



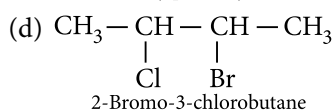
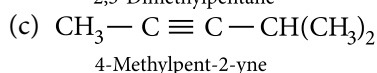
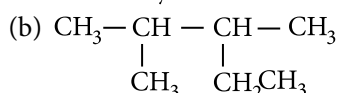
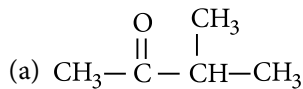
# CHEMISTRY PRACTICE PROBLEMS

# JIPMER

EXAM ON  
2<sup>nd</sup>  
JUNE

1. Mass of one  $^{14}_7\text{N}$  atom is  
(a) 14 amu (b) 7 amu (c) 14 g (d) 7 g

2. The incorrect IUPAC name is



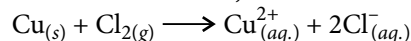
3. Choose the correct statement.  
(a) Saccharin is 650 times sweeter than sucrose.  
(b) Aspartame is 550 times sweeter than sucrose.  
(c) Sucralose is 160 times sweeter than sucrose.  
(d) Alitame is 2000 times sweeter than sucrose.
4. Which of the following represents the correct order of boiling points of the given substances?  
(a) *n*-pentane > isopentane > neopentane  
(b) isopentane > neopentane > *n*-pentane  
(c) neopentane > *n*-pentane > isopentane  
(d) *n*-pentane > neopentane > isopentane
5. For the non-stoichiometric reaction :  
 $2A + B \rightarrow C + D$ , the following kinetic data was obtained in three separate experiments, all at 298 K.

Initial concentration [A]	Initial concentration [B]	Initial rate of formation of C ( $\text{mol L}^{-1}\text{s}^{-1}$ )
0.1 M	0.1 M	$1.2 \times 10^{-3}$
0.1 M	0.2 M	$1.2 \times 10^{-3}$
0.2 M	0.1 M	$2.4 \times 10^{-3}$

The rate law for the formation of C is

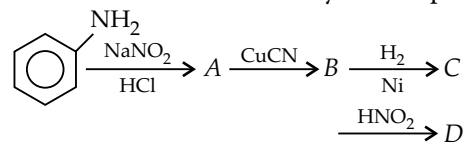
- (a)  $\frac{dC}{dt} = k[A]$  (b)  $\frac{dC}{dt} = k[A][B]$   
(c)  $\frac{dC}{dt} = k[A]^2[B]$  (d)  $\frac{dC}{dt} = k[A][B]^2$

6. For the cell reaction,



Cell notation is

- (a)  $\text{Cu}_{(s)}|\text{Cu}_{(aq)}^{2+}||\text{Cl}_{(aq)}^{-}|\text{Cl}_{2(g)}|\text{C}_{(s)}$   
(b)  $\text{C}_{(s)}|\text{Cl}_{(aq)}^{-}|\text{Cl}_{2(g)}||\text{Cu}_{(aq)}^{2+}|\text{Cu}_{(s)}$   
(c)  $\text{Cu}_{(s)}|\text{Cu}_{(aq)}^{2+}||\text{Cl}_{(aq)}^{-}|\text{Cl}_{2(g)}$   
(d)  $\text{Cu}_{(s)}|\text{Cu}_{(aq)}^{2+}|\text{Cl}_{2(g)}|\text{Cl}_{(aq)}^{-}$
7. Aniline in a set of reactions yielded a product D.



The product D would be

- (a)  $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$  (b)  $\text{C}_6\text{H}_5\text{NHCH}_2\text{CH}_3$   
(c)  $\text{C}_6\text{H}_5\text{NHOH}$  (d)  $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$
8. Which of the following has an ester linkage?  
(a) Nylon-6,6 (b) Dacron  
(c) PVC (d) Bakelite
9. If  $K_1$  and  $K_2$  are respective equilibrium constants for the two reactions,

- (i)  $\text{XeF}_{6(g)} + \text{H}_2\text{O}_{(g)} \rightleftharpoons \text{XeOF}_{4(g)} + 2\text{HF}_{(g)}$   
(ii)  $\text{XeO}_{4(g)} + \text{XeF}_{6(g)} \rightleftharpoons \text{XeOF}_{4(g)} + \text{XeO}_3\text{F}_{2(g)}$

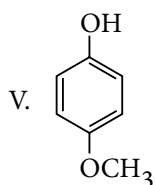
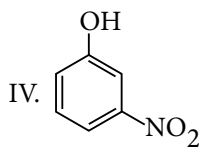
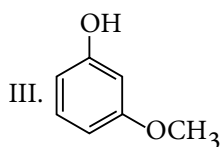
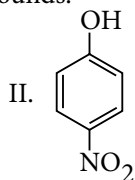
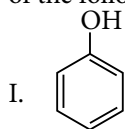
the equilibrium constant for the reaction,  
 $\text{XeO}_{4(g)} + 2\text{HF}_{(g)} \rightleftharpoons \text{XeO}_3\text{F}_{2(g)} + \text{H}_2\text{O}_{(g)}$   
will be

- (a)  $\frac{K_1}{K_2}$  (b)  $K_1 \cdot K_2$   
(c)  $\frac{K_1}{K_2}$  (d)  $\frac{K_2}{K_1}$

10.  $\text{XeF}_6$  on complete hydrolysis gives

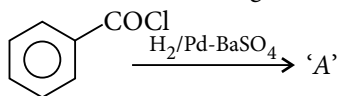
- (a)  $\text{XeO}_4$  (b)  $\text{XeO}_3$   
(c)  $\text{XeO}_2$  (d)  $\text{Xe}$

11. Mark the correct order of decreasing acid strength of the following compounds.



- (a)  $\text{V} > \text{IV} > \text{II} > \text{I} > \text{III}$  (b)  $\text{II} > \text{IV} > \text{I} > \text{III} > \text{V}$   
(c)  $\text{IV} > \text{V} > \text{III} > \text{II} > \text{I}$  (d)  $\text{V} > \text{IV} > \text{III} > \text{II} > \text{I}$

12. Consider the following reaction :



The product 'A' is

- (a)  $\text{C}_6\text{H}_5\text{Cl}$  (b)  $\text{C}_6\text{H}_5\text{CHO}$   
(c)  $\text{C}_6\text{H}_5\text{OH}$  (d)  $\text{C}_6\text{H}_5\text{COCH}_3$

13. Hinsberg's reagent is used to distinguish

- (a) amines (b) alcohols  
(c) acids (d) amides.

14. The vapour pressures of ethanol and methanol are 42.0 mm Hg and 88.5 mm Hg respectively. An ideal solution is formed at the same temperature by mixing 46.0 g of ethanol with 16.0 g of methanol. What is the mole fraction of methanol vapour?

- (a) 0.467 (b) 0.502  
(c) 0.513 (d) 0.556

15. Which of the following does not give a precipitate of  $\text{AgCl}$  with  $\text{AgNO}_3$  solution?

- (a)  $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$  (b)  $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$   
(c)  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$  (d)  $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$

16.  $\text{Cr}_2\text{O}_7^{2-} \xrightarrow{\text{pH} = x} \text{CrO}_4^{2-} \xrightarrow{\text{pH} = y} \text{Cr}_2\text{O}_7^{2-}$

pH values  $x$  and  $y$  can be

- (a) 4 and 5 (b) 4 and 8  
(c) 8 and 3 (d) 8 and 9

17. Among the following oxoacids, the correct decreasing order of acid strength is

- (a)  $\text{HClO}_2 > \text{HClO}_4 > \text{HClO}_3 > \text{HOCl}$   
(b)  $\text{HOCl} > \text{HClO}_2 > \text{HClO}_3 > \text{HClO}_4$   
(c)  $\text{HClO}_4 > \text{HOCl} > \text{HClO}_2 > \text{HClO}_3$   
(d)  $\text{HClO}_4 > \text{HClO}_3 > \text{HClO}_2 > \text{HOCl}$

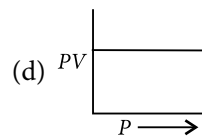
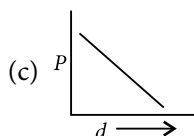
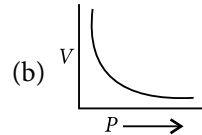
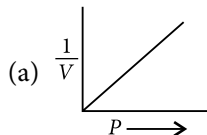
18. The increasing order of the rate of  $\text{HCN}$  addition to compounds I-IV is

- I.  $\text{HCHO}$  II.  $\text{CH}_3\text{COCH}_3$   
III.  $\text{PhCOCH}_3$  IV.  $\text{PhCOPh}$   
(a)  $\text{I} < \text{II} < \text{III} < \text{IV}$  (b)  $\text{IV} < \text{II} < \text{III} < \text{I}$   
(c)  $\text{IV} < \text{III} < \text{II} < \text{I}$  (d)  $\text{III} < \text{IV} < \text{II} < \text{I}$

19. When first ionisation energy is plotted against the atomic number, the peaks in curve are occupied by

- (a) halogens (b) rare gases  
(c) alkali metals (d) transition elements.

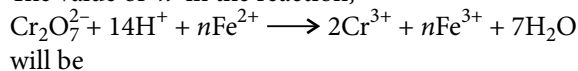
20. Which is not a correct representation of Boyle's law?



21. First ionisation enthalpy of  $\text{Al}$  is lower than that of  $\text{Mg}$ . This is because

- (a) the size of  $\text{Al}$  is bigger than  $\text{Mg}$   
(b) ionisation enthalpy decreases in a period from left to right  
(c) it is easier to remove electron from unpaired  $3p^1$  than from paired  $3s^2$   
(d) aluminium is a passive metal while magnesium is active.

22. The value of ' $n$ ' in the reaction,

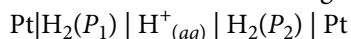


- will be  
(a) 2 (b) 3 (c) 6 (d) 7

23. In Hell-Volhard-Zelinsky reaction, the carboxylic acids are halogenated at A position by using B and C. Identify, A, B and C.

- |     | A        | B              | C                    |
|-----|----------|----------------|----------------------|
| (a) | $\alpha$ | $\text{NaOH}$  | Iodine               |
| (b) | $\alpha$ | Phosphorus     | Halogen              |
| (c) | $\beta$  | Phosphorus     | $\text{H}_2\text{O}$ |
| (d) | $\beta$  | $\text{PCl}_5$ | $\text{NaOH}$        |

24. What will be the emf of the given cell?



- (a)  $\frac{RT}{F} \ln \frac{P_2}{P_1}$                       (b)  $\frac{RT}{2F} \ln \frac{P_1}{P_2}$   
 (c)  $\frac{RT}{2F} \ln \frac{P_2}{P_1}$                       (d) None of these

25. The number of atoms in 100 g of a fcc crystal with density,  $d = 10 \text{ g/cm}^3$  and cell edge equal to 100 pm, is equal to

- (a)  $2 \times 10^{25}$                       (b)  $1 \times 10^{25}$   
 (c)  $4 \times 10^{25}$                       (d)  $3 \times 10^{25}$

26. At a given temperature, total vapour pressure (in torr) of a mixture of volatile components A and B is given by  $P_{\text{total}} = 120 - 75x_B$ .

The vapour pressures of pure A and B respectively (in torr) are

- (a) 120, 75                      (b) 120, 195  
 (c) 120, 45                      (d) 75, 45

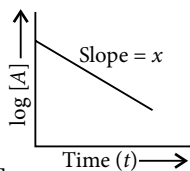
27. The major product formed when 2-bromobutane is treated with alcoholic KOH is

- (a) 2-butanol                      (b) 1-butene  
 (c) 1-butanol                      (d) *trans*-2-butene.

28. For a first order reaction, the graph  $\log [A]$  vs  $t$  is given as follows :  
 $x$  is equal to

- (a)  $\frac{0.693}{k}$   
 (c)  $-\frac{k}{2.303}$

- (b)  $\frac{k}{2.303}$   
 (d)  $\log [A]_0$



29. The correct formula of plaster of Paris is

- (a)  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$                       (b)  $\text{CaSO}_4 \cdot \text{H}_2\text{O}$   
 (c)  $\text{CaSiO}_4 \cdot 2\text{H}_2\text{O}$                       (d)  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$

30.  $\Delta H_f^\circ$  of water is  $-285.8 \text{ kJ mol}^{-1}$ . If enthalpy of neutralisation of monoacidic strong base is  $-57.3 \text{ kJ mol}^{-1}$ ,  $\Delta H_f^\circ$  of  $\text{OH}^-$  ion will be

- (a)  $-114.25 \text{ kJ mol}^{-1}$                       (b)  $114.25 \text{ kJ mol}^{-1}$   
 (c)  $228.5 \text{ kJ mol}^{-1}$                       (d)  $-228.5 \text{ kJ mol}^{-1}$

31. A 4 : 1 mixture of helium and methane is contained in a vessel at 10 bar pressure. Due to a hole in the vessel, the gas mixture leaks out. The composition of the mixture effusing out initially is

- (a) 8 : 1                      (b) 8 : 3  
 (c) 4 : 1                      (d) 1 : 1

32. Four metals and their methods of refinement are given :

- (i) Ni, Cu, Zr, Ga  
 (ii) Electrolysis, van-Arkel process, zone refining, Mond's process

Choose the right method for each.

- (a) Ni : Electrolysis, Cu : van-Arkel process, Zr : Zone refining, Ga : Mond's process  
 (b) Ni : Mond's process, Cu : Electrolysis, Zr : van-Arkel process, Ga : Zone refining  
 (c) Ni : Mond's process, Cu : van-Arkel process, Zr : Zone refining, Ga : Electrolysis  
 (d) Ni : Electrolysis, Cu : Zone refining, Zr : van-Arkel process, Ga : Mond's process

33. Haemoglobin contains 0.334% of iron by weight. The molecular weight of haemoglobin is approximately 67200 u. The number of iron atoms (Atomic weight of Fe is 56 u) present in one molecule of haemoglobin is

- (a) 1                      (b) 2  
 (c) 4                      (d) 6

34. Element A forms an oxide  $\text{A}_2\text{O}_3$ . What would be the formulae of its carbonate and phosphate?

- (a)  $\text{A}_2(\text{CO}_3)$ ,  $\text{A}(\text{PO}_4)$                       (b)  $\text{A}(\text{CO}_3)$ ,  $\text{A}_2(\text{PO}_4)_3$   
 (c)  $\text{A}_2(\text{CO}_3)_3$ ,  $\text{A}(\text{PO}_4)$                       (d)  $\text{A}_2(\text{CO}_3)_3$ ,  $\text{A}_2(\text{PO}_4)_3$

35. The two functional groups present in a typical carbohydrate are

- (a)  $-\text{OH}$  and  $-\text{COOH}$   
 (b)  $-\text{CHO}$  and  $-\text{COOH}$   
 (c)  $>\text{C}=\text{O}$  and  $-\text{OH}$   
 (d)  $-\text{COOH}$  and  $-\text{CHO}$

36. The total number of possible isomers of the complex compound  $[\text{Cu}^{\text{II}}(\text{NH}_3)_4][\text{Pt}^{\text{II}}\text{Cl}_4]$  is

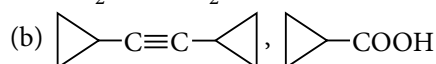
- (a) 3                      (b) 6                      (c) 5                      (d) 4

37. 2-Phenylethanol may be prepared by the reaction of phenyl magnesium bromide with

- (a) HCHO                      (b)  $\text{CH}_3\text{CHO}$   
 (c)  $\text{CH}_3\text{COCH}_3$                       (d)

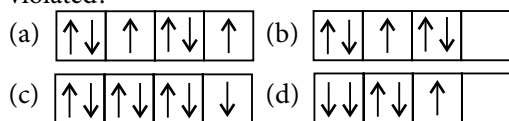
38.  $\text{C}_8\text{H}_{10}$  (A) by oxidative cleavage forms  $\text{C}_3\text{H}_5\text{COOH}$  (B). Thus, A and B respectively are

- (a)  $\text{CH}_2=\text{CHCH}_2\text{C}\equiv\text{CCH}_2\text{CH}=\text{CH}_2$ ,  
 $\text{CH}_2=\text{CHCH}_2\text{COOH}$



- (c) both (a) and (b) are correct  
 (d) none of the above is correct.

39. In which of the following orbital diagrams are both Pauli's exclusion principle and Hund's rule violated?



40. Which one of the following acts as an oxidising agent?

- (a)  $Tb^{4+}$  (b)  $Sm^{2+}$   
(c)  $Eu^{2+}$  (d)  $Yb^{2+}$

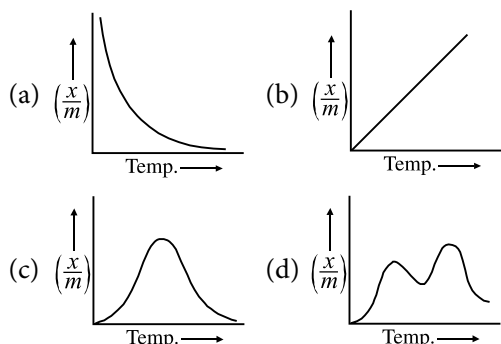
41. Nitrogen in an organic compound can be estimated by

- (a) Kjeldahl's method  
(b) Carius method  
(c) Victor Meyer's method  
(d) Lassaigne's method.

42. The maximum kinetic energy of the photoelectrons is found to be  $6.63 \times 10^{-19}$  J. When the metal is irradiated with a radiation of frequency  $2 \times 10^{15}$  Hz, the threshold frequency of the metal is about

- (a)  $2 \times 10^{15} s^{-1}$  (b)  $1 \times 10^{15} s^{-1}$   
(c)  $2.5 \times 10^{15} s^{-1}$  (d)  $4 \times 10^{15} s^{-1}$

43. Which of the following represents physical adsorption?



44. The number of possible resonance structures for  $CO_3^{2-}$  is

- (a) 2 (b) 3  
(c) 6 (d) 9

45. Amount of oxalic acid present in a solution can be determined by its titration with  $KMnO_4$  solution in the presence of  $H_2SO_4$ . The titration gives unsatisfactory result when carried out in the presence of HCl, because HCl

- (a) oxidises oxalic acid to carbon dioxide and water  
(b) gets oxidised by oxalic acid to chlorine

(c) furnishes  $H^+$  ions in addition to those from oxalic acid

(d) reduces permanganate to  $Mn^{2+}$ .

46. Which of the following is incorrect with respect to Frenkel defect?

- (a) One or more ions (generally cations) shift from lattice points to interstitial sites.  
(b) It appears in ionic compounds having high coordination number.  
(c)  $r^+/r^-$  ratio should be low.  
(d) All of the above.

47.  $H_2O_2$  is manufactured these days by

- (a) electrolysis of 50%  $H_2SO_4$   
(b) the action of  $H_2SO_4$  on  $Na_2O_2$   
(c) the action of  $H_2O_2$  on  $BaO_2$   
(d) burning hydrogen in excess of oxygen.

48. 17.675 is rounded off to four significant figures as

- (a) 17.68 (b) 17.67  
(c) 17.6750 (d) 17.7

49. Ge(II) compounds are powerful reducing agents whereas Pb(IV) compounds are strong oxidants. This can be due to

- (a) Pb is more electropositive than Ge  
(b) ionization potential of Pb is less than that of Ge  
(c) ionic radii of  $Pb^{2+}$  and  $Pb^{4+}$  are larger than those of  $Ge^{2+}$  and  $Ge^{4+}$   
(d) more pronounced inert pair effect in Pb than in Ge.

50. Rutherford's experiment which established the nuclear model of the atom used a beam of

- (a)  $\beta$ -particles which impinged on a metal foil and got absorbed  
(b)  $\gamma$ -rays which impinged on a metal foil and ejected electrons  
(c) helium atoms, which impinged on a metal foil and got scattered  
(d) helium nuclei, which impinged on a metal foil and got scattered.

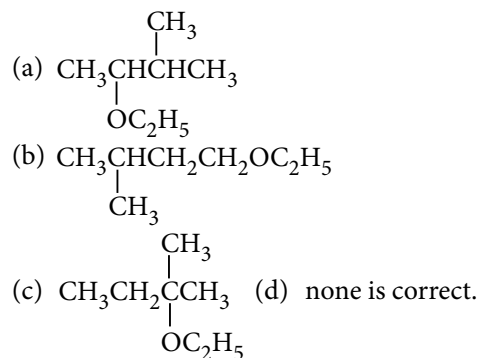
51.  $E_1$ ,  $E_2$  and  $E_3$  are the emf values of the three given Galvanic cells respectively.

- (i)  $Zn|Zn^{2+}(1 M)||Cu^{2+}(0.1 M)|Cu$   
(ii)  $Zn|Zn^{2+}(1 M)||Cu^{2+}(1 M)|Cu$   
(iii)  $Zn|Zn^{2+}(0.1 M)||Cu^{2+}(1 M)|Cu$

Which one of the following is true?

- (a)  $E_2 > E_3 > E_1$  (b)  $E_3 > E_2 > E_1$   
(c)  $E_1 > E_2 > E_3$  (d)  $E_1 > E_3 > E_2$

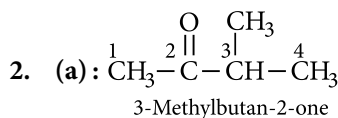
52. To prepare an ether by Williamson's synthesis, the reactants needed are
- ethyl alcohol and *tert*-butyl alcohol
  - sodium ethoxide and *tert*-butyl bromide
  - sodium *tert*-butoxide and ethyl bromide
  - sodium ethoxide and sodium *tert*-butoxide
53. The correct order of acidic nature of oxides is in the order
- $\text{NO} < \text{N}_2\text{O} < \text{N}_2\text{O}_3 < \text{NO}_2 < \text{N}_2\text{O}_5$
  - $\text{N}_2\text{O} < \text{NO} < \text{N}_2\text{O}_3 < \text{NO}_2 < \text{N}_2\text{O}_5$
  - $\text{N}_2\text{O}_5 < \text{NO}_2 < \text{N}_2\text{O}_3 < \text{NO} < \text{N}_2\text{O}$
  - $\text{N}_2\text{O}_5 < \text{N}_2\text{O}_3 < \text{NO}_2 < \text{NO} < \text{N}_2\text{O}$
54. Compound X is highly volatile and insoluble in water. Bonding in X is
- ionic
  - covalent
  - polar covalent
  - coordinate.
55. At a particular temperature under high pressure  $K_w(\text{H}_2\text{O}) = 1 \times 10^{-10}$ . A solution of pH 5.4 under these conditions is said to be
- acidic
  - basic
  - neutral
  - amphoteric.
56. In coagulating the colloidal solution of  $\text{As}_2\text{S}_3$  which of the following has the minimum coagulating value?
- $\text{NaCl}$
  - $\text{KCl}$
  - $\text{BaCl}_2$
  - $\text{AlCl}_3$
57. In an irreversible process taking place at constant  $T$  and  $P$  and in which only pressure-volume work is being done, the change in Gibbs' free energy ( $dG$ ) and change in entropy ( $dS$ ) satisfy the criteria
- $(dS)_{V,E} < 0, (dG)_{TP} < 0$
  - $(dS) > 0, (dG)_{TP} < 0$
  - $(dS) = 0, (dG)_{TP} = 0$
  - $(dS) = 0, (dG)_{TP} > 0$
58. Which of the following statements about photochemical smog is incorrect?
- It is also called as Los Angeles smog.
  - It has low concentration of oxidising agents.
  - It can be controlled by controlling the release of  $\text{NO}_2$ , hydrocarbons, etc.
  - Plantation of some plants like pinus helps in controlling photochemical smog.
59. Major product of the following  $\text{S}_{\text{N}}1$  reaction is
- $$\text{CH}_3\underset{\text{Br}}{\underset{\text{CH}_3}{\text{C}}}\text{CH}_2\text{CH}_3 + \bar{\text{O}}\text{C}_2\text{H}_5 \longrightarrow$$



60. Aniline on treatment with  $\text{HCl}$  and  $\text{NaNO}_2$  at low temperature gives
- aminophenol
  - chloroaniline
  - diazonium salt
  - nitroaniline.

### SOLUTIONS

1. (a)



3. (d): Saccharin is 550 times sweeter than sucrose, aspartame is 100 times sweeter than sucrose. Sucralose is 600 times sweeter than sucrose.
4. (a): Branching decreases the boiling point.
5. (a): For the reaction,  $2A + B \rightarrow C + D$   
Rate of reaction

$$= -\frac{1}{2} \frac{d[A]}{dt} = -\frac{d[B]}{dt} = \frac{d[C]}{dt} = \frac{d[D]}{dt}$$

Now, rate of reaction,  $\frac{d[C]}{dt} = k[A]^x[B]^y$

From table,

$$1.2 \times 10^{-3} = k(0.1)^x(0.1)^y \quad \dots\text{(i)}$$

$$1.2 \times 10^{-3} = k(0.1)^x(0.2)^y \quad \dots\text{(ii)}$$

$$2.4 \times 10^{-3} = k(0.2)^x(0.1)^y \quad \dots\text{(iii)}$$

On dividing equation (i) by (ii), we get

$$\frac{1.2 \times 10^{-3}}{1.2 \times 10^{-3}} = \frac{k(0.1)^x(0.1)^y}{k(0.1)^x(0.2)^y}$$

$$1 = \left(\frac{1}{2}\right)^y \Rightarrow y = 0$$

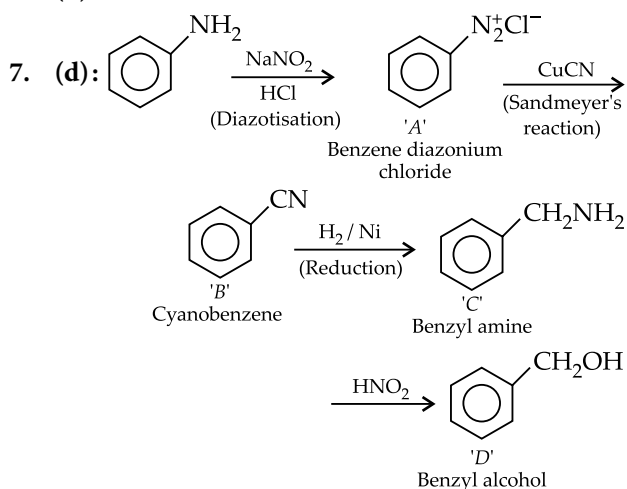
On dividing equation (i) by (iii), we get

$$\frac{1.2 \times 10^{-3}}{2.4 \times 10^{-3}} = \frac{k(0.1)^x(0.1)^y}{k(0.2)^x(0.1)^y}$$

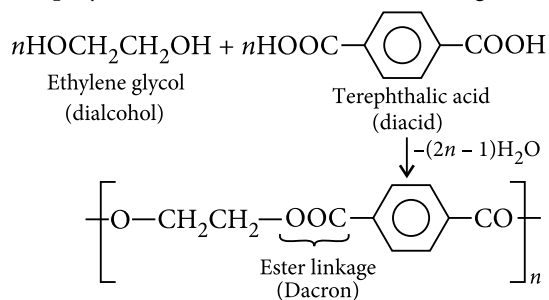
$$\left(\frac{1}{2}\right)^1 = \left(\frac{1}{2}\right)^x \Rightarrow x = 1$$

Hence,  $\frac{d[C]}{dt} = k[A]^1[B]^0 = k[A]$

6. (d)

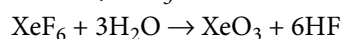


8. (b): When a diacid is condensed with dialcohol, the polymer obtained contains ester linkage.



9. (d): Reaction (ii) and reverse of reaction (i) gives the desired reaction hence,  $K = K_2 \times \frac{1}{K_1} = \frac{K_2}{K_1}$ .

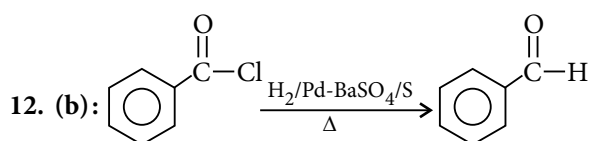
10. (b):  $\text{XeF}_6$  on complete hydrolysis yields xenon trioxide,  $\text{XeO}_3$ .



11. (b): Phenols are acidic in nature due to resonance stabilisation of phenoxide ion. Presence of electron withdrawing groups (such as  $-\text{NO}_2$ ,  $-\text{X}$ ,  $-\text{NR}_3^+$ ,  $-\text{CHO}$ ,  $-\text{COX}$ ,  $-\text{COOR}$ ,  $-\text{CN}$ ) in the ring stabilises phenoxide ion and increases the acidic nature of phenols. On the other hand, presence of electron releasing groups (such as  $-\text{CH}_3$ ,  $-\text{OR}$ ) in the ring destabilises the phenoxide ion and decreases the acidic nature of phenols.

Furthermore, *meta*-isomer of nitrophenol is less acidic than *p*- and *o*-isomers because it is stabilised by inductive effect only. Similarly, *meta*-isomer of methoxyphenol is destabilised to lesser extent than the *para*-isomer.

Thus, correct order of acidic strength is  $\text{II} > \text{IV} > \text{I} > \text{III} > \text{V}$ .



It is Rosenmund reduction.

13. (a): Hinsberg's reagent ( $\text{C}_6\text{H}_5\text{SO}_2\text{Cl}$ ) is used to distinguish amines.

14. (c):

	$\text{CH}_3\text{OH}$ (A)	$\text{C}_2\text{H}_5\text{OH}$ (B)
Vapour pressure	88.5 mm Hg	42.0 mm Hg
Mass	16.0 g	46.0 g
No. of moles	0.5	1

$\therefore$  Total moles = 1 + 0.5 = 1.5

$$P_{\text{total}} = p_A^{\circ}x_A + p_B^{\circ}x_B = \frac{88.5 \times 0.5}{1.5} + \frac{42 \times 1}{1.5}$$

$$P_{\text{total}} = 29.5 + 28 = 57.5 \text{ mm Hg}$$

Mole fraction of methanol in vapour phase is  $y_A$ .

$$p_A = y_A \times \text{Total pressure}$$

$$\therefore y_A = \frac{29.5}{57.5} = 0.513$$

15. (d):  $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$  does not ionise to furnish  $\text{Cl}^-$  ion as no chlorine atom is present outside the coordination sphere. Evidently, it would not give white precipitate with  $\text{AgNO}_3$ .

16. (c):  $\text{Cr}_2\text{O}_7^{2-} + 2\text{OH}^- \rightarrow 2\text{CrO}_4^{2-} + \text{H}_2\text{O}$ ;  $\text{pH} > 7$  ( $x > 7$ )

$2\text{CrO}_4^{2-} + 2\text{H}^+ \rightarrow \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{O}$ ;  $\text{pH} < 7$  ( $y < 7$ )

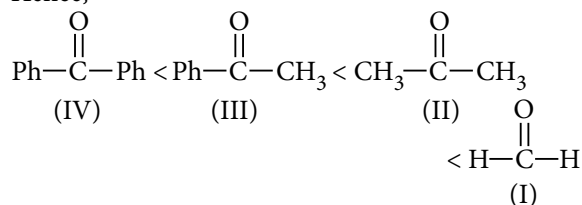
17. (d): No. of O-atoms (*i.e.* oxidation state)  $\propto$

Acidic strength

Hence, the decreasing order of acidic strength will be  $\text{HClO}_4 > \text{HClO}_3 > \text{HClO}_2 > \text{HOCl}$

18. (c): Addition of  $\text{HCN}$  is a nucleophilic addition reaction. Greater the electron deficiency of carbonyl group, higher is the rate of reaction.

Hence,



19. (b): Generally, the first ionization energy increases as we go across a period. Hence, the maximum peaks in curve are occupied by rare gases.

20. (c)

21. (c) : Electronic configuration of Al -  $1s^2 2s^2 2p^6 3s^2 3p^1$   
Electronic configuration of Mg -  $1s^2 2s^2 2p^6 3s^2$

It is difficult to remove electron from paired  $3s^2$ -orbital than the unpaired  $3p^1$ . Hence,  $I.E._1$  of Al is lower than Mg.

22. (c) :  $Cr_2O_7^{2-} + 14H^+ + nFe^{2+} \longrightarrow 2Cr^{3+} + nFe^{3+} + 7H_2O$   
 $Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$  (reduction)

...(i)

$Fe^{2+} \longrightarrow Fe^{3+} + e^-$  (oxidation) ... (ii)

Eq. (ii) is multiplied by 6,

$6Fe^{2+} \longrightarrow 6Fe^{3+} + 6e^-$

Thus, balanced equation is

$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \longrightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$

Hence, the value of  $n$  is 6.

23. (b) :  $RCH_2COOH \xrightarrow[\text{(ii) } H_2O]{\text{(i) } X_2/P} R-\underset{\substack{| \\ X}}{CH}-COOH$   
( $X = Cl, Br$ )  
 $\alpha$ -Halocarboxylic acid

24. (b) : Anode :  $H_2 (P_1) \longrightarrow 2H^+ + 2e^-$

Cathode :  $2H^+ + 2e^- \longrightarrow H_2 (P_2)$

$H_2 (P_1) \longrightarrow H_2 (P_2)$

$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{RT}{nF} \ln \frac{P_2}{P_1} = \frac{RT}{2F} \ln \frac{P_1}{P_2}$$

25. (c) : Mass ( $m$ ) = 100 g; Density ( $d$ ) = 10 g/cm<sup>3</sup> and length ( $l$ ) = 100 pm =  $100 \times 10^{-12}$  m =  $100 \times 10^{-10}$  cm

We know that volume of the unit cell

$$= (a)^3 = (100 \times 10^{-10} \text{ cm})^3 = 10^{-24} \text{ cm}^3$$

and volume of 100 g of element

$$= \frac{\text{Mass}}{\text{Density}} = \frac{100}{10} = 10 \text{ cm}^3$$

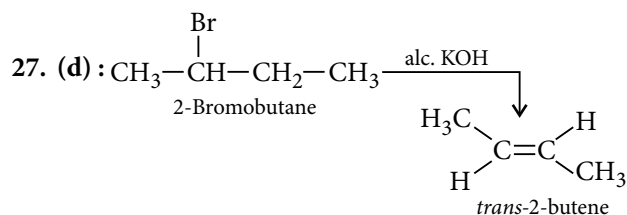
Therefore, number of unit cells =  $\frac{10}{10^{-24}} = 10^{25}$

Since each fcc cube contains 4 atoms, therefore total number of atoms in 100 g =  $4 \times 10^{25}$ .

26. (c) :  $P_{\text{total}} = p_A^{\circ} x_A + p_B^{\circ} x_B$   
 $= p_A^{\circ} (1 - x_B) + p_B^{\circ} x_B = p_A^{\circ} - (p_A^{\circ} - p_B^{\circ}) x_B$   
 $= 120 - 75 x_B$  (given)

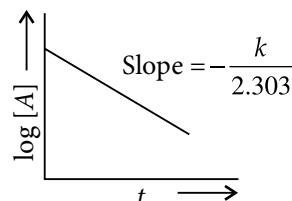
Thus,  $p_A^{\circ} = 120$  torr

$$p_A^{\circ} - p_B^{\circ} = 75 \text{ torr}, \therefore p_B^{\circ} = 45 \text{ torr}$$



28. (c) : For first order reaction,

$$\log[A] = -\frac{kt}{2.303} + \log[A]_0$$



29. (d) : Plaster of Paris is calcium sulphate hemihydrate,  $CaSO_4 \cdot \frac{1}{2} H_2O$ .

30. (d) :  $H_{2(g)} + \frac{1}{2} O_{2(g)} \longrightarrow H_2O_{(l)}; \Delta H_f^{\circ} = -285.8 \text{ kJ mol}^{-1}$  ... (i)

$H_{(aq)}^+ + OH_{(aq)}^- \longrightarrow H_2O_{(l)}; \Delta H_{\text{neut}}^{\circ} = -57.3 \text{ kJ mol}^{-1}$  ... (ii)

$\frac{1}{2} H_{2(g)} \longrightarrow H_{(aq)}^+ + e^-; \Delta H_f^{\circ} = 0$  (by convention) ... (iii)

(i) - (ii) - (iii) gives,

$\frac{1}{2} H_{2(g)} + \frac{1}{2} O_{2(g)} + e^- \longrightarrow OH_{(aq)}^-$

$\Delta H_f^{\circ}$  of  $OH^- = -285.8 + 57.3 = -228.5 \text{ kJ mol}^{-1}$

31. (a) : Pressure of helium = 8 bar,  $CH_4 = 2$  bar  
According to Graham's law,

$$\frac{r_1}{r_2} = \frac{P_1}{P_2} \sqrt{\frac{M_2}{M_1}}$$

$$\frac{r_{He}}{r_{CH_4}} = \frac{P_{He}}{P_{CH_4}} \sqrt{\frac{M_{CH_4}}{M_{He}}} = \frac{8}{2} \sqrt{\frac{16}{4}} = \frac{8}{1} = 8:1$$

32. (b) : Ni — Mond's process;

Cu — Electrolysis ;

Zr — van-Arkel process;

Ga — Zone refining

33. (c) :  $\therefore 100$  g of haemoglobin contains = 0.334 g Fe

$\therefore 67200$  g of haemoglobin contains

$$= \frac{0.334 \times 67200}{100} = 224.45 \text{ g Fe}$$

Now,

$\therefore 56$  g iron = 1 mole of Fe atoms

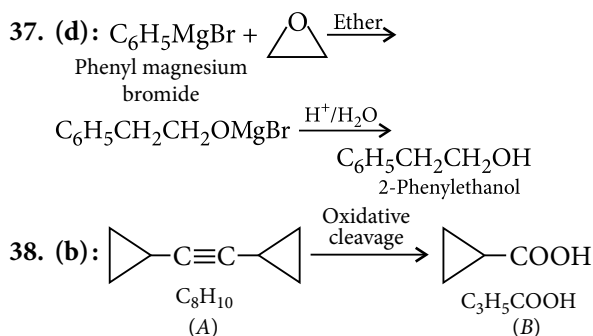


$$\therefore 224.45 \text{ g iron} = \frac{1 \times 224.45}{56}$$

$$= 4 \text{ moles of Fe atoms}$$

$$\therefore 1 \text{ molecule of haemoglobin} = 4 \text{ Fe atoms}$$

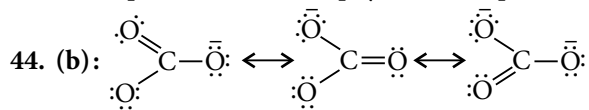
34. (c):  $A_2O_3 \Rightarrow$  Valency of  $A$  is 3.  
So, the formulae of carbonate ( $CO_3^{2-}$ ) will be  $A_2(CO_3)_3$  and that of phosphate ( $PO_4^{3-}$ ) will be  $A(PO_4)$ .
35. (c): Carbohydrates are essentially polyhydroxy aldehydes and polyhydroxy ketones. Thus, the two functional groups present are  $>C=O$  (aldehyde or ketone) and  $-OH$ .
36. (d): For  $[Cu^{II}(NH_3)_4][Pt^{II}Cl_4]$ , four isomers are possible which are  $[Cu(NH_3)_4][PtCl_4]$ ,  $[CuCl_4][Pt(NH_3)_4]$ ,  $[PtCl_3(NH_3)][Cu(NH_3)_3Cl]$  and  $[Pt(NH_3)_3Cl][Cu(NH_3)Cl_3]$ .



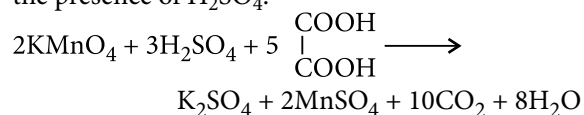
Formation of  $B$  indicates that  $A$  is symmetrical.

39. (d): Two electrons with parallel spins in the same orbital are violating Pauli's exclusion principle whereas pairing without single occupancy of all orbitals is violating Hund's rule.
40. (a): All those inner-transition elements having +2 oxidation state, change to +3, and act as reducing agents. While those having +4 oxidation state tend to change to +3 oxidation state and act as oxidising agents. Therefore,  $Tb^{4+}$  acts as an oxidising agent.
41. (a): Nitrogen can be estimated by Kjeldahl's method. This method cannot be used for organic compounds (i) containing nitrogen in the ring. *e.g.*, pyridine, quinoline etc. (ii) containing nitro and diazo groups. However, Lassaigne's test is used to detect nitrogen.
42. (b): Kinetic energy  $= h(\nu - \nu_0)$   
 $KE = h\nu - h\nu_0$   
 $\nu_0 = \nu - \frac{KE}{h} = 2 \times 10^{15} - \frac{6.63 \times 10^{-19}}{6.63 \times 10^{-34}}$   
 $= 1 \times 10^{15} \text{ s}^{-1}$

43. (a): The amount of adsorption decreases with rise in temperature in case of physical adsorption.



45. (d): Oxalic acid present in a solution can be determined by its titration with  $KMnO_4$  solution in the presence of  $H_2SO_4$ .



Titration cannot be done in the presence of  $HCl$  because  $KMnO_4$  being a strong oxidising agent oxidises  $HCl$  to  $Cl_2$  and itself gets reduced to  $Mn^{2+}$ . So, actual amount of oxalic acid in solution cannot be determined.

46. (b): Frenkel defect appears in ionic crystals having low coordination number, *i.e.*, low  $r^+/r^-$  ratio. The void can accommodate small cation easily.

47. (a):  $H_2O_2$  is manufactured by electrolysis of 50% sulphuric acid.

48. (a)

49. (d):  $Ge^{4+}$  is more stable than  $Ge^{2+}$  as a result of which  $Ge^{2+}$  has a tendency to be oxidised to  $Ge^{4+}$  so,  $Ge^{2+}$  compounds act as powerful reducing agents. But  $Pb^{2+}$  is more stable than  $Pb^{4+}$  because of pronounced inert pair effect as a result of which  $Pb^{4+}$  has a tendency to get reduced to  $Pb^{2+}$  so,  $Pb^{4+}$  compounds act as strong oxidising agents (*i.e.*, oxidants).

50. (d): Rutherford used doubly charged helium particles ( $\alpha$ -particles).

51. (b):  $E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{0.0591}{n} \log_{10} \frac{[Zn^{2+}]}{[Cu^{2+}]}$

Higher the  $\frac{[Zn^{2+}]}{[Cu^{2+}]}$  ratio lower is the emf of cell.

(i)  $\frac{[Zn^{2+}]}{[Cu^{2+}]} = 10$ ; (ii)  $\frac{[Zn^{2+}]}{[Cu^{2+}]} = 1$

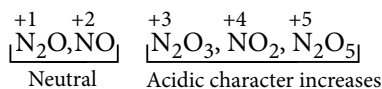
(iii)  $\frac{[Zn^{2+}]}{[Cu^{2+}]} = 0.1$

So, order is  $E_3 > E_2 > E_1$ .

52. (c):  $1^\circ$  alkyl halides on treatment with an alkoxide ion tend to undergo substitution to form ethers. So, sodium *tert*-butoxide and ethyl bromide reagent is used.



53. (b): The acidic character of oxides increases with increase in oxidation number of element. However,



54. (b): Compounds which are insoluble in water have covalent bonds. Due to their low boiling points, they are highly volatile.

55. (b):  $K_w = 1 \times 10^{-10}$

$$\therefore [\text{H}^+] = [\text{OH}^-] = 10^{-5} \text{ M}$$

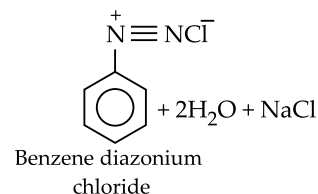
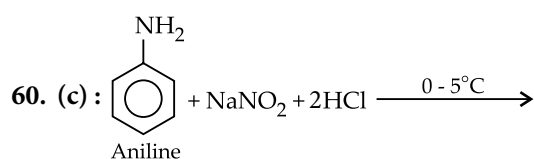
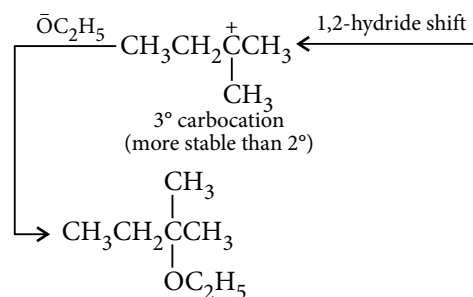
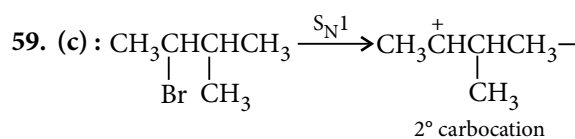
Thus, pH = 5 for neutral solution.

pH < 5 acidic, pH > 5 basic

56. (d):  $\text{As}_2\text{S}_3$  is a negative sol. For coagulating negative sol,  $\text{Al}^{3+}$  is most effective. Higher the magnitude of the charge, lower is the coagulating value.

57. (b): An irreversible process is spontaneous hence, entropy increases and free energy decreases.

58. (b): Photochemical smog has high concentration of oxidising agents and it can be controlled by controlling the release of  $\text{NO}_2$ , hydrocarbons, etc. Plantation of some plants like pinus helps in controlling photochemical smog.



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