ANSWER KEYS																		
1	(c)	7	(a)	13	(d)	19	(c)	25	(c)	31	(d)	37	(c)	43	(a)	49	(c)	55	(a)
2	(b)	8	(c)	14	(b)	20	(c)	26	(b)	32	(c)	38	(c)	44	(a)	50	(d)		
3	(c)	9	(a)	15	(b)	21	(b)	27	(c)	33	(a)	39	(a)	45	(d)	51	(d)		
4	(c)	10	(b)	16	(c)	22	(c)	28	(b)	34	(d)	40	(a)	46	(a)	52	(c)		
5	(b)	11	(c)	17	(a)	23	(d)	29	(b)	35	(a)	41	(b)	47	(a)	53	(d)		
6	(c)	12	(a)	18	(a)	24	(b)	30	(c)	36	(c)	42	(d)	48	(d)	54	(b)		

SOLUTIONS

1. **(c)** $H_3PO_3 + 2KOH \rightarrow K_2HPO_3 + 2H_2O$

2. **(b)** As electrophile Cl^+ attacks on electron rich benzene ring and substitutes hydrogen on ortho and para position w.r.to. $- CH_3$ group. So, the reaction is electrophilic substitution reaction.

3. **(c)** Maximum amount of solid that can be dissolved in a specified amount of a given solvent does not depend upon pressure. This is because solid and liquid are highly incompressible and practically remain unaffected by change in pressure.
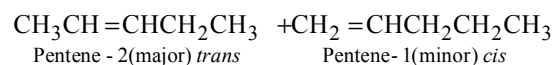
4. **(c)** Structure of H_3PO_4 is

O
‖
P
HO ⁄ | ＼ OH
OH
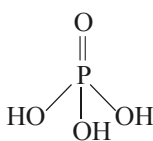
H_3PO_4 has 3 – OH groups *i.e.*, three ionisable H-atoms and hence, it forms three series of salts: NaH_2PO_4, Na_2HPO_4 and Na_3PO_4

5. **(b)** When solute is added to the solution three cases may arise
   (i) It dissolves into solution then solution is unsaturated.
   (ii) It does not dissolve in the solution then solution is known as saturated.
   (iii) When solute get precipitated solution is known as supersaturated solution.

6. **(c)** Polypeptide chains, in fibrous proteins, are held together by disulphide and hydrogen bonds.

7. **(a)** No compound of He as yet been reported.

8. **(c)** S_N1 reactions involve the formation of carbocations, hence higher the stability of carbocation, more will be reactivity of the parent alkyl halide. Thus tertiary carbocation formed from (c) is stabilized by two phenyl groups and one methyl group, hence most stable.

9. **(a)** No compound of Ar as yet been reported with F_2

10. **(b)** As, $a = b \neq c$, $\alpha = \beta = 90°$ and $\gamma = 120°$
    the given crystal system of a compound is a hexagonal system.

11. **(c)**

12. **(a)** Four atoms of Ca^{2+} and eight atoms of F^- are in the unit cell. Each F^- atom occupies 8 tetrahedral voids.

13. **(d)** Weaker the C–X bond, greater is the reactivity.

14. **(b)** At high temp. i.e., 400°C substitution occurs in preference to addition.

$$CH_3CH = CH_2 \xrightarrow[-HCl]{Cl_2, 400°C} ClCH_2CH = CH_2$$
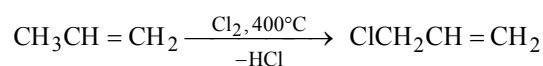
15. **(b)** Epimers are those diastereomers which differ in the configuration of only one chiral carbon which may be C_1, C_2, C_3, etc.; while anomers are diastereomers that differ in the configuration of a specific chiral carbon which is C_1 in aldoses and C_2 in ketoses.

16. **(c)** Potassium ethoxide is a strong base, and 2-bromopentane is a 2° bromide, so elimination reaction predominates

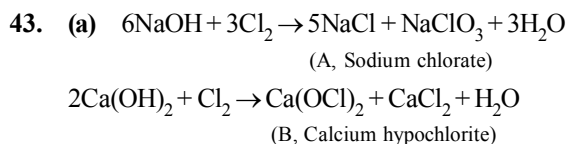$$CH_3CH(Br)CH_2CH_2CH_3 \xrightarrow{OC_2H_5^-}$$

$CH_3CH = CHCH_2CH_3$ + $CH_2 = CHCH_2CH_2CH_3$
Pentene - 2(major) *trans*   Pentene- 1(minor) *cis*

Since *trans*- alkene is more stable than *cis, thus trans*-pentene -2 is the main product.

17. **(a)** Mixture of $(He + O_2)$ is used for asthma patient.

18. **(a)** When primary $(1°)$ alcohols are treated with copper at 300°C, then aldehydes are obtained by dehydrogenation of alcohols. Similarly secondary $(2°)$ alcohols form ketone and alkene is obtained by dehydration of tertiary $(3°)$ - alcohols. But phenol does not respond to this test.

19. **(c)** The coordination number is 8 : 8 for Cs^+ and Cl^-.

20. **(c)** $KMnO_4$ (alkaline) and OsO_4 / CH_2Cl_2 are used for hydroxylation of double bond while O_3 /Zn is used for ozonolysis. Therefore, the right option is (c), i.e.,

$$3CH_3CH = CH_2 \xrightarrow{BH_3 \text{ in THF}} (CH_3CH_2CH_2)_3B$$

$$\xrightarrow[\text{NaOH}]{3H_2O_2} 3CH_3CH_2CH_2OH + H_3BO_3$$

1-propanol

21. **(b)** $x \propto 1/K_H$

22. **(c)**
$$\overset{6}{C}H_3 - \overset{5}{C}H - \overset{4}{C}H_2 - \overset{3}{C}H_2 - \overset{2}{C}H - \overset{1}{C}H_3$$
with Cl on carbon 5 and OH on carbon 2

5-Chlorohexan-2-ol

23. **(d)** Electron gain enthalpy for noble gases is positive and it becomes less positive with increase in size of atom.

Value of electron gain enthalpy

$He - 48 \, kJ \, mol^{-1}$, $Ne - 116 \, kJ \, mol^{-1}$

Ar, $Kr - 96 \, kJ \, mol^{-1}$, $Xe - 77 \, kJ \, mol^{-1}$

Hence, Ne has highest positive electron gain enthalpy.

24. **(b)**   **25.** **(c)**

26. **(b)** Reaction (i) is not possible because OH^- is a stronger base than Cl^-; hence it can't be replaced by Cl^-. However, in reaction (ii) OH group is first protonated to form $R\overset{+}{O}H_2$ in which H_2O, being a very weak base, is easily replaced by Cl^-.

27. **(c)**
$$Pb(NO_3)_2 \xrightarrow{\Delta} PbO + 2NO_2(g) + O_2$$
$$\text{'A'(brown gas)}$$

$$2NO_2(g) \xrightarrow{\text{cooling}} N_2O_4$$
$$\text{'A'} \qquad\qquad\quad \text{'B'}$$

$$N_2O_4 + NO \longrightarrow \overset{+3}{N_2O_3}$$
$$\text{'B'} \qquad\qquad\quad \text{'C' (Blue solid)}$$

28. **(b)** As $\Delta T_f = K_f \cdot m$

$\Delta T_b = K_b \cdot m$

Hence, we have $m = \dfrac{\Delta T_f}{K_f} = \dfrac{\Delta T_b}{K_b}$

or $\Delta T_f = \Delta T_b \dfrac{K_f}{K_b} \Rightarrow [\Delta T_b = 100.18 - 100 = 0.18°C]$

$\therefore \Delta T_f = 0.18 \times \dfrac{1.86}{0.512} = 0.654°C$

As the freezing point of pure water is 0°C,

$\Delta T_f = 0 - T_f \Rightarrow 0.654 = 0 - T_f \therefore T_f = -0.654$

Thus the freezing point of solution will be $-0.654°C$.

29. **(b)** $P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$
$$\text{(X)}$$

$$NaH_2PO_2 \xrightarrow{HCl} H_3PO_2$$
$$\text{(X)} \qquad\qquad \text{(Y)}$$

Basicity of $H_3PO_2 = 1$

30. **(c)**

31. **(d)**

Oxide	oxidation state
N_2O	+1
NO	+2
N_2O_3	+3
NO_2	+4

So, $N_2O < NO < N_2O_3 < NO_2$

32. **(c)** Compounds (A) and (D) are phenols. On the other hand, in compounds (B) and (C), — OH group is bonded to sp^3 hybridised carbon which in turn is bonded to benzene ring. Hence, these are considered as aromatic alcohols.

33. **(a)** At room temperature, water is liquid and has boiling point 373 K due to hydrogen bonding. Whereas H_2S is a gas and it has no hydrogen bonding. Hence boiling point of H_2S is less than 300 K (boiling point of H_2S is $-60°C$).

34. **(d)** Osmotic pressure is a colligative property. Hence resulting osmotic pressure of the solution is given by

$\pi_T = \pi_1 + \pi_2 + \pi_3 ....$

$\pi_T = 1.64 + 2.46 = 4.10 \, atm.$

35. **(a)** $7.4 = n \times 0.0821 \times 300 \quad \therefore \quad n = 0.3$

36. **(c)**

37. **(c)** $X = Na_2SO_3$

$$SO_3^{2-} + H_2SO_4 \to [H_2SO_3] \to H_2O + SO_2$$
$$\text{(X)} \qquad\qquad\qquad\qquad\qquad\qquad \text{(Y)}$$

$$SO_2 + 2NaOH \to Na_2SO_3 + H_2O$$
$$\text{(X)}$$

$$Na_2SO_3 + SO_2 + H_2O \to 2NaHSO_3$$
$$\text{(X)} \qquad \text{(Y)} \qquad\qquad\qquad \text{(Z)}$$

38. **(c)** During denaturation 2° and 3° structures are destroyed but 1° structure remains intact.

39. **(a)** (benzene ring with Cl) $+ (CH_3)_2 NLi \xrightarrow{(CH_3)_2 NH}$ (benzene ring with $N(CH_3)_2$) $+ LiCl$

40. **(a)** Generally, bond energy $\propto \dfrac{1}{\text{Bond length}}$

So, bond energy order is $C–F > C–Cl > C–Br > C–I$

41. **(b)** $\rho = \dfrac{Z \times M}{N_A \times a^3} = \dfrac{2 \times 100}{6.023 \times 10^{23} \times (400 \times 10^{-10})^3}$
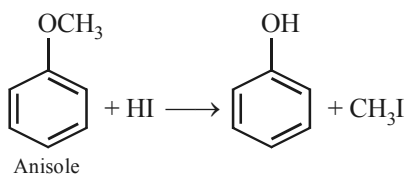
$$= 5.188 \text{ g}/\text{cm}^3$$

42. **(d)**

43. **(a)** $6NaOH + 3Cl_2 \rightarrow 5NaCl + NaClO_3 + 3H_2O$

(A, Sodium chlorate)

$2Ca(OH)_2 + Cl_2 \rightarrow Ca(OCl)_2 + CaCl_2 + H_2O$

(B, Calcium hypochlorite)

44. **(a)** $\Delta T_f = K_f \dfrac{1000 W_2}{M_2 W_1} = \dfrac{1.86 \times 1000 \times 68.5}{342 \times 1000} = 0.372$

$T_f = -0.372°C$

45. **(d)** I^- is a good leaving group. With HI, anisole gives phenol and methyl iodide.

Anisole

46. **(a)** Fluorine exists in only -1 oxidation state due to the absence of vacant d-orbital.

47. **(a)** Graphite is an example of hexagonal crystal system for which $\alpha = \beta = 90°, \gamma = 120°$ and $a = b \neq c$.

48. **(d)** Fluorine is a highly reactive non-metal due to its low bond dissociation energy.

49. **(c)**

50. **(d)** $A \rightarrow (iv), B \rightarrow (iii), C \rightarrow (ii), D \rightarrow (i)$

(a) $CH_3 - O - CH_3$ is a symmetrical ether so the products are CH_3I and CH_2OH.

(b) In $(CH_3)_2CHOCH_3$ unsymmetrical ether, one alkyl group is primary while another is secondary. So, it follow S_N2 mechanism. Thus, the halide ion attacks the smaller alkyl group and the products are

$$\begin{matrix} CH_3 \\ CH_3 \end{matrix} \bigg\rangle CHOH - CH_3I$$
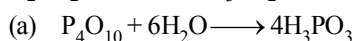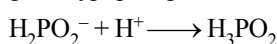
(c) In this case, one of the alkyl group is tertiary and the other is primary. It follows S_N1 mechanism and halide ion
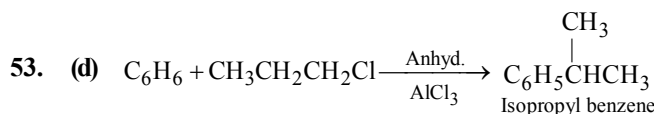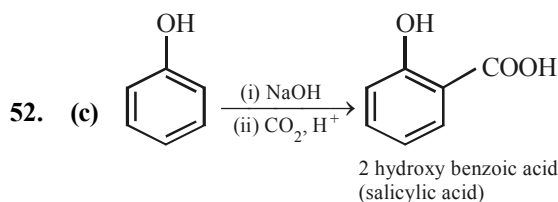
attacks the tertiary alkyl group and the products are $(CH_3)_3C - I$ and CH_3OH.

(d) Here, the unsymmetrical ether is alkyl aryl ether. In this ether $O - CH_3$ bond is weaker than $O - C_6H_5$ bond which has partial double bond character due to resonance. So, the halide ion attacks on alkyl group and the products are $C_6H_5 - OH$ and CH_3I.

51. **(d)** $P_4 + 2Ca(OH)_2 + 4H_2O \longrightarrow 2\,Ca(H_2PO_2)_2 + 2H_2$

(white P)   (hot)   (calcium hypophosphite)
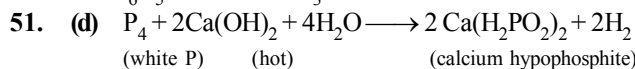
The salt is then treated with a strong non-oxidizing acid to give hypophosphorous acid.

$H_2PO_2^- + H^+ \longrightarrow H_3PO_2$

(a) $P_4O_{10} + 6H_2O \longrightarrow 4H_3PO_3$

(b) $P_2O_3 + 3H_2O \longrightarrow 2H_3PO_3$

(c) $P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$

White

52. **(c)**

2 hydroxy benzoic acid (salicylic acid)

53. **(d)** $C_6H_6 + CH_3CH_2CH_2Cl \xrightarrow[\text{AlCl}_3]{\text{Anhyd.}} C_6H_5\overset{\displaystyle CH_3}{\underset{}{\overset{|}{C}}HCH_3}$
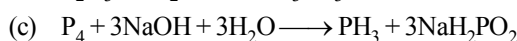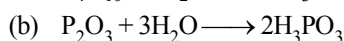
Isopropyl benzene

54. **(b)** S_N2 reaction follow a 2nd order kinetic, i.e., the rate depends upon the concentration of both the reactants, where in S_N1 reactions rate depends only upon the concentration of only one reactant.

The order of reactivity order of alkyl halides for S_N1 reaction $3° > 2° > 1°$ and for S_N2 reactions $3° < 2° < 1°$

55. **(a)** Since S_N1 reactions involve the formation of carbocation as intermediate in the rate determining step, more is the stability of carbocation higher will be the reactivity of alkyl halides towards S_N1 route. Now we know that stability of carbocations follows the order : $3° > 2° > 1°$, so S_N1 reactivity should also follow the same order.

$3° > 2° > 1° > $ Methyl **(S_N1 reactivity)**