$, increases the concentration of HSO_4^- ions, thus shifting the equilibrium backwards. This decreases the formation of nitronium (NO_2^+) ions, hence lowering the rate of reaction.

Hence, the correct option is (2).

25. Predict the correct order among the following:

(1) lone pair – lone pair > lone pair – bond pair > bond pair – bond pair

(2) lone pair – lone pair > bond pair – bond pair > lone pair – bond pair

(3) bond pair – bond pair > lone pair – bond pair > lone pair – lone pair

(4) lone pair – bond pair > bond pair – bond pair > lone pair – lone pair

Solution:

As per VSEPR theory, lone pair − lone pair repulsion is the highest and bond pair-bond pair repulsion is the weakest.

) lone pair – lone pair > lone pair – bond pair > bond pair – bond pair

Hence, the correct option is (1).

26. The product obtained as a result of a reaction of nitrogen with CaC_2 is:

(1) $Ca(CN)_2$

(2) CaCN

(3) $CaCN_3$

(4) Ca_2CN

Solution:

When CaC_2 is heated in an electric furnace with atmospheric nitrogen at 1373 K, calcium cyanamide CaNCN is formed. It is an important method of atmospheric fixation of nitrogen.

$$CaC_2 + N_2 \xrightarrow{\Delta} \underset{\text{Calcium cyanamide}}{CaNCN} + C$$

BaC_2 also reacts with N_2, but it forms cyanide, $Ba(CN)_2$ not a cyanamide $(NCN)^{2-}$.

Hence, no option is correct.

27. Consider the following liquid –vapour equilibrium.

$$\text{Liquid} \rightleftharpoons \text{Vapour}$$

Which of the following relations is correct?

(1) $\frac{d \ln G}{dT^2} = \frac{\Delta H_v}{RT^2}$

(2) $\frac{d \ln P}{dT} = \frac{-\Delta H_v}{RT}$

(3) $\frac{d \ln P}{dT^2} = \frac{-\Delta H_v}{T^2}$

(4) $\frac{d \ln P}{dT} = \frac{-\Delta H_v}{RT^2}$

Solution:

Clausius Clapeyron equation

$$p = Ke^{-\Delta H/RT}$$

$$\ln p = \ln K - \frac{\Delta H}{RT}$$

$$\frac{d}{dT} \ln p = \frac{\Delta H_v}{RT^2}$$

$$\therefore \frac{d \ln p}{dT} = \frac{\Delta H_v}{RT^2}$$

Hence, the correct option is (4).

28. Match the compounds given in column I with the hybridization and shape given in column II and mark the correct option.

Column I	Column II
(a) XeF_6	(i) Distorted octahedral
(b) XeO_3	(ii) Square planar
(c) $XeOF_4$	(iii) Pyramidal
(d) XeF_4	(iv) Square pyramidal

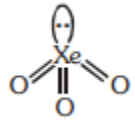
Code:

	(a)	(b)	(c)	(d)
(1)	(i)	(iii)	(iv)	(ii)
(2)	(i)	(ii)	(iv)	(iii)
(3)	(iv)	(iii)	(i)	(ii)
(4)	(iv)	(i)	(ii)	(iii)

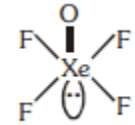
Solution:

XeF_6 is sp^3d^3 hybridized with one lone pair. It has distorted octahedral geometry.

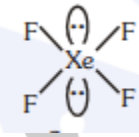
XeO_3 is sp^3 hybridized with one lone pair. It has pyramidal geometry.



$XeOF_4$ is sp^3d^2 hybridized with one lone pair. It has square pyramidal geometry.



XeF_4 is sp^3d^2 hybridized with two lone pairs. It has square planar geometry.



Hence, the correct option is (1).

29. Which of the following has longest C – O bond length? (Free C – O bond length is CO is 1.128 Å.)

(1) $Ni(CO)_4$

(2) $\left[Co(CO)_4\right]^-$

(3) $[Fe(CO)_4]^{2-}$

(4) $[Mn(CO)_6]^+$

Solution:

The metal carbon bond in metal carbonyls possesses both σ and π character. On donation of a pair of electrons from filled metal orbitals ($d\pi$) to vacant antibonding orbital ($p\pi$) of CO, a π bond is formed between metal and carbon.

More is the negative charge on the metal atom, more easily the transfer of electron from the metal to π* orbital of CO would occur. Thus, as M−C bond order increases, C−O bond order decreases.

Hence, the correct option is (3).

30. The pressure of H_2 required to make the potential of H_2-electrode zero in pure water at 298 K is:

(1) 10^{-14} atm

(2) 10^{-12} atm

(3) 10^{-10} atm

(4) 10^{-4} atm

Solution:

The half reaction for hydrogen electrode is

$$2H^+(aq) + 2e^- \rightleftharpoons H_2(g)$$

At 25°C, $[H^+] = 10^{-7}$ M, then using Nerst equation

$$E^\circ = -\frac{0.0591}{2}\log\frac{[H^+]^2}{p_{H_2}}$$

For hydrogen electrode, Pt, $H_2(g)/H^+$,

$$E^\circ_{H_2/H^+} = 0.0\,V$$

Thus, $\frac{[H^+]^2}{p_{H_2}} = 1$

$$\therefore p_{H_2} = (10^{-7})^2 = 10^{-14}\,\text{atm}$$

Hence, the correct option is (1).

31. The addition of a catalyst during a chemical reaction alters which of the following quantities?
(1) Entropy
(2) Internal energy
(3) Enthalpy
(4) Activation energy
Solution:
Activation energy is the minimum energy required to form activated complex. A catalyst increases the rate of reaction by providing an alternate mechanism for the reaction having smaller (lower) activation energy.
Hence, the correct option is (4).

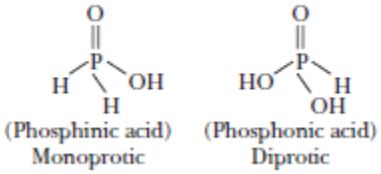
32. The ionic radii of A^+ and B^- ions are 0.98×10^{-10} m and 1.81×10^{-10} m. The coordination number of each ion in AB is:
(1) 6
(2) 4
(3) 8
(4) 2
Solution:
The ratio of cationic to anionic radii is:

$$\frac{r^+}{r^-} = \frac{0.98\times10^{-10}}{1.81\times10^{-10}}$$
$$= 0.54$$

The radius ratio is in between 0.414 and 0.732, thus ionic solid has octahedral geometry, thus coordination number of each ion in AB is 6
Hence, the correct option is (1).

33. Which is the correct statement for the given acids?
(1) Phosphinic acid is a monoprotic acid while phosphonic acid is a diprotic acid.
(2) Phosphinic acid is a diprotic acid while phosphonic acid is a monprotic acid.
(3) Both are diprotic acids.
(4) Both are triprotic acids.
Solution:

The structure of phosphinic and phosphonic acids are as follows:



Phosphinic acid (H_3PO_2) is a monoprotic acid, while phosphonic (H_3PO_3) is a diprotic acid.
Hence, the correct option is (2).

34. Fog is a colloidal solution of:
(1) Liquid in gas
(2) Gas in liquid
(3) Solid in gas
(4) Gas in gas
Solution:
Fog is colloidal solution of liquid droplets in gas (aerosol).
Hence, the correct option is (1).

35. Which of the following statements about the composition of the vapour over an ideal 1:1 molar mixture of benzene and toluene is correct? Assume that the temperature is constant at 25°C. (Given, Vapor Pressure Data at 25°C, benzene = 12.8 kPa, toluene = 3.85 kPa)
(1) The vapor will contain a higher percentage of benzene.
(2) The vapor will contain a higher percentage of toluene.
(3) The vapors will contain equal amounts of benzene and toluene.
(4) Not enough information is given to make a prediction.
Solution:
By Raoult's Law:

$$p_T = p^\circ_{C_6H_6} X_{C_6H_6} + p^\circ_{\text{toluene}} X_{\text{toluene}} \quad \ldots(\text{i})$$

Given, $p^\circ_{C_6H_6} = 12.8\,\text{kPa}; p^\circ_{\text{toluene}} = 3.85\,\text{kPa}$

1 : 1 molar mixture of benzene and toluene, thus $X_{C_6H_6} = 0.5; X_{\text{toluene}} = 0.5$

Putting these values in (i) we get:

$$\begin{aligned} p_T &= (12.8 \times 0.5) + (3.85 \times 0.5) \\ &= 6.2 + 1.925 \\ &= 8.125\,\text{kPa} \end{aligned}$$

Mole fraction of benzene in vapor form

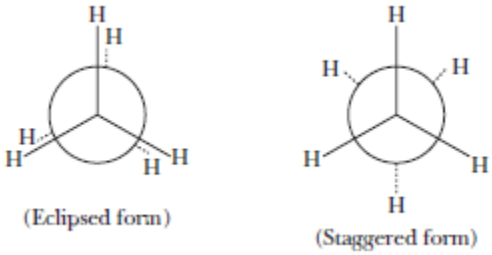
$$Y_{C_6H_6} = \frac{p^\circ_{C_6H_6} X_{C_6H_6}}{p_T} = \frac{12.8 \times 0.5}{8.125} = 0.75$$

Mole fraction of toluene in vapour form

$$\begin{aligned} Y_{\text{toluene}} &= 1 - Y_{C_6H_6} \\ &= 1 - 0.75 \\ &= 0.25 \end{aligned}$$

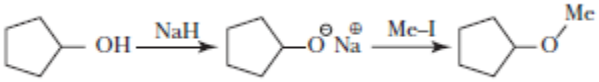
The component having higher vapor pressure will have higher percentage in vapor phase.
Hence, the correct option is (1).

36. The correct statement regarding the comparison of staggered and eclipsed conformations of ethane is:
(1) The staggered conformation of ethane is less stable than eclipsed conformation, because staggered conformation has torsional strain.
(2) The eclipsed conformation of ethane is more stable than staggered conformation, because eclipsed conformation has no torsional strain.
(3) The eclipsed conformation of ethane is more stable than staggered conformation even though the eclipsed conformation has torsional strain.
(4) The staggered conformation of ethane is more stable than eclipsed conformation, because staggered conformation has no torsional strain.
Solution:
Staggered conformation of ethane is more stable.



(Torsional strain) (More stable)
Hence, the correct option is (4).

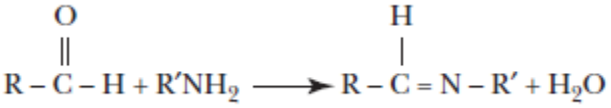
37. The reaction



can be classified as:
(1) Williamson ether synthesis reaction
(2) Alcohol formation reaction
(3) Dehydration reaction
(4) Williamson alcohol synthesis reaction
Solution:
The given reaction depicts Williamson synthesis of ether. In this reaction, sodium alkoxide reacts with alkyl halide to form an ether.
Hence, the correct option is (1).

38. The product formed by the reaction of an aldehyde with a primary amine is:
(1) Schiff base
(2) Ketone
(3) Carboxylic acid
(4) Aromatic acid
Solution:

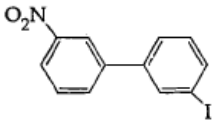
Schiff bases are formed when aldehydes react with primary amines.

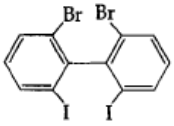


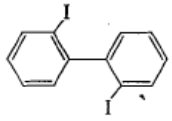
Aldehyde + Primary amine — Schiff base

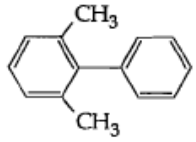
Hence, the correct option is (1).

39. Which of the following biphenyls is optically active?

(1) 

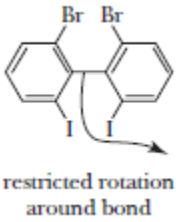
(2) 

(3) 

(4) 

Solution:

Substituted biphenyl compounds can show optical activity even in the absence of chiral carbon because of restricted rotation about carbon-carbon single bond**.**



Steric hindrance arises due to presence of bulkier groups at ortho-positions of benzene rings, the biphenyl system becomes non-planar i.e., optically active. Biphenyl systems are optically active as

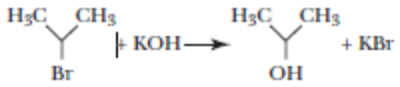
(i) the ortho positions in both the benzene rings are occupied by groups , thus restricting the ree rotation around the single bond.

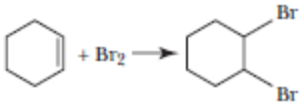
(ii) neither of the rings have plane of symmetry and center of symmetry.

Hence, the correct option is (2).

40. For the following reactions:

(a) $CH_3CH_2CH_2Br + KOH \rightarrow CH_3CH = CH_2 + KBr + H_2O$

(b) 

(c) 

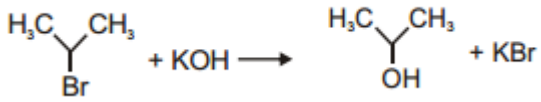
Which of the following statements is correct?
(1) (a) and (b) are elimination reactions and (c) is addition reaction.
(2) (a) is elimination, (b) is substitution and (c) is addition reaction.
(3) (a) is elimination, (b) and (c) are substitution reactions.
(4) (a) is substitution, (b) and (c) are addition reactions.

Solution:

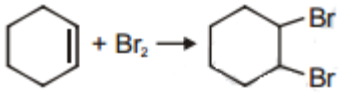
(a) is elimination reaction. It involves breaking of two σ bonds and formation of one π bond.

$$CH_3CH_2CH_2Br + KOH \rightarrow CH_3CH{=}CH_2 + KBr + H_2O$$

(b) is substitution reaction. It involves replacement of Br^- with OH^-.



(c) is addition reaction. It involves breaking of one π bond and formation of two σ bonds.



Hence, the correct option is (2).

41. At 100°C the vapour pressure of a solution of 6.5 g of a solute in 100 g water is 732 mm. If K_b = 0.52, the boiling point of this solution will be:
(1) 102°C
(2) 103°C
(3) 101°C
(4) 100°C

Solution:

Let A be solvent and B be solute.

$$\frac{p^\circ - p_s}{p^\circ} = \frac{n_B}{n_A}$$

At 100°C, p° = 760 mm

$$\frac{760 - 732}{760} = \frac{w_B \times M_A}{M_B \times w_A}$$

$$\frac{28}{760} = \frac{6.5 \times 18}{M_B \times 100}$$

$$M_B = 31.75\,g\,mol^{-1}$$

$\Delta T_b = K_b \times m$

Molality, $m = \frac{w_B \times 1000}{M_B \times w_A}$

$\therefore \Delta T_b = 0.52 \times \frac{6.5 \times 1000}{31.75 \times 100} = 1.06$

Boiling point = 100 + 1.06

= 101.06°C.

Hence, the correct option is (1).

42. The correct statement regarding RNA and DNA, respectively is:

(1) The sugar component in RNA is arabinose and the sugar component in DNA is 2′-deoxyribose.

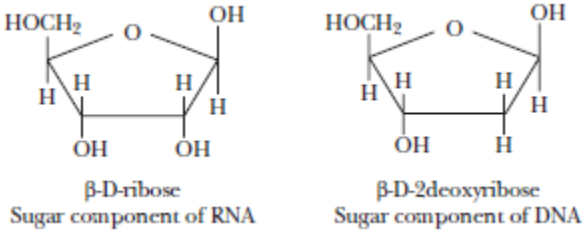
(2) The sugar component in RNA is ribose and the sugar component in DNA is 2′-deoxyribose.

(3) The sugar component in RNA is arabinose and the sugar component in DNA is ribose.

(4) The sugar component in RNA is 2′-deoxyribose and the sugar component in DNA is arabinose.

Solution:

The sugar component of RNA is *β*-D-ribose and that of DNA is *β*-D-2-deoxyribose.



β-D-ribose
Sugar component of RNA

β-D-2deoxyribose
Sugar component of DNA

Hence, the correct option is (2).

43. The correct statement regarding the basicity of arylamines is:

(1) Arylamines are generally less basic than alkylamines because the nitrogen lone-pair electrons are delocalized by interaction with the aromatic ring π electron system.

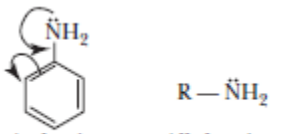
(2) Arylamines are generally more basic than alkylamines because the nitrogen lone-pair electrons are not delocalized by interaction with the aromatic ring π electron system.

(3) Arylamines are generally more basic than alkylamines because of aryl group.

(4) Arylamines are generally more basic than alkylamines, because the nitrogen atom in arylamines is *sp*-hybridized.

Solution:

Arylamines are generally less basic than alkylamines. It is due to delocalization of the lone pair of electrons on nitrogen over ortho and para positions of the ring. The declozide electron pair is less available to a proton..

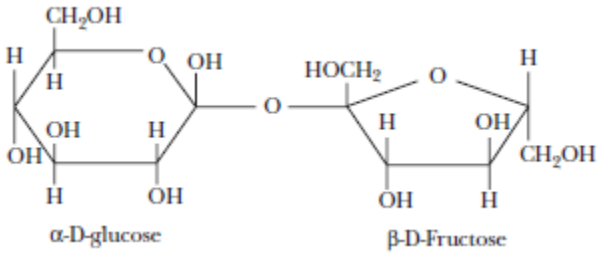


Arylamine
(less basic)

Alkyl amine
(more basic)

Hence, the correct option is (1).

44. Which one given below is a non-reducing sugar?
(1) Maltose
(2) Lactose
(3) Glucose
(4) Sucrose
Solution:
Sucrose is a non-reducing sugar, because reducing parts (groups) of glucose and fructose are involved in glycosidic linkage.



Hence, the correct option is (4).

45. The pair of electron in the given carbanion, $CH_3C \equiv C^-$ is present in which of the following orbitals?
(1) sp^2
(2) sp
(3) $2p$
(4) sp^3
Solution:
In the carbanion, the carbon has one σ bond, two π bonds and one lone pair. Therefore, carbon is *sp* hybridized.
Hence, the correct option is (4).