DAY THIRTY EIGHT

Mock Test 1

Instruction

- This question paper contains of 50 Multiple Choice Questions of Chemistry, divided into two Sections; section A and section B.
- Section A contains 35 questions and all questions are compulsory.
- Section B contains 15 questions out of which only 10 questions are to be attempted.
- Each question carries 4 marks.

Section-A

1 Railway wagon axles are made by heating rods of iron embedded in charcoal powder. The process is known as

(a) case hardening (b) sheradizing
(c) annealing (d) tempering

2 Equal volumes of monoatomic and diatomic gases at same initial temperature and pressure are mixed. The ratio of specific heats of the mixture (C_p / C_V) will be

(a) 1 (b) 2 (c) 1.67 (d) 1.5

3 28 g of N_2 and 6 g of H_2 were kept at 400°C in 1 L vessel, the equilibrium mixture contained 27.54 g of NH_3. The approximate value of K_c for the above reaction can be (in $mol^{-2}\ L^2$)

(a) 75 (b) 50 (c) 25 (d) 100

4 Aluminium chloride exists as dimer, Al_2Cl_6 in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives

(a) $Al^{3+} + 3Cl^-$ (b) $[Al(H_2O)_6]^{3+} + 3Cl^-$
(c) $[Al(OH)_6]^{3-} + 3HCl$ (d) $Al_2O_3 + 6HCl$

5 The dissociation energy of CH_4 and C_2H_6 to convert them into gaseous atoms are 360 and 620 kcal mol^{-1} respectively. The bond energy of C —C bond is

(a) 260 kcal mol^{-1} (b) 180 kcal mol^{-1}
(c) 130 kcal mol^{-1} (d) 80 kcal mol^{-1}

6 When 10 mL of 0.1 M acetic acid ($pK_a = 5.0$) is titrated against 10 mL of 0.1 M ammonia solution ($pK_b = 5.0$), the equivalence point occurs at pH

(a) 5.0 (b) 6.0 (c) 7.0 (d) 9.0

7 Which of the following salts does not get hydrolysed in water?

(a) $KClO_4$ (b) NH_4Cl
(c) CH_3COONa (d) None of these

8 The axial angles in triclinic crystal system are

(a) $\alpha = \beta = \gamma = 90°$
(b) $\alpha = \gamma = 90°, \beta \neq 90°$
(c) $\alpha \neq \beta \neq \gamma \neq 90°$
(d) $\alpha = \beta = \gamma \neq 90°$

9 How many unit cells are present in a cube shaped ideal crystal of NaCl of mass 1.00 g (Atomic mass Na = 23, Cl = 35.5) ?

(a) 1.28×10^{21} unit cells
(b) 1.71×10^{21} unit cells
(c) 2.57×10^{21} unit cells
(d) 5.14×10^{21} unit cells

10 Rearrange the following (I to IV) in the order of increasing masses and choose answer from (a), (b), (c) and (d) (Atomic mass : N = 14, O = 16, Cu = 63)

I. 1 molecule of oxygen
II. 1 atom of nitrogen
III. 1×10^{-10} g molecular weight of oxygen
IV. 1×10^{-10} g atomic weight of copper

(a) II < I < III< IV
(b) IV < III < II < I
(c) II < III < I < IV
(d) III < IV < I < II

11 A monoprotic acid in 1.00 M solution is 0.01% ionised. The dissociation constant of this acid is

(a) 1×10^{-8} (b) 1×10^{-4}
(c) 1×10^{-6} (d) 1×10^{-5}

12 Observe the following abbrevations

π_{obs} = observed colligative property

π_{cal} = theoretical colligative property assuming normal behaviour of solute

van't Hoff factor (i) is given by

(a) $i = \pi_{obs} \times \pi_{cal}$ (b) $i = \pi_{obs} + \pi_{cal}$

(c) $i = \pi_{obs} - \pi_{cal}$ (d) $i = \frac{\pi_{obs}}{\pi_{cal}}$

13 Among the following, the most stable compound is

(a) *cis*-1, 2-cyclohexanediol
(b) *trans*- 1, 2-cyclohexanediol
(c) *cis*- 1, 3-cyclohexanediol
(d) *trans*- 1, 3-cyclohexanediol

14 Ionic compounds are formed most easily by elements with

(a) low electron affinity, high ionisation energy
(b) high electron affinity, low ionisation energy
(c) low electron affinity, low ionisation energy
(d) high electron affinity, high ionisation energy

15 The bond order in NO is 2.5 while that in NO^+ is 3. Which of the following statements is true for these two species?

(a) Bond length in NO^+ is equal to that in NO
(b) Bond length in NO is greater than in NO^+
(c) Bond length in NO^+ is greater than in NO
(d) Bond length is unpredictable

16 The main product obtained when a solution of sodium carbonate react with mercuric chloride is

(a) $Hg(OH)_2$ (b) $HgCO_3 \cdot HgO$
(c) $HgCO_3$ (d) $HgCO_3 \cdot Hg(OH)_2$

17 The change in optical rotation with time, of freshly prepared solution of sugar is known as

(a) rotatory motion (b) inversion
(c) specific rotation (d) mutarotation

18 Which is the most acidic of the following?

(a) Methane (b) Acetylene
(c) 1-butene (d) *Neo* - pentane

19 The maximum number of 90° angles between bond pair-bond pair of electrons is observed in following hybridisation

(a) dsp^3 (b) dsp^2 (c) sp^3d (d) sp^3d^2

20 A reaction, that is of first order with respect to reactant A, has a rate constant 6 min^{-1}. If we start with $[A] = 0.5$ mol L^{-1}, when would $[A]$ reach the value 0.05 mol L^{-1}?

(a) 0.384 min (b) 0.15 min
(c) 3 min (d) 3.84 min

21 Which pair of compounds is expected to show similar colour in aqueous medium?

(a) $FeCl_2$ and $CuCl_2$ (b) $VOCl_2$ and $CuCl_2$
(c) $VOCl_2$ and $FeCl_2$ (d) $FeCl_2$ and $MnCl_2$

22 A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted into CO on the addition of graphite. If the total pressure at equilibrium is 0.8 atm, the value of K_p is

(a) 1.8 atm (b) 3 atm (c) 0.3 atm (d) 0.18 atm

23 CH_3MgI will give methane with

(a) C_2H_5OH (b) $CH_3—CH_2—NH_2$
(c) $CH_3—CO—CH_3$ (d) Both (a) and (b)

24 $E°$ values of Mg^{2+} / Mg is –2.37 V, of Zn^{2+} / Zn is –0.76 V and Fe^{2+} / Fe is –0.44 V. Which of the statements is correct?

(a) Zn will reduce Fe^{2+} (b) Zn will reduce Mg^{2+}
(c) Mg oxidises Fe (d) Zn oxidises Fe

25 A compound A, has a molecular formula C_2Cl_3OH. It reduces Fehling solution and on oxidation gives a monocarboxylic acid (B). A is also obtained by the action of chlorine on ethyl alcohol. A is

(a) chloral (b) $CHCl_3$
(c) CH_3Cl (d) chloroacetic acid

26 At low temperature, phenol reacts with Br_2 in CS_2 to form

(a) *m*-bromophenol (b) *o* and *p*-bromophenol
(c) *p*-bromophenol (d) 2, 4, 6-tribromophenol

27 An organic compound on analysis gave C = 48%, H = 8% and N = 56%. Volume of 1.0 g of the compound was found to be 200 mL at NTP. Molecular formula of the compound is

(a) $C_4H_8N_4$ (b) $C_2H_4N_2$
(c) $C_{12}H_{24}N_{12}$ (d) $C_{16}H_{32}N_{16}$

28 General configuration of outermost and penultimate shell is $(n-1)s^2p^6(n-1)d^xns^2$. If $n = 4$ and $x = 5$, number of protons in the nucleus will be

(a) < 24 (b) 30 (c) 25 (d) > 25

29 Which property of $Na_2S_2O_3$ makes it useful in photography?

(a) Photochemical property
(b) Complex formation property
(c) Oxidising agent
(d) Reducing agent

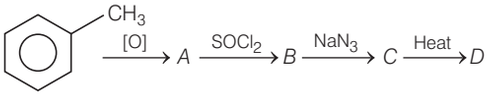
30 A gas decolourised $KMnO_4$ solution but gives no precipitate with ammoniacal cuprous chloride. Which of the following gases does not give a precipitate with ammoniacal solution of silver nitrate but decolourises $KMnO_4$ (neutral or slightly alkaline)?

(a) Ethane (b) Methane
(c) Ethene (d) Acetylene

31 Which one of the following undergoes reaction with 50% sodium hydroxide solution to give the corresponding alcohol and acid salt?

(a) Butanol (b) Benzaldehyde
(c) Phenol (d) Benzoic acid

32 In the following sequence of reactions, what is *D* ?



(a) Primary amine
(b) An amide
(c) Phenyl isocyanate
(d) A chain lengthend hydrocarbon

33 **Assertion** A spectral line will be seen for a $2p_x - 2p_y$ transition.

Reason Energy is released in the form of wave of light when the electron drops from $2p_x$ to $2p_y$ orbital.

(a) Assertion is true, Reason is true and Reason is the correct explanation for Assertion
(b) Assertion is true, Reason is true but Reason is not the correct explanation for Assertion
(c) Assertion is true but Reason is false
(d) Assertion is false but Reason is false

34 $2C + O_2 \longrightarrow 2CO;\ \Delta H = -220\,kJ$

Which of the following statements is correct for this reaction?

(a) Heat of combustion of carbon is 110 kJ
(b) Reaction is exothermic
(c) Reaction needs no initiation
(d) All of the above are correct

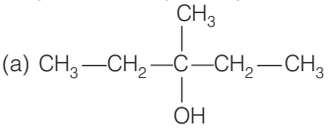
35 **Assertion** Amongst the halogen, fluorine can oxidise the elements to high oxidation state.

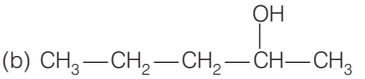
Reason Due to small size of fluoride ion, it is difficult to oxidise fluoride ion to fluorine. Hence, reverse reaction takes place more easily.

(a) Assertion is true, Reason is true and Reason is the correct explanation for Assertion
(b) Assertion is true, Reason is true but Reason is not the correct explanation for Assertion
(c) Assertion is true but Reason is false
(d) Assertion is false but Reason is false

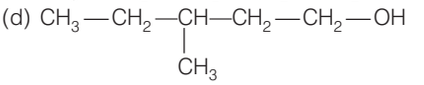
Section B

36 Among the following compounds, which can be dehydrated very easily ?

(a) 

(b) 

(c) $CH_3—CH_2—CH_2—CH_2—CH_2—OH$

(d) 

37 In the following reaction

$$H_3PO_2 \longrightarrow H_3PO_3 + PH_3$$

1. H_3PO_2 undergoes disproportionation reaction
2. equivalent weight of H_3PO_2 is 49.5
3. equivalent weight of H_3PO_2 is 22
4. NaH_2PO_2 is an acid salt

Codes

(a) 1, 2 and 3 are correct (b) 1 and 2 are correct
(c) 2 and 4 are correct (d) 1 and 3 are correct

38 Acid catalysed hydration of alkenes except ethene leads to the formation of

(a) mixture of secondary and tertiary alcohols
(b) mixture of primary and secondary alcohols
(c) secondary or tertiary alcohol
(d) primary alcohol

39 What is obtained when chlorine is passed in boiling toluene and product is hydrolysed?

(a) *o*-cresol (b) *p*-cresol
(c) 2, 4-dihydroxy toluene (d) Benzyl alcohol

40 $CaC_2 + H_2O \longrightarrow A \xrightarrow{H_2SO_4/HgSO_4} B$

Identify *A* and *B* in the given reaction.

(a) C_2H_2 and CH_3CHO (b) C_2H_4 and CH_3COOH
(c) CH_4 and HCOOH (d) C_2H_2 and CH_3COOH

41 Which of the following is not a green house gas?

(a) CO_2 (b) Chlorofluorocarbons
(c) CH_4 (d) None of these

42 The saponification value of an oil or fat is measured in terms of

(a) NH_4OH (b) NaOH (c) KOH (d) C_6H_5OH

43 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

(a) slower (b) unchanged
(c) doubled (d) faster

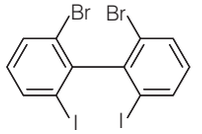
44 The correct statement regarding RNA and DNA, respectively is

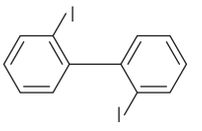
(a) The sugar component in RNA is ribose and the sugar component in DNA is 2′-deoxyribose
(b) The sugar component in RNA is arabinose and the sugar component in DNA is ribose
(c) The sugar component in RNA is 2′-deoxyribose and the sugar component in DNA is arabinose
(d) The sugar component in RNA is arabinose and the sugar component in DNA is 2′-deoxyribose

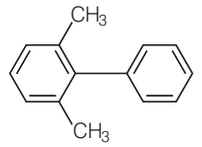
45 Which of the following statements about hydrogen is incorrect?

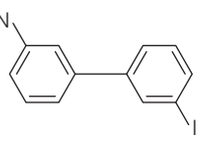
(a) Hydrogen never acts as cation in ionic salts
(b) Hydronium ion, H_3O^+ exists freely in solution
(c) Dihydrogen act as a reducing agent
(d) Hydrogen has three isotopes of which tritium is the most common

46 Which of the following biphenyls is optically active?

(a) 

(b) 

(c) 

(d) 

47 An aqueous solution of $CoCl_2$ on addition of excess of concentrated HCl turns blue due to the formation of

(a) $[Co(H_2O)_4Cl_2]$ (b) $[Co(H_2O)_2Cl_4]^{2-}$
(c) $[CoCl_4]^{2-}$ (d) $[Co(H_2O)_2Cl_2]$

48 Match the salt (in Column I) with its relation for K_{sp} (in Column II) and choose the correct code given below.

	Column I		Column II
A.	Aluminium phosphate	1.	$4s^3$
B.	Calcium chloride	2.	$27s^4$
C.	Ferric sulphate	3.	s^2
D.	Chromium hydroxide	4.	$108s^5$

Codes

	A	B	C	D
(a)	3	1	4	2
(b)	2	3	1	4
(c)	3	2	4	1
(d)	4	1	2	3

49 $RCONH_2$ reacts with a mixture of Br_2 and KOH to yield $R—NH_2$ as a main product. The intermediates involved in this reaction are

1. RNHBr
2. RCONHBr
3. $RCONBr_2$
4. $R—N=C=O$

Codes

(a) 1, 2 and 3 are correct (b) 1 and 2 are correct
(c) 2 and 4 are correct (d) 1 and 3 are correct

50 Which of the following statements is false?

(a) Ca^{2+} ions are important in blood clotting
(b) Ca^{2+} ions are not important in maintaining the regular beating of the heart
(c) Mg^{2+} ions are important in the green parts of plants
(d) Mg^{2+} ions form a complex with ATP

Answers

1	(a)	2	(d)	3	(a)	4	(b)	5	(d)	6	(c)	7	(a)	8	(c)	9	(c)	10	(a)
11	(a)	12	(d)	13	(d)	14	(b)	15	(b)	16	(b)	17	(d)	18	(b)	19	(d)	20	(a)
21	(b)	22	(a)	23	(d)	24	(a)	25	(a)	26	(b)	27	(a)	28	(c)	29	(b)	30	(c)
31	(b)	32	(c)	33	(d)	34	(b)	35	(c)	36	(a)	37	(b)	38	(c)	39	(d)	40	(a)
41	(d)	42	(c)	43	(a)	44	(a)	45	(d)	46	(a)	47	(c)	48	(a)	49	(c)	50	(b)

Hints and Explanations

1 Case hardening is the process of hardening of the surface of wrought iron by depositing a surface layer of steel on it. It is done by heating wrought iron in contact with potassium ferrocyanide. Alternatively, case hardening can also be done by heating wrought iron with charcoal and then, plunging it in a suitable oil.

2 $C_V = \frac{3}{2}RT;\ C_p = \frac{5}{2}RT$ (for monoatomic gas)

$C_V = \frac{5}{2}RT; C_p = \frac{7}{2}RT$ (for diatomic gas)

Thus, for mixture of 1 mole each,

$$C_V = \frac{\frac{3}{2}RT + \frac{5}{2}RT}{2}$$

and $$C_p = \frac{\frac{5}{2}RT + \frac{7}{2}RT}{2}$$

Therefore, $\frac{C_p}{C_V} = \frac{3RT}{2RT} = 1.5$

3 Number of moles of $N_2 = \frac{28}{28} = 1$ mol

Number of moles of $H_2 = \frac{6}{2} = 3$ mol

Number of moles of

$$NH_3 = \frac{27.54}{17} = 1.62 \text{ mol}$$

($\because$ Molecular wt. of NH_3 = 17 g/mol)

	N_2	+	$3H_2$	$\rightleftharpoons$	$2NH_3$
Initial conc.	1		3		0
At equilibrium	1 – 0.81 = 0.19		3 – 2.43 = 0.57		1.62

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{[1.62]^2}{[0.19]\ [0.57]^3} = 75$$

4 $AlCl_3$ is covalent and exists as dimer i.e. Al_2Cl_6 but in water, it becomes ionic due to large hydration energy of Al^{3+}

$$AlCl_3 + 6H_2O \rightleftharpoons [Al(H_2O)_6]^{3+} + 3Cl^-$$

5 $CH_4(g) \longrightarrow C(g) + 4H(g)$

ΔH = 360 kcal for four (C—H) bonds

$$BE(C—H) = \frac{360}{4} = 90 \text{ kcal}$$

$C_2H_6 \longrightarrow 2C\ (g) + 6H\ (g)$

ΔH = 620 kcal for six (C—H) bonds and one (C—C) bond

$\therefore$ 6 BE (C—H) + BE (C—C) = 620

$6 \times 90 +$ BE (C—C) = 620

BE(C—C) = 80 kcal mol^{-1}

6 $pK_a = -\log K_a, pK_b = -\log K_b$

$$pH = -\frac{1}{2}[\log K_a + \log K_w - \log K_b]$$

$$= -\frac{1}{2}[-5 + \log(1 \times 10^{-14}) - (-5)]$$

$[\because K_w = 1 \times 10]$

$$= -\frac{1}{2}[-5 - 14 + 5] = -\frac{1}{2}[-14] = 7$$

7 Only salts of weak acid + strong base and strong acid + weak base get hydrolysed (i.e. show alkalinity or acidity in water). $KClO_4$ is a salt of strong acid and strong base, therefore it does not get hydrolysed in water.

$$KClO_4 \rightleftharpoons K^+ + ClO_4^-$$

$$H_2O \rightleftharpoons OH^- + H^+$$

KOH (Strong base) HClO$_4$ (Strong acid)

8 The axial angles in triclinic crystal system are different and none is perpendicular to any of the others, i.e.

$$\alpha \neq \beta \neq \gamma \neq 90°$$

($\alpha = \beta = \gamma = 90°$ for orthorhombic)

($\alpha = \gamma = 90°; \beta \neq 90°$ for monoclinic)

($\alpha = \beta = \gamma \neq 90°$ for rhombohedral)

9 Number of NaCl in 1 g

$$= \frac{1}{58.5} \times 6.023 \times 10^{23}$$

$$= 1.029 \times 10^{22}$$

A unit cell contains 4 Na^+ and 4 Cl^- ions.

$\therefore$ Number of unit cells in a NaCl crystal of 1g

$$= \frac{1.029 \times 10^{22}}{4}$$

$$= 2.57 \times 10^{21} \text{ unit cells.}$$

10 I. For 1 molecule of oxygen

$\because$ 6.023×10^{23} molecule has mass = 32 g

$\therefore$ 1 molecule of O_2 has mass

$$= \frac{32}{6 \times 10^{23}}$$

$$= 5.3 \times 10^{-23} \text{ g}$$

II. For 1 molecule of nitrogen

$\because$ $2 \times 6 \times 10^{23}$ atoms of N_2 has mass = 28 g

$\therefore$ 1 atom of N_2 has mass

$$= \frac{28}{2 \times 6 \times 10^{23}} = 2.3 \times 10^{-23} \text{ g}$$

III. 1×10^{-10} g molecular weight of oxygen

Gram atomic weight $= 2 \times 1 \times 10^{-10} = 2 \times 10^{-10}$ g

IV. Atomic weight of copper 1×10^{-10} g

So, order of increasing mass is

II < I < III < IV.

11 For weak electrolytes, according to Ostwald's dilution law

$$\alpha = \sqrt{KV}$$

Here, α = 0.01% = 0.0001 = 1×10^{-4}

$$V = \frac{1}{C} = \frac{1}{1.0} = 1 \text{ L}$$

$$\therefore \quad K_a = \frac{\alpha^2}{V} = \frac{(1 \times 10^{-4})^2}{1} = 1 \times 10^{-8}$$

12 van't Hoff factor (i) is given by

$$i = \frac{\text{Observed value of colligative property}}{\text{Normal value of colligative property}}$$

The normal value of colligative property is the theoretically calculated value assuming no association of dissociation.

$$\therefore \quad i = \frac{\pi_{obs}}{\pi_{cal}}$$

13 *Trans* configuration is more stable than *cis* configuration because in *cis* configuration, the higher groups (high molecular weight) are thrown closely enough together to cause crowding or repulsion. Again between 1, 2 and 1, 3-configuration, in 1, 3-configuration the —OH groups are placed farther apart to minimise the repulsion. Hence, more stable is 1, 3-configuration.

14 The formation of ionic bond depends upon ease of formation of cation and anion. Therefore, the ionisation energy value of the metal atom should be low, so that it can easily form cation. On the other hand, the electron affinity value of the non-metal atom should be high, so that it can easily form anion.

15 Bond length $\propto \frac{1}{\text{bond order}}$

Higher the bond order, shorter will be the bond length, thus NO (having lower bond order, i.e. 2.5) as compared to NO^+ (having higher bond order i.e. 3) has greater bond length.

16 Basic mercuric carbonate is obtained in this reaction

$$Na_2CO_3 + 2HgCl_2 \longrightarrow HgCO_3 \cdot HgO + 2NaCl + Cl_2 + CO_2$$

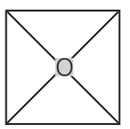
17 α-D-glucose $\rightleftharpoons$ Equilibrium mixture $\rightleftharpoons$ β-D-glucose

$[a]_D = +112°$ (36%); $[a]_D = +52°$ (0.02%); $[a]_D = +19°$ (64%)

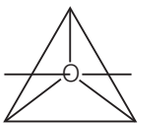
Glucose has two forms α- and β- form. When either of these two is dissolved in water and allowed to stand, it gets converted into an equilibrium mixture of α- and β- forms with different specific rotation. This change in specific rotation in aqueous solution is called **mutarotation**.

18 The *s*-character of C—H bond of acetylene is higher in comparison to C—H bond of ethene and ethane. The electrons of the C—H bond in acetylene are strongly held by carbon nuclei. This facilitates the removal of hydrogen as proton.

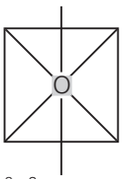
19



dsp^2 -hybridisation (four 90° angles between *bp*-*bp*)



sp^3*d* or *dsp*^{3} -hybridisation (six 90° angles between *bp*-*bp*)



sp^3*d*^{2} -hybridisation (twelve 90° angles between *bp*-*bp*)

sp^3*d*^{2} hybridisation has octahedral or square bipyramidal configuration. All the bond angles are in 90° in it.

20 We know that for first order kinetics,

$$k = \frac{2.303}{t}\log\frac{a}{a-x},$$

$a = 0.5 \text{ mol L}^{-1}$

$(a-x) = 0.05 \text{ mol L}^{-1}$

$$6 = \frac{2.303}{t}\log\frac{0.5}{0.05}$$

or $$t = \frac{2.303}{6}\log\frac{0.5}{0.05}$$

$$= \frac{2.303}{6} = 0.384 \text{ min}$$

21 Colour of transition metal ion salt is due to *d*-*d* transition of unpaired electrons of *d*-orbital. Metal ion salts having similar number of unpaired electrons in *d*-orbital show similar colour in aqueous medium.

V^{4+} : [Ar] $3d^1$ ⇅ | | | | |

Cu^{2+} : [Ar] $3d^9$ ⇅ ⇅ ⇅ ⇅ |

Number of unpaired electrons = 1

So, both will show same colour.

22 $$CO_2(g) + C(s) \rightleftharpoons 2CO(g)$$

Initial : 0.5 atm

At equilibrium : $(0.5-p)$ $2p$ atm

This is a case of heterogeneous equilibrium. C(s) being solid is not considered.

Total pressure of CO_2 and CO gases.

$$p_{CO_2} + p_{CO} = p_{total}$$

$$0.5 - p + 2p = 0.8,$$

$$\therefore \quad p_{CO_2} = 0.5 - 0.3 = 0.2 \text{ atm}$$

$[\because p = 0.3 \text{ atm}]$

$$p_{CO} = 2p = 0.6 \text{ atm}$$

$$K_p = \frac{p_{CO}^2}{p_{CO_2}} = \frac{0.6 \times 0.6}{0.2} = 1.8 \text{ atm}$$

23 $$CH_3MgI + CH_3CH_2NH_2 \longrightarrow CH_4 + CH_3CH_2NHMgI$$

$$CH_3MgI + C_2H_5OH \longrightarrow CH_4 + C_2H_5OMgI$$

Here, alkyl group of Grignard's reagent is involved in the formation of alkane.

24 Higher the negative value of $E°$, more is the reducing power. The order of $E°$ values (negative value) is

$$-2.37 > -0.76 > -0.44$$

(Mg) (Zn) (Fe)

∴ Mg can reduce both Zn^{2+} and Fe^{2+}. Zn can reduce Fe^{2+}, but not Mg^{2+}. Fe cannot reduce Mg and Zn but can oxidise them.

25 C_2Cl_3OH + Fehling solution $\longrightarrow$ CuO

(*A*) Red precipitate

It means —CHO group is present.

$CCl_3CHO \xrightarrow{\text{Oxidation}} CCl_3—COOH$

Monocarboxylic acid

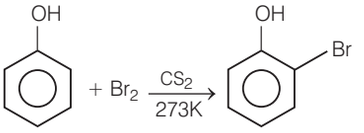
It means only one —CHO group is present.

$$C_2H_5OH + Cl_2 \longrightarrow CH_3CHO + 2HCl$$

$$CH_3CHO + 3Cl_2 \longrightarrow CCl_3CHO + 3HCl$$

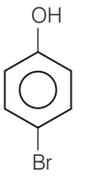
Chloral

26



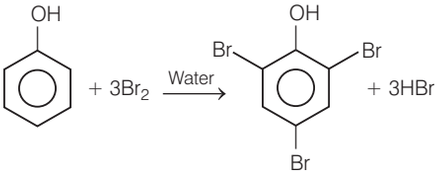
o-bromophenol

+



p-bromophenol

In the presence of non-polar solvent (CS_2), the ionisation of phenol is suppressed. The ring is slightly activated and hence, mono substitution occurs. On the other hand, with Br_2 water phenol forms 2, 4, 6-tribromophenol.



In aqueous solution, phenol ionises to give phenoxide ion. Due to the presence of negative charge on oxygen the benzene ring is highly activated and hence, trisubstituted product is obtained.

27

Element	Atomic number	Percentage	Number of moles	Simple ratio
C	12	48	$\frac{48}{12} = 4$	1
H	1	8	$\frac{8}{1} = 8$	2
N	14	56	$\frac{56}{14} = 4$	1

Empirical formula = CH_2N

Empirical formula mass = 28

Now, 200 mL of compound = 1 g

∴ 22400 mL of compound

$$= \frac{1}{200} \times 22400 = 112 \text{ g}$$

= molecular mass

$$n = \frac{\text{molecular mass}}{\text{empirical formula mass}} = \frac{112}{28} = 4$$

Therefore, molecular formula

$= (CH_2N)_4 = C_4H_8N_4$

28 Given, $n = 4$, $x = 5$

$$\underset{3s^2}{(4-1)s^2}\ \underset{3p^6}{(4-1)p^6}\ \underset{3d^5}{(4-1)d^5}\ \underset{4s^2}{4s^2}$$

Total electrons = 2 + 6 + 5 + 2 = 15

Electrons in I and II orbits = 2 + 8 = 10

∴ Total electrons = 15 + 10 = 25

Number of electrons = number of protons

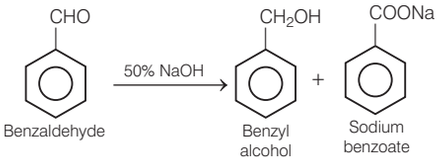
∴ Total protons = 25

29 Sodium thiosulphate ($Na_2S_2O_3$) is useful in photography due to its complex formation property. It is used in photography as a fixer since, it dissolves unexposed silver bromide.

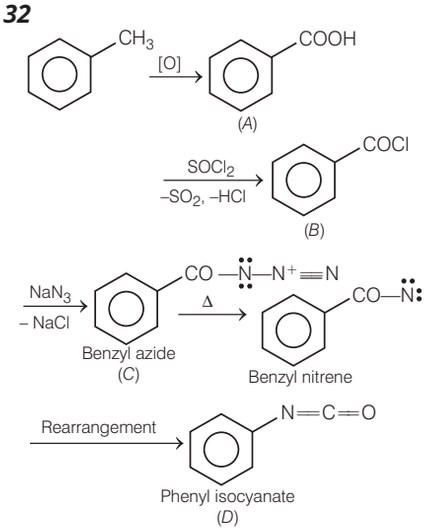
30 Ethane and methane do not decolourise $KMnO_4$ and do not react with ammoniacal cuprous chloride. Acetylene decolourises $KMnO_4$ solution and also gives red precipitate with ammoniacal cuprous chloride.

On the other hand, ethene decolourises $KMnO_4$ solution but does not react with ammoniacal cuprous chloride.

31 Benzaldehyde will undergo Cannizzaro's reaction on treatment with 50% NaOH to produce benzyl alcohol and benzoic acid as it does not contain α-hydrogen.



32



33 Both the Assertion and Reason are false because a spectral line is observed when an electron comes back from the excited state to the ground state in one or more jump. In each jump it come back from higher energy level to lower energy level corresponding to $n = 1, 2, 3, 4, \ldots$ called K, L, M, N … shells. So, shell must be change.

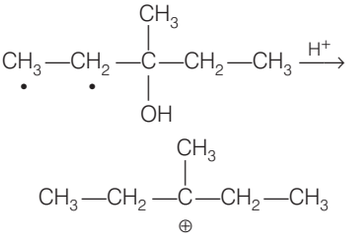
34 $2C + O_2 \longrightarrow 2CO;\ \Delta H = -220\ kJ$

This reaction does not represent complete combustion of carbon, hence heat of combustion of carbon will not be equal to 110 kJ.

The negative sign of ΔH indicates that this reaction is exothermic. Also, despite being spontaneous reaction, it requires initiation.

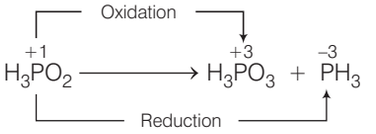
35 Assertion is true but Reason is false because fluorine can oxidise the other elements to higher oxidation state because of being highly electronegative.

36



The more stable carbocation is generated, thus more easily it will be dehydrated.

37.



Thus, H_3PO_2 undergoes disproportionation reaction.

$$E_{(ox)} = \frac{\text{molecular weight}}{\text{increase in oxidation number}}$$

$$= \frac{66}{2} = 33$$

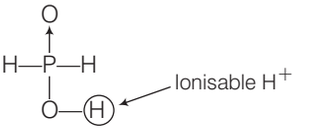
$$E_{(red)} = \frac{\text{molecular weight}}{\text{decrease in oxidation number}}$$

$$= \frac{66}{4} = 16.5$$

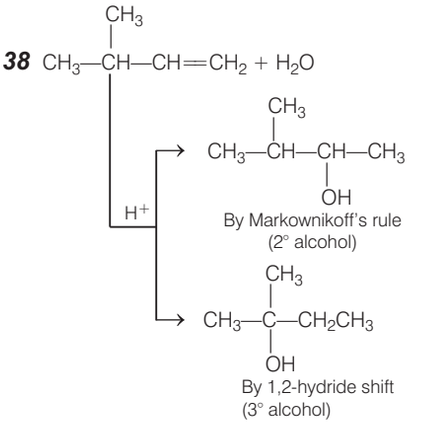
$$\therefore E_{net} = E_{(ox)} + E_{(red)}$$

$$= 33 + 16.5 = 49.5$$

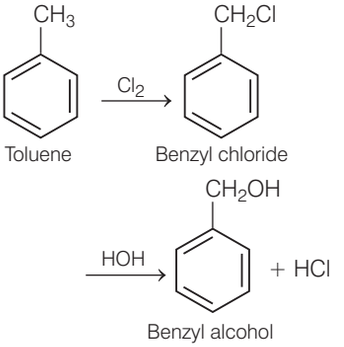
H_3PO_2 is a monobasic salt with only one ionisable H^+. Hence, NaH_2PO_2 is not acid salt.



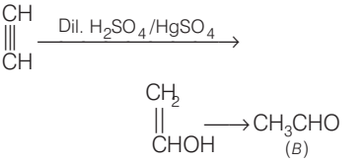
38



39 When chlorine is passed in boiling toluene (free radical) substitution in side chain takes place and benzyl chloride is obtained which on hydrolysis gives benzyl alcohol.



40 $CaC_2 + 2H_2O \longrightarrow \underset{(A)}{C_2H_2} + Ca(OH)_2$



41 Carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbons, water vapour and carbon tetrachloride are the principal greenhouse gases. If the atmospheric concentration of these absorbing gases increases, more heat will be trapped in the atmosphere which will become warmer and overall increase in temperature would be observed (global warming).

42 Saponification value is the number of milligrams of KOH required to neutralise the fatty acid resulting from the complete hydrolysis of 1 g of oil or fat.

43 In the nitration of benzene in the presence of conc. H_2SO_4 and HNO_3, nitrobenzene is formed.

$$HNO_3 + H_2SO_4 \rightleftharpoons \underset{\text{Electrophile}}{NO_2^+} + \underset{}{HSO_4^-} + \underset{\text{Nucleophile}}{H_2O}$$

If large amount of $KHSO_4$ is added to this mixture, more HSO_4^- ion furnishes and hence the concentration of NO_2^+, i.e. electrophile decreases.

As concentration of electrophile decreases, rate of electrophilic aromatic reaction slows down.

44 In DNA, two helically twisted strands connected together by steps. Each strand consists of alternating molecules of deoxyribose at 2′-position and phosphate groups.

On the other hand, in RNA, the pentose sugar has an identical structure with deoxyribose sugar except that there is an —OH group instead of —H on carbon atom 2′.

Hence, it is only called ribose.

45 For ionic salts, hydrogen never behaves as cation, but behaves as anion (H^-).

H_3O^+ exists freely in solution.

Dihydrogen acts as a reducing agent.

Hydrogen has three isotopes.

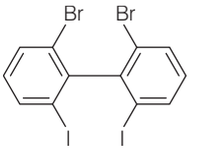
Protium ($_1^1H$)

Deuterium ($_1^2H$)

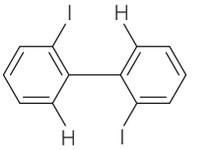
Tritium ($_1^3H$)

Protium is the most common isotopes of hydrogen with an abundance of 99.98%.

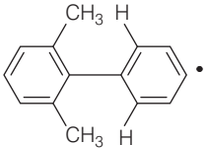
46 The biphenyl compounds having proper substitution at *ortho*-position of benzene rings resulting steric hindrance. This steric hindrance makes the biphenyl system non-planar and hence optically active compounds.



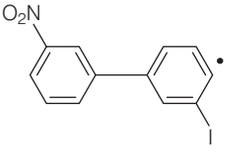
- Proper substitution
- Restricted rotation about single bond



- Improper substitution



- Improper substitution



- No bulkier group present at *ortho* position arising improper substitution

47 $CoCl_2$ is a weak Lewis acid, so reacts with chloride ion to produce salt containing the tetrahedral $[CoCl_4]^{2-}$ ion. $CoCl_2$ is blue when anhydrous, and deep magenta colour when hydrated, for this reason it is widely used as an indicator for water.

48 $AlPO_4 \rightleftharpoons \underset{S}{Al^{3+}} + \underset{S}{PO_4^{3-}}$

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

$CaCl_2 \rightleftharpoons \underset{S}{Ca^{2+}} + \underset{2S}{2Cl^-}$

$\therefore\ K_{sp} = S\,(2S)^2 = 4S^3$

$Fe_2(SO_4)_3 \rightleftharpoons \underset{2S}{2Fe^{2+}} + \underset{3S}{3SO_4^-}$

$\therefore\ K_{sp} = (2S)^2\,(3S)^3 = 108S^5$

$Cr(OH)_3 \rightleftharpoons \underset{S}{Cr^{3+}} + \underset{3S}{3\,OH^-}$

$K_{sp} = S\,(3S)^3 = 27S^4$

49 $R—\overset{\overset{O}{\|}}{C}—NH_2 + OH^- + Br_2 \longrightarrow \underset{(A)}{R—\overset{\overset{O}{\|}}{C}—NHBr}$

$R—\overset{\overset{O}{\|}}{C}—NHBr + OH^- \longrightarrow R—\overset{\overset{O}{\|}}{C}—\overset{-}{N}—Br$ (Unstable)

$R—\overset{\overset{O}{\|}}{C}—\overset{-}{N}—Br \xrightarrow[-Br^-]{} R—\overset{\overset{O}{\|}}{C}—N^+ \xrightarrow{\text{Rearrangement}} R—N=C=O + Br^-$

$R—N=C=O + 2NaOH \longrightarrow RNH_2 + Na_2CO_3$

50 Ca^{2+} ions are very important factor in blood clotting.

Ca^{2+} ions are very important for maintaining the regular heart beating.

Mg^{2+} ions is present in the green parts of plants i.e., chlorophyll.

Mg^{2+} can form a complex with ATP.