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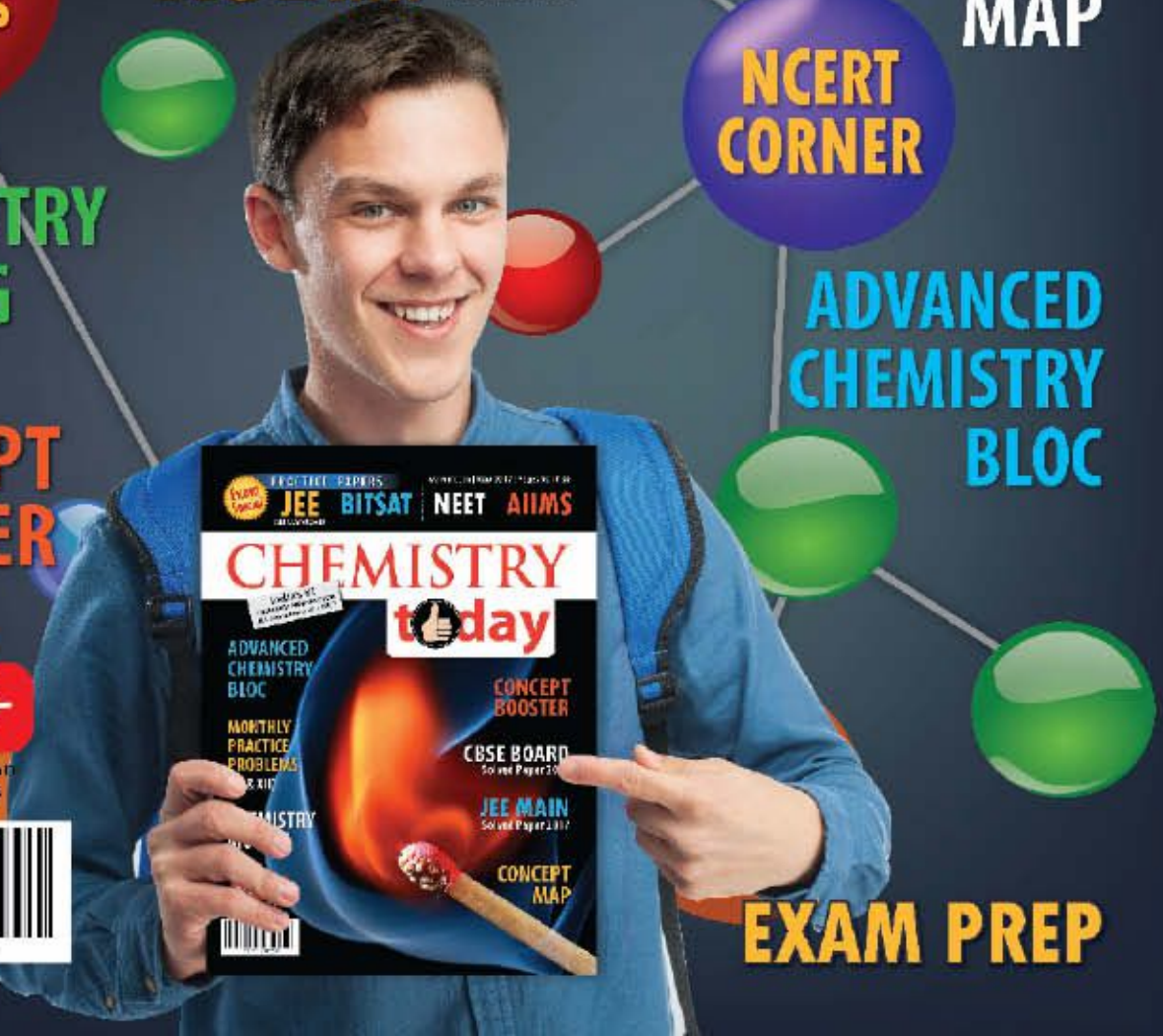

EXAM PREP

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CHEMISTRY today

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NEET

SOLVED PAPER 2017

Hurray!! We are happy to inform our readers that out of the 45 questions asked in NEET 2017, more than 50% questions were either exactly same or of similar type from the **MTG Books.** Hurray!!

Here, the references of few are given :

Exact Questions

S. No.	MTG Books	Q. No.	Pg. No.
2	NEET Guide	17	506
7	29 years NEET-AIPMT	43	60
9	NCERT Fingertips	13	292
11	29 years NEET-AIPMT	60	97
18	29 years NEET-AIPMT	35	141
25	NEET Guide	86	399
41	NCERT Fingertips	10	126

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44	NCERT Fingertips	96	172

and more such questions .....

1. Name the gas that can readily decolourise acidified $KMnO_4$ solution.
(a) SO_2 (b) NO_2 (c) P_2O_5 (d) CO_2

2. Mechanism of a hypothetical reaction $X_2 + Y_2 \rightarrow 2XY$, is given below :
(i) $X_2 \rightarrow X + X$ (fast)
(ii) $X + Y_2 \rightleftharpoons XY + Y$ (slow)
(iii) $X + Y \rightarrow XY$ (fast)
The overall order of the reaction will be
(a) 2 (b) 0 (c) 1.5 (d) 1

3. The element $Z = 114$ has been discovered recently. It will belong to which of the following family/group and electronic configuration?
(a) Carbon family, $[Rn]\ 5f^{14}\ 6d^{10}\ 7s^2\ 7p^2$
(b) Oxygen family, $[Rn]\ 5f^{14}\ 6d^{10}\ 7s^2\ 7p^4$
(c) Nitrogen family, $[Rn]\ 5f^{14}\ 6d^{10}\ 7s^2\ 7p^6$
(d) Halogen family, $[Rn]\ 5f^{14}\ 6d^{10}\ 7s^2\ 7p^5$

4. The heating of phenyl methyl ether with HI produces
(a) iodobenzene (b) phenol
(c) benzene (d) ethyl chloride.

5. Which one is the correct order of acidity?
(a) $CH \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2 > CH_3 - CH_3$
(b) $CH \equiv CH > CH_2 = CH_2 > CH_3 - C \equiv CH > CH_3 - CH_3$
(c) $CH_3 - CH_3 > CH_2 = CH_2 > CH_3 - C \equiv CH > CH \equiv CH$
(d) $CH_2 = CH_2 > CH_3 - CH = CH_2 > CH_3 - C \equiv CH > CH \equiv CH$

6. Predict the correct intermediate and product in the following reaction :

$$H_3C - C \equiv CH \xrightarrow[HgSO_4]{H_2O,\ H_2SO_4} \underset{(A)}{\text{Intermediate}} \longrightarrow \underset{(B)}{\text{Product}}$$

(a) A : $H_3C - \underset{\displaystyle OH}{\underset{|}{C}} = CH_2$ B : $H_3C - \underset{\displaystyle SO_4}{\underset{|}{C}} = CH_2$

(b) A : $H_3C-\underset{\underset{O}{\|}}{C}-CH_3$ B : $H_3C-C\equiv CH$

(c) A : $H_3C-\underset{\underset{OH}{|}}{C}=CH_2$ B : $H_3C-\underset{\underset{O}{\|}}{C}-CH_3$

(d) A : $H_3C-\underset{\underset{SO_4}{|}}{C}=CH_2$ B : $H_3C-\underset{\underset{O}{\|}}{C}-CH_3$

7. The equilibrium constants of the following are :

$N_2 + 3H_2 \rightleftharpoons 2NH_3$; K_1

$N_2 + O_2 \rightleftharpoons 2NO$; K_2

$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$; K_3

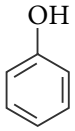
The equilibrium constant (K) of the reaction :

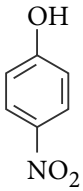
$2NH_3 + \frac{5}{2}O_2 \overset{K}{\rightleftharpoons} 2NO + 3H_2O$, will be

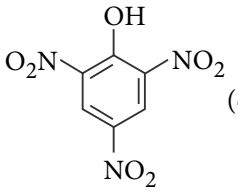
(a) $K_2K_3^3/K_1$ (b) K_2K_3/K_1

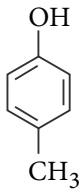
(c) $K_2^3K_3/K_1$ (d) $K_1K_3^3/K_2$

8. Which one is the most acidic compound?

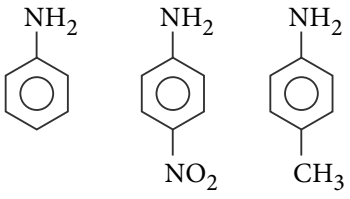
(a) 

(b) 

(c) 

(d) 

9. The correct increasing order of basic strength for the following compounds is



(I) (II) (III)

(a) III < I < II (b) III < II < I

(c) II < I < III (d) II < III < I

10. Ionic mobility of which of the following alkali metal ions is lowest when aqueous solution of their salts are put under an electric field?

(a) K (b) Rb

(c) Li (d) Na

11. The most suitable method of separation of 1 : 1 mixture of *ortho* and *para*-nitrophenols is

(a) chromatography (b) crystallisation

(c) steam distillation (d) sublimation.

12. $HgCl_2$ and I_2 both when dissolved in water containing I^- ions, the pair of species formed is

(a) HgI_2, I^- (b) HgI_4^{2-}, I_3^-

(c) Hg_2I_2, I^- (d) HgI_2, I_3^-

13. Mixture of chloroxylenol and terpineol acts as

(a) antiseptic (b) antipyretic

(c) antibiotic (d) analgesic.

14. An example of a sigma bonded organometallic compound is

(a) Grignard reagent

(b) ferrocene

(c) cobaltocene

(d) ruthenocene.

15. A first order reaction has a specific reaction rate of 10^{-2} sec^{-1}. How much time will it take for 20 g of the reactant to reduce to 5 g?

(a) 138.6 sec (b) 346.5 sec

(c) 693.0 sec (d) 238.6 sec

16. Match the interhalogen compounds of column-I with the geometry in column-II and assign the correct code.

Column I	**Column II**
(A) XX'	(i) T-shape
(B) XX_3'	(ii) Pentagonal bipyramidal
(C) XX_5'	(iii) Linear
(D) XX_7'	(iv) Square pyramidal
	(v) Tetrahedral

Code :

	A	**B**	**C**	**D**
(a)	(iii)	(i)	(iv)	(ii)
(b)	(v)	(iv)	(iii)	(ii)
(c)	(iv)	(iii)	(ii)	(i)
(d)	(iii)	(iv)	(i)	(ii)

17. Concentration of the Ag^+ ions in a saturated solution of $Ag_2C_2O_4$ is 2.2×10^{-4} mol L^{-1}. Solubility product of $Ag_2C_2O_4$ is

(a) 2.66×10^{-12} (b) 4.5×10^{-11}

(c) 5.3×10^{-12} (d) 2.42×10^{-8}

18. In the electrochemical cell :

$Zn|ZnSO_4(0.01\ M)||CuSO_4(1.0\ M)|Cu$, the emf of this Daniell cell is E_1. When the concentration of $ZnSO_4$ is changed to 1.0 M and that of $CuSO_4$ changed to 0.01 M, the emf changes to E_2. From the

following, which one is the relationship between E_1 and E_2? (Given, $RT/F = 0.059$)

(a) $E_1 < E_2$ (b) $E_1 > E_2$

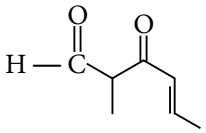
(c) $E_2 = 0 \neq E_1$ (d) $E_1 = E_2$

19. Which of the following pairs of compounds is isoelectronic and isostructural?

(a) TeI_2, XeF_2 (b) IBr_2^-, XeF_2

(c) IF_3, XeF_2 (d) $BeCl_2$, XeF_2

20. The IUPAC name of the compound



is _____.

(a) 5-formylhex-2-en-3-one

(b) 5-methyl-4-oxohex-2-en-5-al

(c) 3-keto-2-methylhex-5-enal

(d) 3-keto-2-methylhex-4-enal

21. Which one is the wrong statement?

(a) The uncertainty principle is $\Delta E \times \Delta t \geq \frac{h}{4\pi}$.

(b) Half filled and fully filled orbitals have greater stability due to greater exchange energy, greater symmetry and more balanced arrangement.

(c) The energy of 2*s*-orbital is less than the energy of 2*p*-orbital in case of hydrogen like atoms.

(d) de-Broglie's wavelength is given by $\lambda = \frac{h}{mv}$, where m = mass of the particle, v = group velocity of the particle.

22. Which is the incorrect statement?

(a) Density decreases in case of crystals with Schottky defect.

(b) $NaCl_{(s)}$ is insulator, silicon is semiconductor, silver is conductor, quartz is piezoelectric crystal.

(c) Frenkel defect is favoured in those ionic compounds in which sizes of cation and anions are almost equal.

(d) $FeO_{0.98}$ has non-stoichiometric metal deficiency defect.

23. The species, having bond angles of 120° is

(a) ClF_3 (b) NCl_3

(c) BCl_3 (d) PH_3

24. For a given reaction, ΔH = 35.5 kJ mol^{-1} and ΔS = 83.6 J K^{-1} mol^{-1}. The reaction is spontaneous at (Assume that ΔH and ΔS do not vary with temperature.)

(a) $T > 425$ K (b) all temperatures

(c) $T > 298$ K (d) $T < 425$ K

25. Which of the following is a sink for CO?

(a) Microorganisms present in the soil

(b) Oceans

(c) Plants

(d) Haemoglobin

26. If molality of the dilute solution is doubled, the value of molal depression constant (K_f) will be

(a) halved (b) tripled

(c) unchanged (d) doubled.

27. Which of the following is dependent on temperature?

(a) Molarity

(b) Mole fraction

(c) Weight percentage

(d) Molality

28. Which one of the following statements is not correct?

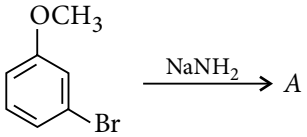
(a) The value of equilibrium constant is changed in the presence of a catalyst in the reaction at equilibrium.

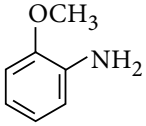
(b) Enzymes catalyse mainly bio-chemical reactions.

(c) Coenzymes increase the catalytic activity of enzyme.

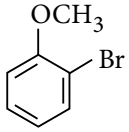
(d) Catalyst does not initiate any reaction.

29. Identify *A* and predict the type of reaction.

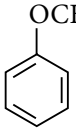


(a) 

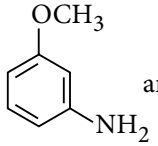
and elimination addition reaction

(b) 

and cine substitution reaction

(c) 

and cine substitution reaction

(d) 

and substitution reaction

30. The correct order of the stoichiometries of AgCl formed when $AgNO_3$ in excess is treated with the complexes : $CoCl_3.6NH_3$, $CoCl_3.5NH_3$, $CoCl_3.4NH_3$ respectively is
(a) 3AgCl, 1AgCl, 2AgCl
(b) 3AgCl, 2AgCl, 1AgCl
(c) 2AgCl, 3AgCl, 2AgCl
(d) 1AgCl, 3AgCl, 2AgCl

31. The correct statement regarding electrophile is
(a) electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from another electrophile
(b) electrophiles are generally neutral species and can form a bond by accepting a pair of electrons from a nucleophile
(c) electrophile can be either neutral or positively charged species and can form a bond by accepting a pair of electrons from a nucleophile
(d) electrophile is a negatively charged species and can form a bond by accepting a pair of electrons from a nucleophile.

32. A gas is allowed to expand in a well insulated container against a constant external pressure of 2.5 atm from an initial volume of 2.50 L to a final volume of 4.50 L. The change in internal energy ΔU of the gas in joules will be
(a) –500 J (b) –505 J
(c) +505 J (d) 1136.25 J

33. Which of the following reactions is appropriate for converting acetamide to methanamine?
(a) Hoffmann hypobromamide reaction
(b) Stephen's reaction
(c) Gabriel phthalimide synthesis
(d) Carbylamine reaction

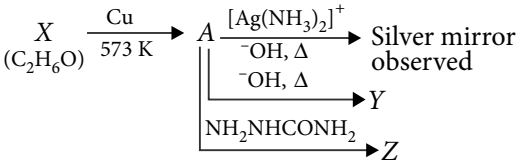
34. With respect to the conformers of ethane, which of the following statements is true?
(a) Bond angle changes but bond length remains same.
(b) Both bond angle and bond length change.
(c) Both bond angle and bond length remain same.
(d) Bond angle remains same but bond length changes.

35. In which pair of ions both the species contain S — S bond?
(a) $S_4O_6^{2-}$, $S_2O_3^{2-}$ (b) $S_2O_7^{2-}$, $S_2O_8^{2-}$
(c) $S_4O_6^{2-}$, $S_2O_7^{2-}$ (d) $S_2O_7^{2-}$, $S_2O_3^{2-}$

36. It is because of inability of ns^2 electrons of the valence shell to participate in bonding that
(a) Sn^{2+} is oxidising while Pb^{4+} is reducing
(b) Sn^{2+} and Pb^{2+} are both oxidising and reducing
(c) Sn^{4+} is reducing while Pb^{4+} is oxidising
(d) Sn^{2+} is reducing while Pb^{4+} is oxidising.

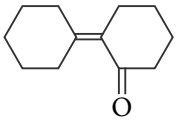
37. Correct increasing order for the wavelengths of absorption in the visible region for the complexes of Co^{3+} is
(a) $[Co(H_2O)_6]^{3+}$, $[Co(en)_3]^{3+}$, $[Co(NH_3)_6]^{3+}$
(b) $[Co(H_2O)_6]^{3+}$, $[Co(NH_3)_6]^{3+}$, $[Co(en)_3]^{3+}$
(c) $[Co(NH_3)_6]^{3+}$, $[Co(en)_3]^{3+}$, $[Co(H_2O)_6]^{3+}$
(d) $[Co(en)_3]^{3+}$, $[Co(NH_3)_6]^{3+}$, $[Co(H_2O)_6]^{3+}$

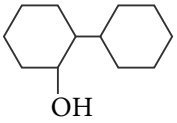
38. Consider the reactions,

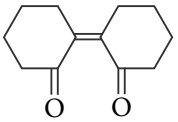


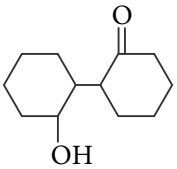
Identify *A*, *X*, *Y* and *Z*.
(a) *A*-Methoxymethane, *X*-Ethanol, *Y*-Ethanoic acid, Z-Semicarbazide.
(b) *A*-Ethanal, *X*-Ethanol, *Y*-But-2-enal, Z-Semicarbazone.
(c) *A*-Ethanol, *X*-Acetaldehyde, *Y*-Butanone, Z-Hydrazone.
(d) *A*-Methoxymethane, *X*-Ethanoic acid, *Y*-Acetate ion, *Z*-Hydrazine.

39. Of the following, which is the product formed when cyclohexanone undergoes aldol condensation followed by heating?

(a) 

(b) 

(c) 

(d) 

40. Which one of the following pairs of species have the same bond order?
(a) O_2, NO^+ (b) CN^-, CO
(c) N_2, O_2^- (d) CO, NO

41. Extraction of gold and silver involves leaching with CN^- ion. Silver is later recovered by
(a) distillation
(b) zone refining
(c) displacement with Zn
(d) liquation.

42. A 20 litre container at 400 K contains $CO_{2(g)}$ at pressure 0.4 atm and an excess of SrO (neglect the volume of solid SrO). The volume of the container is now decreased by moving the movable piston fitted in the container. The maximum volume of the container, when pressure of CO_2 attains its maximum value, will be
(Given that : $SrCO_{3(s)} \rightleftharpoons SrO_{(s)} + CO_{2(g)}$, $K_p = 1.6$ atm)
(a) 10 litre (b) 4 litre
(c) 2 litre (d) 5 litre

43. Pick out the correct statement with respect to $[Mn(CN)_6]^{3-}$.
(a) It is sp^3d^2 hybridised and tetrahedral.
(b) It is d^2sp^3 hybridised and octahedral.
(c) It is dsp^2 hybridised and square planar.
(d) It is sp^3d^2 hybridised and octahedral.

44. The reason for greater range of oxidation states in actinoids is attributed to
(a) actinoid contraction
(b) 5*f*, 6*d* and 7*s* levels having comparable energies
(c) 4*f* and 5*d* levels being close in energies
(d) the radioactive nature of actinoids.

45. Which of the following statements is not correct?
(a) Ovalbumin is a simple food reserve in egg-white.
(b) Blood proteins thrombin and fibrinogen are involved in blood clotting.
(c) Denaturation makes the proteins more active.
(d) Insulin maintains sugar level in the blood of a human body.

SOLUTIONS

1. (a) : SO_2 readily decolourises pink violet colour of acidified $KMnO_4$ solution.

$$\underset{\text{(Pink violet)}}{2KMnO_4} + 5SO_2 + 2H_2O \longrightarrow K_2SO_4 + \underset{\text{(Colourless)}}{2MnSO_4} + 2H_2SO_4$$

2. (c) : **Note :** Correct the reactions given in question as

$X_2 \rightleftharpoons X + X$ (fast)

$X + Y_2 \longrightarrow XY + Y$ (slow)

Slow step is the rate determining step.

$$\text{Rate} = k[X][Y_2] \quad ...(i)$$

Equilibrium constant for fast step, $K = \dfrac{[X]^2}{[X_2]}$

$$[X] = \sqrt{K[X_2]}$$

By substituting $[X]$ in equation (i), we get

$$\text{Rate} = k\sqrt{K[X_2]}\ [Y_2] = k'[X_2]^{1/2}\ [Y_2]$$

$$\therefore \quad \text{Order of reaction} = \frac{1}{2} + 1 = \frac{3}{2} = 1.5$$

3. (a) : The electronic configuration of the element with $Z = 114$ (flerovium) is $[Rn]5f^{14}6d^{10}7s^27p^2$. Hence, it belongs to carbon family which has the same outer electronic configuration.

4. (b) : In case of phenyl methyl ether, methyl phenyl oxonium ion $\left(C_6H_5\overset{+}{\underset{\underset{H}{|}}{O}}CH_3\right)$ is formed by protonation of ether. The O—CH_3 bond is weaker than O—C_6H_5 bond as O—C_6H_5 has partial double bond character. Therefore, the attack by I^- ion breaks O—CH_3 bond to form CH_3I.

Step I :

$$C_6H_5-\ddot{O}-CH_3 + HI \rightleftharpoons C_6H_5-\overset{H}{\overset{|}{\overset{+}{\ddot{O}}}} - CH_3 + I^-$$

Oxonium ion

Step II :

$$I^- + CH_3-\overset{H}{\overset{|}{\overset{+}{\ddot{O}}}} - C_6H_5 \longrightarrow CH_3I + C_6H_5OH$$

5. (a) : Alkanes, alkenes and alkynes follow the following trend in their acidic behaviour :

$$\underset{sp\ \ sp}{HC\equiv CH} > \underset{sp^2\ \ sp^2}{H_2C=CH_2} > \underset{sp^3\ \ sp^3}{CH_3-CH_3}$$

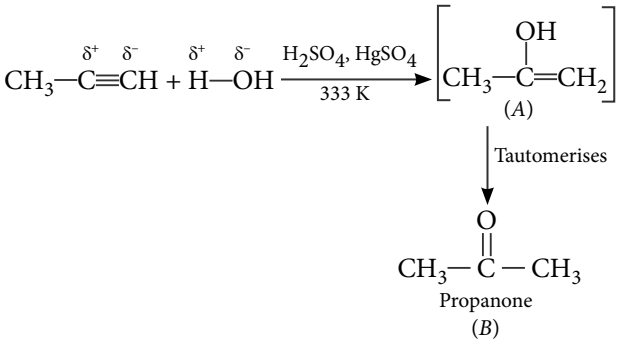
This is because *sp*-hybridised carbon is more electronegative than sp^2-hybridised carbon which is further more electronegative than sp^3-hybridised carbon. Hence, in ethyne proton can be released more easily than ethene and ethane.

Among alkynes the order of acidity is :

$HC\equiv CH > CH_3-C\equiv CH >> CH_3-C\equiv C-CH_3$

This is due to +*I* effect of $-CH_3$ group.

6. (c) : In case of unsymmetrical alkynes addition of H_2O occurs in accordance with Markownikoff's rule.



7. (a) : From the given equations,

$$2NH_3 \rightleftharpoons N_2 + 3H_2;\ \frac{1}{K_1} \quad ...(i)$$

$$N_2 + O_2 \rightleftharpoons 2NO;\ K_2 \quad ...(ii)$$

$$3H_2 + \frac{3}{2}O_2 \longrightarrow 3H_2O;\ K_3^3 \quad ...(iii)$$

By adding equations (i), (ii) and (iii), we get

$$2NH_3 + \frac{5}{2}O_2 \overset{K}{\rightleftharpoons} 2NO + 3H_2O,\ K = \frac{K_2K_3^3}{K_1}$$

8. (c) : Electron withdrawing groups increase the acidity while electron donating groups decrease the acidity of phenol.

9. (c)

10. (c) : The hydration enthalpy of alkali metal ions decreases with increase in ionic sizes *i.e.*,

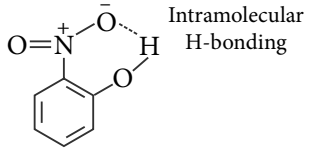
$Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

Hence, lithium having maximum degree of hydration will be least mobile.

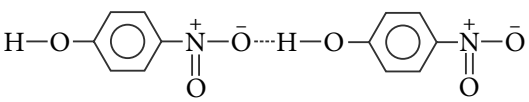
The order of ionic mobility is

$[Li_{(aq)}]^+ < [Na_{(aq)}]^+ < [K_{(aq)}]^+ < [Rb_{(aq)}]^+$

11. (c) : The *o*- and *p*-nitrophenols are separated by steam distillation since *o*-isomer is steam volatile due to intramolecular H-bonding while *p*-isomer is not steam volatile due to association of molecules by intermolecular H-bonding.



(*o*-Nitrophenol)



Intermolecular
H-bonding
(*p*-Nitrophenol)

12. (b) : $HgCl_2 + 4I^-_{(aq)} \longrightarrow HgI^{2-}_{4(aq)} + 2Cl^-_{(aq)}$

$I_{2(s)} + I^-_{(aq)} \longrightarrow I^-_{3(aq)}$

13. (a) : Dettol which is a well known antiseptic is a mixture of chloroxylenol and α-terpineol in a suitable solvent.

14. (a)

15. (a) : For a first order reaction,

$$k = \frac{2.303}{t}\log\frac{[A]_0}{[A]_t}$$

$$10^{-2} = \frac{2.303}{t}\log\frac{20}{5}$$

$$10^{-2} = \frac{2.303 \times 0.6020}{t}$$

$t = 138.6$ sec

16. (a)

17. (c) : Let solubility of $Ag_2C_2O_4$ be s mol L^{-1}

$$\underset{s}{Ag_2C_2O_{4(s)}} \rightleftharpoons \underset{2s}{2Ag^+_{(aq)}} + \underset{s}{C_2O^{2-}_{4(aq)}}$$

$K_{sp} = (2s)^2(s) \Rightarrow 4s^3$

$K_{sp} = 4 \times (1.1 \times 10^{-4})^3$

$(\because [Ag^+] = 2s = 2.2 \times 10^{-4})$

$K_{sp} \approx 5.3 \times 10^{-12}$

18. (b) : $E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log\frac{[Zn^{2+}]}{[Cu^{2+}]}$

$$E_1 = E^\circ - \frac{0.059}{2}\log\frac{0.01}{1}$$

$$E_1 = E^\circ - \frac{0.059}{2}(-2) = E^\circ + 0.059$$

$$E_2 = E^\circ - \frac{0.059}{2}\log\frac{1}{0.01} = E^\circ - 0.059$$

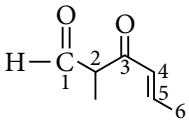
Hence, $E_1 > E_2$

19. (None)

Species	No. of electrons	Structure
TeI_2	158	Bent
XeF_2	72	Linear
IBr_2^-	124	Linear
XeF_2	72	Linear
IF_3	80	T-shaped
XeF_2	72	Linear
$BeCl_2$	38	Linear
XeF_2	72	Linear

Note : In this question, in place of isoelectronic there should be same number of valence electrons.

20. (d):



3-Keto-2-methylhex-4-enal

21. (c) : In case of hydrogen like atoms, energy depends on the principal quantum number only. Hence, 2*s*-orbital will have energy equal to 2*p*-orbital.

22. (c, d) : Frenkel defect is favoured in those ionic compounds in which there is large difference in the size of cations and anions.
Non-stoichiometric defects due to metal deficiency is shown by Fe_xO where $x = 0.93$ to 0.96.

23. (c) : BCl_3-Trigonal planar, sp^2-hybridised, 120° angle.

24. (a) : For a spontaneous reaction,
$\Delta G < 0$ *i.e.*, $\Delta H - T\Delta S < 0$

$$T > \frac{\Delta H}{\Delta S}$$

$$T > \left(\frac{35.5\times1000}{83.6} = 424.6 \approx 425\ \text{K}\right)$$

$\therefore \quad T > 425$ K

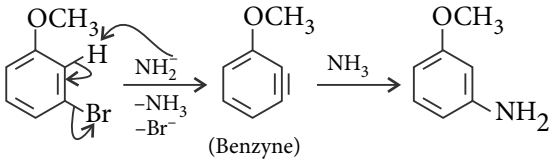
25. (a, d) : Microorganisms present in the soil consume atmospheric CO. Haemoglobin has higher affinity for CO and it combines with CO to form carboxyhaemoglobin.

26. (c) : The value of molal depression constant, K_f is constant for a particular solvent, thus, it will be unchanged when molality of the dilute solution is doubled.

27. (a)

28. (a) : Calatyst does not change the value of equilibrium constant as they affect forward as well as backward reactions equally.

29. (d): *m*-Bromoanisole gives only the respective *meta* substituted aniline. This is a substitution reaction which goes by an elimination-addition pathway.



(Benzyne)

30. (b): $[Co(NH_3)_6]Cl_3 + 3AgNO_3 \longrightarrow 3AgCl\downarrow + [Co(NH_3)_6](NO_3)_3$

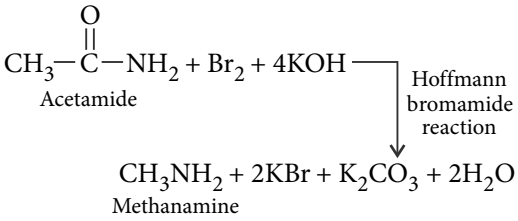
$[Co(NH_3)_5Cl]Cl_2 + 2AgNO_3 \longrightarrow 2AgCl\downarrow + [Co(NH_3)_5Cl](NO_3)_2$

$[Co(NH_3)_4Cl_2]Cl + AgNO_3 \longrightarrow AgCl\downarrow + [Co(NH_3)_4Cl_2]NO_3$

31. (c)

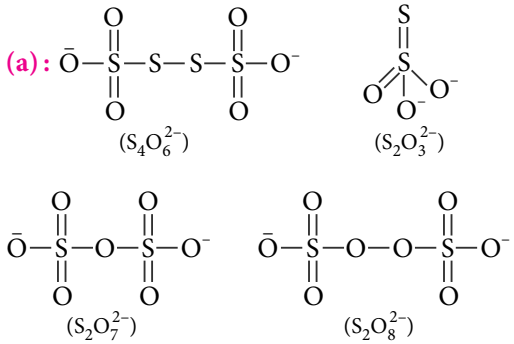
32. (b): $w = -P_{ext}\Delta V = -2.5(4.50 - 2.50)$
$= -5$ L atm $= -5 \times 101.325$ J $= -506.625$ J
$\Delta U = q + w$
As, the container is insulated, thus $q = 0$
Hence, $\Delta U = w = -506.625$ J

33. (a) :



34. (c) : Conformers of ethane have different dihedral angles.

35. (a) :



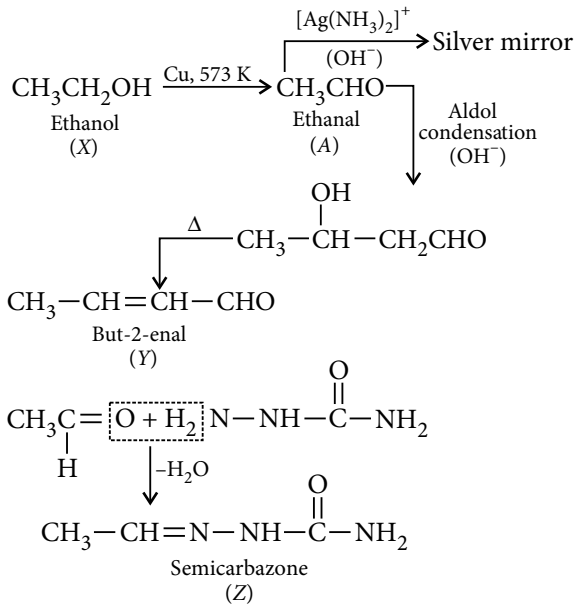
36. (d): The inertness of *s*-subshell electrons towards bond formation is known as inert pair effect. This effect increases down the group thus, for Sn, +4 oxidation state is more stable, whereas, for Pb, +2 oxidation state is more stable, *i.e.*, Sn^{2+} is reducing while Pb^{4+} is oxidising.

37. (d): Increasing order of crystal field splitting energy is : $H_2O < NH_3 < en$
Thus, increasing order of energy for the given complexes is :
$[Co(H_2O)_6]^{3+} < [Co(NH_3)_6]^{3+} < [Co(en)_3]^{3+}$

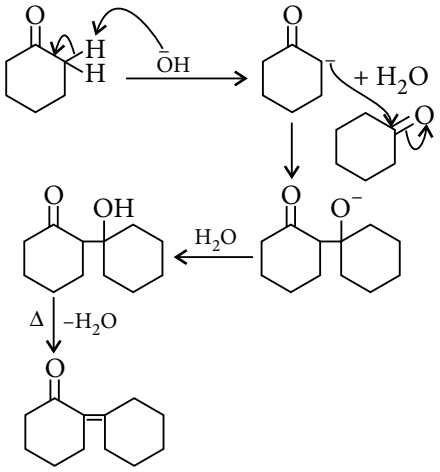
As, $E = \frac{hc}{\lambda}$

Thus, increasing order of wavelength of absorption is :
$[Co(en)_3]^{3+} < [Co(NH_3)_6]^{3+} < [Co(H_2O)_6]^{3+}$

38. (b): Since, *A* gives silver mirror test, it must be an aldehyde and aldehydes are formed by oxidation of 1° alcohols. Thus, '*X*' is a 1° alcohol, *i.e.*, CH_3CH_2OH.



39. (a):



40. (b): Molecular orbital electronic configurations and bond order values are :

$O_2 : \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^*2p_x^1 = \pi^*2p_y^1$

$\text{B.O.} = \frac{1}{2}(N_b - N_a) = \frac{1}{2}(10 - 6) = 2$

$NO^+ : \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2$

$\text{B.O.} = \frac{1}{2}(10 - 4) = 3$

$CN^- : \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

$\text{B.O.} = \frac{1}{2}(10 - 4) = 3$

$CO : \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

$\text{B.O.} = \frac{1}{2}(10 - 4) = 3$

$N_2 : \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

$\text{B.O.} = \frac{1}{2}(10 - 4) = 3$

$O_2^- = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^*2p_x^2 = \pi^*2p_y^1$

$\text{B.O.} = \frac{1}{2}(10 - 7) = 1.5$

$NO : \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^*2p_x^1$

$\text{B.O.} = \frac{1}{2}(10 - 5) = 2.5$

41. (c): Extraction of gold and silver involves leaching the metal with CN^- and the metals silver and gold are later recovered by displacement method.

$4M_{(s)} + 8CN^-_{(aq)} + 2H_2O_{(aq)} + O_{2(g)} \longrightarrow 4[M(CN)_2]^-_{(aq)} + 4OH^-_{(aq)}$

$2[M(CN)_2]^-_{(aq)} + Zn_{(s)} \longrightarrow 2M_{(s)} + [Zn(CN)_4]^{2-}_{(aq)}$

42. (d): $SrCO_{3(s)} \rightleftharpoons SrO_{(s)} + CO_{2(g)}$; $K_p = 1.6$ atm

$$K_p = \frac{p_{CO_2} \times p_{SrO}}{p_{SrCO_3}}$$

$\Rightarrow \quad 1.6 = p_{CO_2} \qquad (\because p_{SrO} = p_{SrCO_3} = 1)$

$\therefore$ Maximum pressure of $CO_2 = 1.6$ atm

Let the maximum volume of the container when pressure of CO_2 is 1.6 atm be V L.

During the process, PV = constant

$$\therefore \quad 0.4 \times 20 = 1.6 \times V \Rightarrow V = \frac{0.4 \times 20}{1.6} = 5 \text{ L}$$

43. (b): $[Mn(CN)_6]^{3-}$

Let oxidation state of Mn be x.

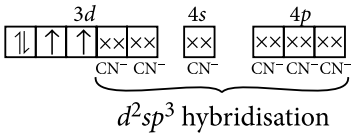
$x + 6 \times (-1) = -3$

$x = +3$

Electronic configuration of Mn : $[Ar]4s^2\,3d^5$

Electronic configuration of Mn^{3+} : $[Ar]3d^4$

CN^- is a strong field ligand thus, it causes pairing of electrons in $3d$-orbital.



Thus, $[Mn(CN)_6]^{3-}$ has d^2sp^3 hybridisation and has octahedral geometry.

44. (b): Actinoids have a greater range of oxidation states due to comparable energies of $5f$, $6d$ and $7s$ orbitals. Hence, all their electrons can take part in bond formation.

45. (c): Denaturation changes the structure of a protein and protein loses its activity.

SOLVED PAPER **2017**

Karnataka CET

1. The correct statement regarding defect in solids is
(a) Schottky defect has no effect on the physical properties of solids
(b) Frenkel defect is a dislocation defect
(c) Frenkel defect is usually favoured by a very small difference in the sizes of cations and anions
(d) trapping of proton in the lattice leads to the formation of *F*-centers.

2. Which of the following structures of a molecule is expected to have three bond pairs and one lone pair of electrons?
(a) Trigonal Planar (b) Tetrahedral
(c) Octahedral (d) Pyramidal

3. Which of the following statements is wrong regarding lanthanoids?
(a) Ln(III) compounds are predominantly ionic in character.
(b) Ln(III) hydroxides are mainly basic in nature.
(c) The ionic size of Ln(III) ions decreases with increasing atomic number.
(d) Ln(III) compounds are generally colourless.

4. By passing electric current, $NaClO_3$ is converted into $NaClO_4$ according to the following equation :
$NaClO_3 + H_2O \longrightarrow NaClO_4 + H_2$
How many moles of $NaClO_4$ will be formed when three faradays of charge is passed through $NaClO_3$?
(a) 0.75 (b) 3.0 (c) 1.5 (d) 1.0

5. Extraction of chlorine from brine solution is based on
(a) acidification (b) reduction
(c) oxidation (d) chlorination.

6. Pick the correct statement among the following :
(a) Sodium dodecylbenzene sulphonate used in tooth paste is a cationic detergent.
(b) Sodium lauryl sulphate forms an insoluble scum with hard water.
(c) Cetyltrimethyl ammonium bromide is a popular cationic detergent used in hair conditioner.
(d) Non-ionic detergents are formed when polyethylene glycol reacts with adipic acid.

7. Which of the following is not a favourable condition for physical adsorption?
(a) High pressure
(b) Low temperature
(c) High temperature
(d) Higher critical temperature of adsorbate

8. Toluene reacts with halogen in presence of iron (III) chloride giving *ortho*- and *para*- halo compounds. The reaction is
(a) free radical addition reaction
(b) electrophilic elimination reaction
(c) nucleophilic substitution reaction
(d) electrophilic substitution reaction.

9. Identify the correct statement in the following :
(a) Dimethyl ether and ethanol are chain isomers.
(b) Ethanoic acid and methyl methanoate are position isomers.
(c) *n*-butane and isobutane are functional isomers.
(d) Propan-1-ol and propan-2-ol are position isomers.

10. For a reaction $\frac{1}{2}A \longrightarrow 2B$, rate of disappearance of A is related to rate of appearance of B by the expression

(a) $\frac{-d[A]}{dt} = \frac{1}{4}\frac{d[B]}{dt}$ (b) $\frac{-d[A]}{dt} = 4\frac{d[B]}{dt}$

(c) $\frac{-d[A]}{dt} = \frac{1}{2}\frac{d[B]}{dt}$ (d) $\frac{-d[A]}{dt} = \frac{d[B]}{dt}$

11. The monomer used in novolac, a polymer used in paints
(a) butadiene and styrene
(b) butadiene and acrylonitrile
(c) phenol and formaldehyde
(d) melamine and formaldehyde.

12. In the manufacture of hydrogen from water gas ($CO + H_2$), which of the following is correct statement?
(a) CO is oxidized to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali.
(b) H_2 is removed by occlusion with Pd.
(c) Hydrogen is isolated by diffusion.
(d) CO and H_2 are separated based on difference in their densities.

13. Select wrong chemical reaction among the following:
(a) $MnO_2 + 4HCl \longrightarrow MnCl_2 + Cl_2 + 2H_2O$
(b) $8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$
(c) $2NaOH + Cl_2 \longrightarrow 2NaCl + H_2 + O_2$
(d) $2Ca(OH)_2 + 2Cl_2 \longrightarrow Ca(OCl)_2 + CaCl_2 + 2H_2O$

14. $3ClO^-_{(aq)} \longrightarrow ClO^- + 2Cl^-$ is an example of
(a) oxidation reaction
(b) reduction reaction
(c) disproportionation reaction
(d) decomposition reaction.

15. Which of the following is not a biodegradable polymer?
(a) Glyptal
(b) Polyhydroxybutyrate–co–β hydroxyvalerate
(c) PHBV (d) Nylon-2-Nylon-6

16. Plaster of Paris is represented as
(a) $CaSO_4 \cdot 2H_2O$ (b) $CaSO_4 \cdot H_2O$
(c) $CaSO_4 \cdot \frac{1}{2}H_2O$ (d) $CaSO_4$

17. The process which is responsible for the formation of delta at a place where rivers meet the sea is
(a) peptization (b) colloidal formation
(c) emulsification (d) coagulation.

18. If 3.01×10^{20} molecules are removed from 98 mg of H_2SO_4, then number of moles of H_2SO_4 left are
(a) 0.5×10^{-3} mol (b) 0.1×10^{-3} mol
(c) 9.95×10^{-2} mol (d) 1.66×10^{-3} mol

19. Which of the following aqueous solutions has highest freezing point?
(a) 0.1 molal $Al_2(SO_4)_3$
(b) 0.1 molal $BaCl_2$
(c) 0.1 molal $AlCl_3$ (d) 0.1 molal NH_4Cl

20. Gabriel phthalimide synthesis is used in the preparation of primary amines from phthalimide, which of the following reagent is not used during the process?
(a) NaOH (b) HCl
(c) KOH (d) Alkyl Halides

21. Lower members of aliphatic carboxylic acid are soluble in water. This is due to
(a) formation of hydrogen bonds with water
(b) London forces
(c) water is non-electrolyte
(d) van der-Waals' interaction with water molecules.

22. Which of the following orders is true regarding the acidic nature of phenol?
(a) Phenol > *o*-cresol > *o*-nitrophenol
(b) *o*-cresol < phenol < *o*-nitrophenol
(c) Phenol < *o*-cresol > *o*-nitrophenol
(d) Phenol < *o*-cresol < *o*-nitrophenol

23. Reduction of ketones cannot be carried out with which of the following reagents?
(a) Hydrogen in presence of palladium in barium sulphate and quinoline
(b) Sodium borohydride or lithium aluminium hydride
(c) Zinc amalgam and concentrated HCl
(d) Hydrazine and KOH in ethylene glycol.

24. Which one of the following metallic oxides exhibit amphoteric nature?
(a) BaO (b) Al_2O_3
(c) Na_2O (d) CaO

25. The co-ordination number and the oxidation state of the element '*M*' in the complex $[M(en)_2(C_2O_4)]NO_2$ (where, *en* is ethane-1,2-diamine) are respectively
(a) 6 and 2 (b) 4 and 2
(c) 6 and 3 (d) 4 and 3

26. Which of the following crystals has unit cell such that $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90°$?
(a) $K_2Cr_2O_7$ (b) $NaNO_3$
(c) KNO_3 (d) K_2SO_4

27. Square planar complex of the type M_{AXBL} (where *A*, *B*, *X* and *L* are unidentate ligands) shows following set of isomers
(a) two *cis* and one *trans*
(b) two *trans* and one *cis*

(c) two *cis* and two *trans*
(d) three *cis* and one *trans*.

28. Which of the following statements is in accordance with the Arrhenius equation?
(a) Rate of a reaction increases with increase in temperature.
(b) Rate of reaction does not change with increase in activation energy.
(c) Rate constant decreases exponentially with increase in temperature.
(d) Rate of a reaction increases with decrease in activation energy.

29. In a face centred cubic arrangement of *A* and *B* atoms in which '*A*' atoms are at the corners of the unit cell and '*B*' atoms are at the face centers. One of the '*A*' atoms is missing from one corner in unit cell. The simplest formula of compound is
(a) AB_3 (b) A_7B_{24} (c) A_7B_8 (d) A_7B_8

30. The standard reduction potential at 298 K for the following half cell reaction :
$Zn^{2+}_{(aq)} + 2e^- \longrightarrow Zn_{(s)}$; $E^\circ = -0.762$ V
$Cr^{3+}_{(aq)} + 3e^- \longrightarrow Cr_{(s)}$; $E^\circ = 0.740$ V
$2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$; $E^\circ = 0.0$ V
$F_{2(g)} + 2e^- \longrightarrow 2F^-_{(aq)}$; $E^\circ = 2.87$ V
Which of the following is the strongest reducing agent?
(a) $Cr_{(s)}$ (b) $Zn_{(s)}$ (c) $H_{2(g)}$ (d) $F_{2(g)}$

31. Which of the following cannot be used to oxidize primary alcohols to aldehydes?
(a) CrO_3 in anhydrous medium
(b) Pyridinium chlorochromate
(c) $KMnO_4$ in acidic medium
(d) Heating in presence of Cu at 573 K

32. In the following sequence of reactions,

$$CH_3Br \xrightarrow{KCN} A \xrightarrow{H_3O^+} B \xrightarrow{LiAlH_4} C$$

The end product *C* is
(a) methane (b) ethyl alcohol
(c) acetone (d) acetaldehyde.

33. When the pure solvent diffuses out of the solution through the semipermeable membrane then the process is called
(a) sorption (b) dialysis
(c) osmosis (d) reverse osmosis.

34. The metal extracted by leaching with cyanide is
(a) Cu (b) Al (c) Na (d) Ag

35. Addition of mineral acid to an aqueous solution of borax, the following compound is formed :
(a) boron hydride (b) pyroboric acid
(c) metaboric acid (d) orthoboric acid

36. According to crystal field theory, the $M-L$ bond in a complex is
(a) purely ionic (b) purely coordinate
(c) purely covalent (d) partially covalent.

37. Which of the following statements is incorrect?
(a) Molecularity is only applicable for elementary reaction.
(b) The rate law for any reaction cannot be determined experimentally.
(c) Biomolecular reactions involve simultaneous collision between two species.
(d) Complex reactions have fractional order.

38. The glycosidic linkage present in sucrose is between
(a) C – 1 of α-glucose and C – 2 of β-fructose
(b) C – 1 of β-galactose and C – 4 of α-glucose
(c) C – 1 of α-glucose and C – 4 of α-glucose
(d) C – 1 of α-glucose and C – 4 of β-fructose.

39. Pick the wrong statement from the following :
(a) Consumption of citrus fruits and green leafy vegetables in food prevents scurvy.
(b) Deficiency of vitamin B_6 (pyridoxine) results in convulsions.
(c) Sources of vitamin B_1 are yeast, milk, green vegetables and cereals.
(d) Deficiency of vitamin D causes xerophthalmia.

40. Which of the following elements forms $p\pi - p\pi$ bond with itself?
(a) N (b) Te (c) P (d) Se

41. Which one of the following noble gases has an unusual property of diffusing through the materials such as rubber, glass or plastic?
(a) He (b) Ne (c) Kr (d) Ar

42. The van't Hoff factor '*i*' accounts for
(a) extent of dissolution of solute
(b) extent of dissociation of solute
(c) extent of mobility of solute
(d) extent of solubility of solute.

43. The pressure of real gases is less than that of ideal gas because of
(a) increase in the kinetic energy of the molecules
(b) intermolecular attraction
(c) finite size of particles
(d) increase in the number of collisions.

44. The reaction quotient, 'Q_c' is useful in predicting the direction of the reaction. Which of the following is incorrect?
(a) If $Q_c > K_c$, the reverse reaction is favoured.
(b) If $Q_c < K_c$, the forward reaction is favoured.
(c) If $Q_c > K_c$, forward reaction is favoured.
(d) If $Q_c = K_c$, no reaction occur.

45. In the electrolysis of aqueous sodium chloride solution, which of the half cell reaction will occur at anode?

(a) $Cl^-_{(aq)} \longrightarrow \frac{1}{2}Cl_2 + e^-$; $E^\circ_{cell} = 1.36$ volts

(b) $2H_2O_{(l)} \longrightarrow O_2 + 4H^+ + 4e^-$; $E^\circ_{cell} = 1.23$ volts

(c) $Na^+_{(aq)} + e^- \longrightarrow Na_{(s)}$; $E^\circ = -2.71$ volts

(d) $H^+_{(aq)} + e^- \longrightarrow \frac{1}{2}H_2$; $E^\circ_{cell} = 0.00$ volts

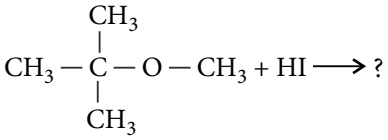
46. The electronegativities of C, N, Si and P are in the order of
(a) Si < P < C < N (b) Si < P < N < C
(c) P < Si < N < C (d) P < Si < C < N

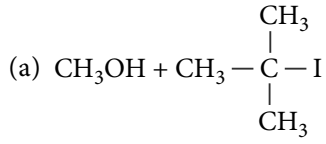
47. The correct set of quantum numbers for the unpaired electron of chlorine atom is

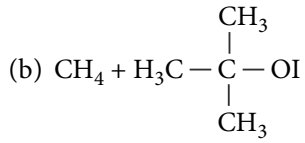
(a) $2, 0, 0, +\frac{1}{2}$ (b) $3, 0, 0, \pm\frac{1}{2}$

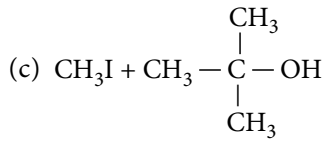
(c) $2, 1, -1, +\frac{1}{2}$ (d) $3, 1, 1, \pm\frac{1}{2}$

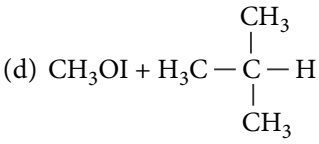
48. The products formed during the following reaction are



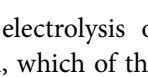
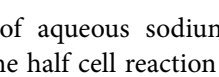
(a) 

(b) 

(c) 

(d) 

49. Which of the following is the correct electron dot structure of N_2O molecule?

(a)  (b) 

(c) (d)

50. Hydrogenation of vegetable oils in presence of finely divided nickel as catalyst, the reaction is
(a) enzyme catalysed reaction
(b) liquid catalysed reaction
(c) heterogeneous catalysis
(d) homogeneous catalysis.

51. The equilibrium constant for the reaction $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$ is 4×10^{-4} at 2000 K. In presence of a catalyst, the equilibrium is attained ten times faster. Therefore, the equilibrium constant in presence of catalyst at 2000 K is
(a) 4×10^{-3} (b) 40×10^{-4}
(c) 4×10^{-4} (d) 4×10^{-2}

52. A reaction has both ΔH and ΔS –ve. The rate of reaction
(a) cannot be predicted for change in temperature
(b) increases with increase in temperature
(c) increases with decreases in temperature
(d) remains unaffected by change in temperature.

53. Which one of the following is not a common component of photochemical smog?
(a) Ozone (b) Acrolein
(c) Peroxyacetylnitrate
(d) Chloroflourocarbons

54. In which of the following, homolytic bond fission takes place?
(a) Free radical chlorination of methane
(b) Alkaline hydrolysis of ethyl chloride
(c) Addition of HBr to double bond
(d) Nitration of Benzene

55. Hormones are secreted by ductless glands of human body. Iodine containing hormone is
(a) insulin (b) adrenaline
(c) testosterone (d) thyroxine.

56. Cannizzaro's reaction is an example of auto oxidation
(a) It is a typical reaction of aliphatic aldehyde.
(b) It is a reaction answered by only aldehydes containing α-hydrogen.

(c) It is a reaction answered only by aromatic aldehydes.
(d) It is a reaction answered by all aldehydes.

57. For the preparation of alkanes, aqueous solution of sodium or potassium salt of carboxylic acid is subjected to
(a) hydrogenation (b) oxidation
(c) electrolysis (d) hydrolysis.

58. The correct order of increasing basic nature for the bases NH_3, CH_3NH_2 and $(CH_3)_2NH$ in aqueous solutions
(a) $CH_3NH_2 < NH_3 < (CH_3)_2NH$
(b) $CH_3NH_2 < (CH_3)_2NH < NH_3$
(c) $(CH_3)_2NH < NH_3 < CH_3NH_2$
(d) $NH_3 < CH_3NH_2 < (CH_3)_2NH$

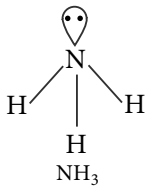
59. Bactericidal antibiotic among the following is
(a) ofloxacin (b) erythromycin
(c) chloramphenicol (d) tetracycline.

60. The magnetic nature of elements depends on the presence of unpaired electrons. Identify the configuration of transition elements which shows highest magnetic moment?
(a) $3d^2$ (b) $3d^8$
(c) $3d^7$ (d) $3d^5$

SOLUTIONS

1. (b): (a) Schottky defect has effect on the physical properties of solids *i.e.*, it decreases the density of crystal. (c) Frenkel defect is usually favoured by a large difference in the sizes of cations and anions. (d) Trapping of electron in the lattice site leads to the formation of *F*-centers.

2. (d): A molecule with three bond pairs and one lone pair of electrons like NH_3 is sp^3 hybridised with tetrahedral geometry and trigonal pyramidal structure.



NH_3
(Tetrahedral structure)

3. (d): Many of the trivalent ions of lanthanoids are coloured, both in the solid state as well as in solution. The colour of lanthanoid ions arises due to absorption of light from visible region of spectrum resulting in *f-f* transitions as lanthanoids have partly filled *f*-orbitals.

4. (c): $\overset{+5}{NaClO_3} + H_2O \longrightarrow \overset{+7}{NaClO_4} + H_2$
Or
$NaClO_3 - 2e^- \longrightarrow NaClO_4$
This is clear that 2 moles of electrons or 2 faradays charge produce 1 mole of $NaClO_4$.
Thus, 3 faradays charge will produce
$= \frac{1}{2} \times 3$ moles of $NaClO_4$ = 1.5 moles of $NaClO_4$

5. (c): Chlorine can be manufactured by electrolysis of a sodium chloride solution (brine). Electrolysis of brine solution involves the following reactions :
At cathode:
$2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$ (Reduction)
At anode:
$2Cl^-_{(aq)} \longrightarrow Cl_{2(g)} + 2e^-$ (Oxidation)
Overall reaction:
$2NaCl_{(aq)} + 2H_2O_{(l)} \longrightarrow Cl_{2(g)} + H_{2(g)} + 2NaOH$

6. (c): Sodium dodecylbenzene sulphonate is an anionic detergent. Cationic detergents (cetyltrimethylammonium bromide) possess excellent germicidal properties and are used in hair conditoners.
Non-ionic detergents are obtained by the reactions between polyethylene glycol and stearic acid.

7. (c): Usually the physical adsorption process is exothermic in nature, so extent of adsorption decreases with increase in temperature.

8. (d)

9. (d): Functional isomers : $CH_3—O—CH_3$, Dimethyl ether (ether); CH_3CH_2OH, Ethanol (alcohol)

Functional isomers : CH_3COOH, Ethanoic acid (Carboxylic acid); $H—\overset{\overset{O}{\|}}{C}—OCH_3$, Methyl methanoate (ester)

Chain isomers : $CH_3—CH_2—CH_2—CH_3$, *n*-Butane; $CH_3—\underset{\underset{CH_3}{|}}{CH}—CH_3$, Isobutane

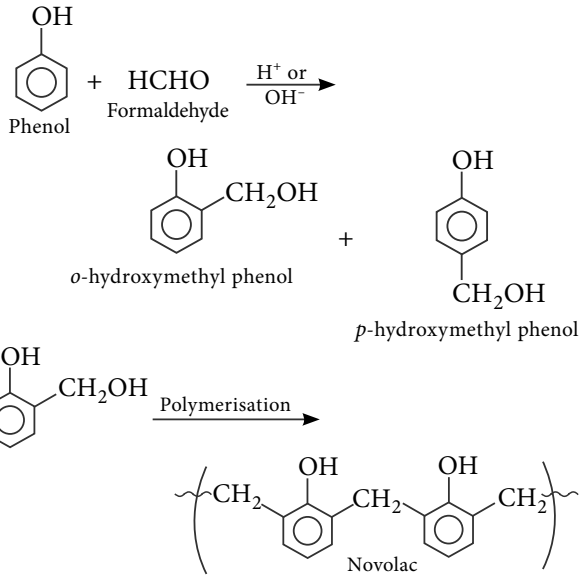
Position isomers : $CH_3—CH_2—CH_2—OH$, Propan-1-ol; $CH_3—\underset{\underset{OH}{|}}{CH}—CH_3$, Propan-2-ol

10. (a): $\frac{1}{2}A \longrightarrow 2B$

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

or $-\frac{2d[A]}{dt} = \frac{1}{2}\frac{d[B]}{dt} \Rightarrow \frac{-d[A]}{dt} = \frac{1}{4}\frac{d[B]}{dt}$

11. (c) : Monomers of novolac are phenol and formaldehyde.



12. (a)

13. (c) : NaCl and NaClO are formed when Cl_2 reacts with cold dilute NaOH.

$$Cl_2 + 2NaOH \xrightarrow{cold} NaCl + NaClO + H_2O$$

With hot concentrated NaOH, NaClO formed is rapidly decomposed to give NaCl and $NaClO_3$.

$$3Cl_2 + 6NaOH \xrightarrow{hot} 5NaCl + NaClO_3 + 3H_2O$$

14. (b): $\overset{+1}{3ClO^-} \longrightarrow \overset{+1}{ClO^-} + 2\overset{-1}{Cl^-}$ (Reduction)

15. (a) : Glyptal is non-biodegradable polymer while polyhydroxybutyrate-co-β-hydroxyvalerate (PHBV) and nylon-2-nylon-6 are biodegradable polymers.

16. (c) : $CaSO_4 . \frac{1}{2}H_2O$ is plaster of Paris (POP).

17. (d)

18. (a) : No. of moles of H_2SO_4 in 98 mg $= \frac{98\times10^{-3}}{98}$
$= 1 \times 10^{-3}$

No. of moles of 3.01×10^{20} molecules of H_2SO_4
$= \frac{3.01\times10^{20}}{6.02\times10^{23}} = \frac{1}{2}\times10^{-3}$

Moles of H_2SO_4 left $= (1 \times 10^{-3} - 0.5 \times 10^{-3})$
$= 0.5 \times 10^{-3}$

19. (d): $\Delta T_f = iK_f m$

As m = 0.1 molal for all given solutions, thus, lower the value of i, lower will be the depression in freezing point (ΔT_f) and higher will be the freezing point of the solution.

For $Al_2(SO_4)_3$; $i = 5$
For $BaCl_2$; $i = 3$
For $AlCl_3$; $i = 4$
For NH_4Cl ; $i = 2$

Thus, 0.1 molal NH_4Cl will have highest freezing point.

20. (None) : All these are used in Gabriel phthalimide reaction.

21. (a)

22. (b): *o*-cresol is less acidic than phenol due to stronger +*I* effect of methyl group while *o*-nitrophenol is more acidic than phenol due to –*I* effect of $-NO_2$ group. So, the correct order of acidic nature will be:

o-Cresol < Phenol < *o*-Nitrophenol

23. (a) : Reduction of ketones can be carried out with hydrogen in presence of Ni, Pt or Pd.

24. (b)

25. (c) : Let the oxidation state of metal '*M*' be *x*.

For complex, $[M(en)_2(C_2O_4)]NO_2$

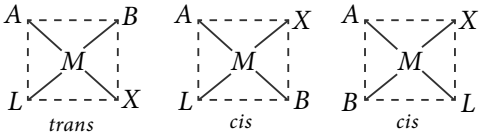
$x + 0 - 2 = +1$

$x = +3$

Also, ethylenediamine and $C_2O_4^{2-}$ both are bidentate ligands. Thus, coordination number will be '6'.

26. (a) : Among the following options, only $K_2Cr_2O_7$ exhibits triclinic crystal system in which $\alpha \neq \beta \neq \gamma \neq 90°$ and $a \neq b \neq c$.

27. (a) : Square planar complex of type M_{AXBL} will show two-*cis* and one-*trans* isomers.



These above three isomers are formed by fixing the position of one ligand, *A*.

28. (a, d) : According to Arrhenius equation,

$k = Ae^{-E_a/RT}$

On increasing temperature and decreasing activation energy (E_a), rate of reaction increases.

29. (b): Number of *A* atoms at the corners $= 7\times\frac{1}{8} = \frac{7}{8}$

No. of B atoms at face-centres $= 6 \times \frac{1}{2} = 3$

Ratio of $A : B = \frac{7}{8} : 3 = 7 : 24$

$\therefore$ Formula of compound is A_7B_{24}.

30. (b): Lower the reduction potential, more easily it is oxidised and stronger is the reducing agent. As zinc has high negative value of reduction potential hence, it is the strongest reducing agent.

31. (c): Primary alcohols can be oxidised to aldehydes with $KMnO_4$ in aqueous or alkaline medium. Acidified $KMnO_4$ oxidises alcohols to carboxylic acids directly.

32. (b): $CH_3Br \xrightarrow{KCN} \underset{\text{'A'}}{CH_3CN} \xrightarrow{H_3O^+} \underset{\text{'B'}}{CH_3COOH}$

$\underset{\text{'C'}}{CH_3CH_2OH} \xleftarrow{LiAlH_4}$

(Ethyl alcohol)

33. (d) **34. (d)**

35. (d): Orthoboric acid is formed when an aqueous solution of borax is treated with hydrochloric or sulphuric acid.

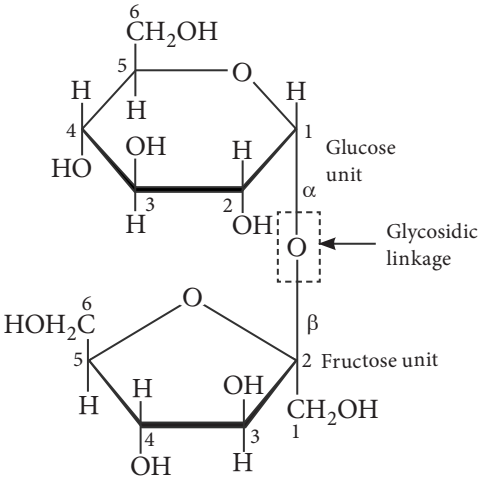
$Na_2B_4O_7 + 2HCl + 5H_2O \longrightarrow 4H_3BO_3 + 2NaCl$

$Na_2B_4O_7 + H_2SO_4 + 5H_2O \longrightarrow 4H_3BO_3 + Na_2SO_4$

36. (a): According to crystal field theory, the bonding in a complex is purely electrostatic or ionic.

37. (b): The rate law for any reaction cannot be determined theoretically but it is determined experimentally.

38. (a): The glycosidic linkage present in sucrose is between C-1 of α-glucose and C-2 of β-fructose.



39. (d): Deficiency of vitamin A causes xerophthalmia and deficiency of vitamin D causes rickets.

40. (a): Nitrogen can form $p\pi - p\pi$ bond with itself due to its small size and high electronegativity and exists as a diatomic molecule ($N \equiv N$, one σ and two π-bonds). While other given elements do not form $p\pi - p\pi$ bonds due to their large atomic size they do not exhibit effective overlapping of orbitals.

41. (a)

42. (b): van't Hoff factor (i) expresses the extent of association or dissociation of solute in the solution.

43. (b): The gas molecules have attractive forces between them due to which the observed pressure is less than the ideal pressure.

44. (c): (a) If $Q_C > K_C$, the reaction will proceed from right to left *i.e.*, reverse reaction is favoured.

(b) If $Q_C < K_C$, the reaction will proceed from left to right *i.e.*, forward reaction is favoured.

(d) If $Q_C = K_C$, the reaction is already at equilibrium and no reaction occurs.

45. (a): During electrolysis of aqueous NaCl following oxidation reactions are possible :

$Cl^-_{(aq)} \longrightarrow \frac{1}{2}Cl_{2(g)} + e^-$; $E^\circ_{cell} = 1.36$ V ...(i)

$2H_2O_{(l)} \longrightarrow O_{2(g)} + 4H^+_{(aq)} + 4e^-$;

$E^\circ_{cell} = 1.23$ V ...(i)

The reaction at anode with lower value of $E°$ is preferred and therefore, water should get oxidised in preference to $Cl^-_{(aq)}$. However, on account of overpotential of oxygen, reaction (i) is preferred.

Thus,

Cathode : $H_2O_{(l)} + e^- \longrightarrow \frac{1}{2}H_{2(g)} + OH^-_{(aq)}$

Anode : $Cl^-_{(aq)} \longrightarrow \frac{1}{2}Cl_{2(g)} + e^-$

46. (a): Electronegativity generally increases on moving across a period from left to right and decreases from top to bottom in a group as atomic size increases.

So, the order of electronegativity is :

Si < P < C < N

47. (d): Electronic configuration of Cl ($Z = 17$) atom :

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

So, the unpaired electron of Cl atom is in $3p$-orbital.

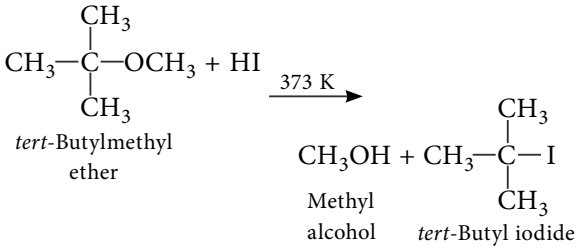
Hence, quantum numbers for unpaired electron ;

$n = 3, l = 1$ (for p-orbital),

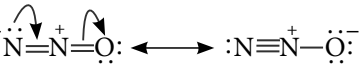
$m = +1, 0, -1$ and $s = \pm 1/2$

Thus, only possible set is 3, 1, 1, ± 1/2.

48. (a) : When one of the alkyl groups is tertiary, the alkyl halide is formed from the tertiary alkyl group.



This is due to the reason that the reaction occurs by S_N1 mechanism and the formation of products is controlled by the stability of the carbocation resulting from the cleavage of C—O bond in protonated ether (oxonium ion). Since a *tert*-butyl carbocation is more stable than methyl carbocation, therefore, cleavage of C—O bond gives methyl alcohol and the more stable *tert*-butyl carbocation. This carbocation then reacts with I^- ion to form *tert*-butyl iodide.

49. (d): 

50. (c) : Hydrogenation of vegetable oils in presence of finely divided nickel as catalyst is an example of heterogeneous catalytic reaction because one of the reactants is in liquid state and the other is in gaseous state, while the catalyst is in solid state.

$$\text{Vegetable oil}_{(l)} + H_{2(g)} \xrightarrow{Ni_{(s)}} \text{Vegetable ghee}_{(s)}$$

51. (c) : Equilibrium constant is independent of the presence of catalyst. This is so because the catalyst affects the rates of forward and backward reactions equally.

52. (c) **53. (d)**

54. (a) : Free radical formation takes place due to homolytic cleavage.

55. (d)

56. (none): Aldehydes, which do not contain an α-hydrogen atom undergoes Cannizaro reaction.

57. (c) : Electrolysis of aqueous solutions of sodium or potassium salts of fatty acids gives alkane having twice the number of carbon atoms present in the alkyl group of the acid. This process is known as Kolbe's electrolytic reaction.

$$2RCOONa \longrightarrow 2RCOO^- + 2Na^+$$

At anode :

$$2RCOO^- - 2e^- \longrightarrow 2RCOO$$

$$\underset{\text{Unstable}}{2RCOO} \longrightarrow \underset{\text{Alkane}}{R—R} + 2CO_2$$

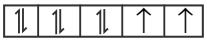
58. (d): Due to $+I$ effect of methyl group, 2° amines are more basic than 1° amine.

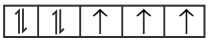
Hence, order of basicity of methyl amines in aqeuous solution is :

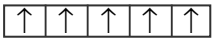
$NH_3 < CH_3NH_2 < (CH_3)_2NH_2$

59. (a) : Ofloxacin is bactercidal antibiotic while erythromycin, chloramphenicol and tetracycline are bacteriostatic antibiotics.

60. (d): $3d^2$  ; unpaired electrons = 2

$3d^8 \Rightarrow$  ; unpaired electrons = 2

$3d^7 \Rightarrow$  ; unpaired electrons = 3

$3d^5 \Rightarrow$  ; unpaired electrons = 5

Magnetic moment = $\sqrt{n(n+2)}$

where, n = number of unpaired electrons

Thus, higher the number of unpaired electrons, higher will be the magnetic moment.

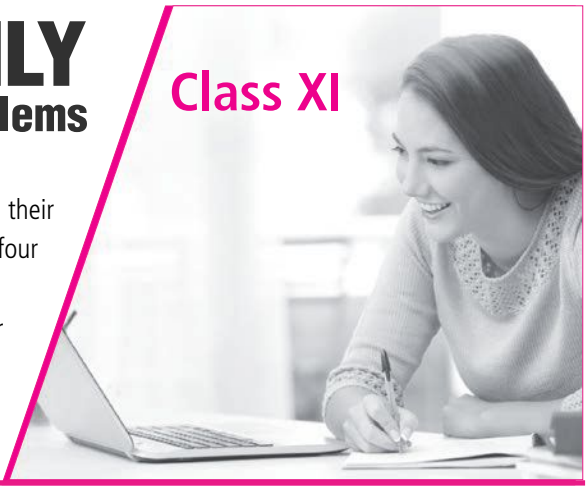
So, $3d^5$ configuration will have highest magnetic moment.

SOLUTIONS OF MAY 2017 CROSSWORD

1,2 I	N	D	I	C	3 A	N						4,5 C	O	L	L	O	I	D	
C					T						6 Q	U	A	R	K	S			
7 O	P	8 A	L		R					9 C	A	L	C	I	T	E			
S		R		10 S	O	M	M	E	R	F	E	L	D					11 D	
A		G			P						12 B	E	C	Q	U	E	R	E	L
H		O		13 B	I	U	R	E	T			T	14 A					C	
E		L			S								N					A	
D				15 C	O	P	E	R	E	A	C	T	I	O	16 N			L	
R		17 F	E	R	M	I	U	M					L		U	18 E		I	
O				19 L	E	X	A	N					I		G	P		N	
N		20 C			R		21,22 E	M	E	R	Y		N		G	O			
		23 A	N	I	S	Y	L						E		E	X			
		R				24 L	I	P	A	S	E		B		T	I			
		A			25 G		N						L		S	D		26 P	
		M			L		V		27 S	E	E	S	A	W		A		H	
		E			U		A		28 B	O	R	I	C	L	O	T	I	O	N
29 M	E	L	M	A	C		R						K			I		S	
					A											O		S	
30 M	E	T	H	A	N	A	T	I	O	N						N		Y	
																		J	
																		A	
																		W	

MPP-2 MONTHLY Practice Problems

Class XI



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer.
Self check table given at the end will help you to check your readiness.

Structure of Atom | Classification of Elements and Periodicity in Properties

Total Marks : 120 **Time Taken : 60 Min.**

NEET / AIIMS

Only One Option Correct Type

1. Photoelectric emission is observed from a surface for frequencies ν_1 and ν_2 of the incident radiation ($\nu_1 > \nu_2$). If the maximum kinetic energies of the photoelectrons in the two cases are in the ratio 1 : k, then the threshold frequency ν_0 is given by

(a) $\frac{\nu_2 - \nu_1}{k-1}$ (b) $\frac{k\nu_1 - \nu_2}{k-1}$

(c) $\frac{k\nu_2 - \nu_1}{k-1}$ (d) $\frac{\nu_2 - \nu_1}{k}$

2. IE_1 and IE_2 of Mg are 178 and 348 kcal mol^{-1} respectively. The energy required for the reaction, $Mg_{(g)} \rightarrow Mg^{2+}_{(g)} + 2e^-$ is

(a) + 170 kcal mol^{-1} (b) + 526 kcal mol^{-1}
(c) – 170 kcal mol^{-1} (d) – 525 kcal mol^{-1}

3. Two nuclides X and Y are isotonic to each other with mass numbers 70 and 72 respectively. If the atomic number of X is 34, then that of Y would be

(a) 32 (b) 34
(c) 36 (d) 38

4. The atomic masses of He and Ne are 4 and 20 amu respectively. The value of the de Broglie wavelength of He gas at – 73°C is 'M' times that of the de Broglie wavelength of Ne gas at 727°C. 'M' is

(a) 2 (b) 3
(c) 4 (d) 5

5. What is the general electronic configuration for 2nd row transition series?

(a) [Ne]$3d^{1-10}$, $4s^2$ (b) [Ar]$3d^{1-10}$, $4s^{1-2}$
(c) [Kr]$4d^{1-10}$, $5s^{1-2}$ (d) [Xe]$5d^{1-10}$, $5s^{1-2}$

6. In a given shell, the order of screening effect is

(a) $s > p > d > f$ (b) $f > d > p > s$
(c) $p < d < s < f$ (d) $d > f < s > p$

7. The potential energy of an electron in the first Bohr orbit in the He^+ ion is

(a) – 13.6 eV (b) – 27.2 eV
(c) – 54.4 eV (d) – 108.8 eV

8. The first (Δ_iH_1) and second (Δ_iH_2) ionisation enthalpies (in kJ mol^{-1}) and the electron gain enthalpy ($\Delta_{eg}H$) (in kJ mol^{-1}) of the elements I, II, III, IV and V are given below :

Elements	Δ_iH_1	Δ_iH_2	$\Delta_{eg}H$
I	520	7300	– 60
II	419	3051	– 48
III	1681	3374	– 328
IV	1008	1846	–295
V	2372	5251	+ 48

The most reactive and the least reactive element amongst these are respectively

(a) I and V (b) V and II
(c) II and V (d) IV and V

9. If azimuthal quantum number could have value of n also (in addition to normal value), then electronic configuration of V(Z = 23) would have been

(a) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^3$
(b) $1s^2, 1p^6, 2s^2, 2p^6, 2d^7$
(c) $1s^2, 1p^6, 2s^2, 2p^6, 3s^2, 2d^5$
(d) $1s^2, 1p^6, 2s^2, 2p^6, 3s^1, 2d^6$

10. Which one of the following exhibits the maximum covalent character?
(a) $FeCl_2$ (b) $AlCl_3$
(c) $MgCl_2$ (d) $SnCl_2$

11. In which of the following pairs the difference between the covalent radii of the two metals is maximum?
(a) K, Ca (b) Mn, Fe
(c) Co, Ni (d) Cr, Mn

12. The wavelength of a spectral line in Lyman series, when electron jumping back to 2nd orbit is
(a) 1162 Å (b) 1216 Å
(c) 1362 Å (d) 1176 Å

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

13. **Assertion :** Helium has the highest value of ionisation energy among all the elements known.
Reason : Helium has the highest value of electron affinity among all the elements known.

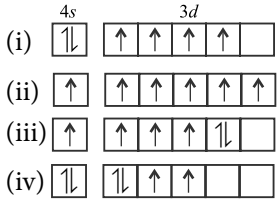
14. **Assertion :** Energies of two electrons in an atom can be compared by using '$n + l$' rule.
Reason : No two electrons in an atom can have equal energies.

15. **Assertion :** F atom has a less negative electron affinity than Cl atom.
Reason : Additional electrons are repelled more effectively by $3p$ electrons in Cl atom than by $2p$ electrons in F atom.

JEE MAIN / JEE ADVANCED

Only One Option Correct Type

16. Out of the following electronic arrangements, for outer electronic configurations



the most stable arrangement is
(a) (i) (b) (ii)
(c) (iii) (d) (iv)

17. The first ionisation energy for Li is 5.4 eV and electron affinity of Cl is 3.61 eV. The ΔH (in kJ/mol) for the reaction,
$Li_{(g)} + Cl_{(g)} \longrightarrow Li^+_{(g)} + Cl^-_{(g)}$,
if the resulting ions do not combine with each other is
(a) 70 (b) 100
(c) 170 (d) 270

18. The first orbital of H is represented by :
$\psi = \frac{1}{\sqrt{x}}\left(\frac{Z}{a_0}\right)^{3/2} e^{-Zr/a_0}$, where a_0 is Bohr's radius.
The probability of finding the electron at a distance r, from the nucleus in the region dV is
(a) $\psi^2\, dr$ (b) $\int \psi^2 4\pi r^2 dV$
(c) $\psi^2\, 4\pi r^2\, dr$ (d) $\int \psi dV$

19. Predict the approximate density of Cs from the following data using law of triads.
(Given : Density of K = 0.868 g cm^{-3}; Rb = 1.532 g cm^{-3})
(a) 2.196 g cm^{-3}
(b) 4.392 g cm^{-3}
(c) 1.098 g cm^{-3}
(d) None of these

More than One Options Correct Type

20. Which of the following reactions have an endothermic step?
(a) $S^-_{(g)} \longrightarrow S^{2-}_{(g)}$
(b) $Na^+_{(g)} + Cl^-_{(g)} \longrightarrow NaCl_{(s)}$
(c) $N_{(g)} \longrightarrow N^-_{(g)}$
(d) $Al^{2+}_{(g)} \longrightarrow Al^{3+}_{(g)}$

Winners of May 2017 Crossword

- Aneet Thakur, Punjab
- Karan Saluja, New Delhi

Solution Senders of Chemistry Musing

Set - 46

- Prashant Pandey, Maharashtra
- T. Naidu, Kerala

21. Electron in He^+ ion falls from seventh level and subsequent lower levels to first level, then
(a) total of six emission lines are obtained
(b) the spectrum belongs to Lyman series
(c) total of five emission lines are obtained
(d) the spectrum belongs to Balmer series.

22. Which of the following statements are correct?
(a) van der Waals' radius of iodine is more than its covalent radius.
(b) All isoelectronic ions belong to the same period of the periodic table.
(c) IE_1 of N is higher than that of O while IE_2 of O is higher than that of N.
(d) The electron gain enthalpy of N is positive while that of P is negative.

23. Which of the following sets of quantum numbers are possible?

	n	l	m	s
(a)	4	2	−2	$+\frac{1}{2}$
(b)	3	0	0	$-\frac{1}{2}$
(c)	3	2	−3	$-\frac{1}{2}$
(d)	5	3	0	$+\frac{1}{2}$

Integer Answer Type

24. The atomic number of an element E is 26. xy electrons are present in the M shell of the element in its E^{3+} state. The value of $x + y$ is

25. The period number of an inert gas atom in which the total number of d-electrons is equal to the difference of the number of total p- and s-electrons is

26. A microscope using suitable photons is employed to locate an electron in an atom within a distance of 0.1 Å. The uncertainty involved in the measurement of velocity is 5.79×10^x m s^{-1}. The value of x is

Comprehension Type

The hydrogen-like species Li^{2+} is in a spherically symmetric state, S_1 with one radial node. Upon absorbing light, the ion undergoes transition to a state S_2. The state, S_2 has one radial node and its energy is equal to the ground state energy of the hydrogen atom.

27. The state S_1 is
(a) 1s (b) 2s (c) 2p (d) 3s

28. The orbital angular momentum quantum number of the state S_2 is
(a) 0 (b) 1 (c) 2 (d) 3

Matrix Match Type

29. Match the Column I with Column II and mark the appropriate option.

Column I	Column II
(A) O	(P) Diatomic
(B) N	(Q) Tetrahedral
(C) P	(R) Puckered ring
(D) S	(S) Solid at room temperature

	A	B	C	D
(a)	P	Q	Q, S	R
(b)	R	P	R, S	Q
(c)	P	P	Q, S	R, S
(d)	P, Q	R	R, S	P, Q

30. Match the Column I with Column II and mark the appropriate option.

Column I	Column II
(A) 1s	(P) $m_l = 0$
(B) $2p_z$	(Q) Nodal planes = 2
(C) $3d_{xy}$	(R) Radial nodes = 0
(D) $3d_{z^2}$	(S) Number of maxima = 1

	A	B	C	D
(a)	P, R, S	P, R, S	Q, R, S	P, R, S
(b)	Q, S	P, R, S	Q, R	P, S
(c)	P, R, S	Q	P	P, Q
(d)	R, S	P, Q	Q, S	Q, R, S

Keys are published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

VIT Engineering Entrance Exam (VITEEE-2017) Results

VITEEE - 2017 TOP 10 RANK HOLDERS

RANK 1
AASHISH WAIKAR

RANK 2
DIVYANSH TRIPATHI

RANK 3
DIVYANSHU MANDOWARA

RANK 4
ABHISHEK RAO

RANK 5
BHANUTEJA BOLISETTI

RANK 6
HRITWIK SINGHAI

RANK 7
PRATHEEK D SOUZA REBELLO

RANK 8
AVVARI SAI S S V BHARADWAJ

RANK 9
PATEL MANAN BRIJESH

RANK 10
SHOURYA AGGARWAL

AASHISH WAIKAR, a student of BHAVAN VIDYALAYA PANCHKULA, Madhya Pradesh has secured the first rank in the VIT Engineering Entrance Examination (VITEEE)-2017 which was held from April 5th to 16 in 119 selected cities across India, as well as Dubai, Kuwait and Muscat. The entrance exam was held for admission to the various B.Tech programmes offered by VIT University at its Vellore, Chennai, Bhopal & Amaravati (AP).

Releasing the results, VIT Chancellor Dr.G.Viswanathan said that a record 2,23,081 candidates had registered for the VITEEE-2017. The other rank holders among the top 10 are 2nd rank: DIVYANSH TRIPATHI (Prabhat Sr Sec Public School, Uttar Pradesh), 3rd rank: DIVYANSHU MANDOWARA (Arcadia Academy Co-Educational English Medium Senior Secondary School, Rajasthan), 4th rank: ABHISHEK RAO (Remal Public School, Uttar Pradesh), 5th rank : BHANUTEJA BOLISETTI (Sri Chaitanaya Narayana Jr College, Telengana), 6th rank: HRITWIK SINGHAI (Little Kingdom Senior Secondary School, Madhya Pradesh), 7th rank: PRATHEEK D SOUZA REBELLO (Mushtifund Aryaan Higher Secondary School, GOA), 8th rank : AVVARI SAI S S V BHARADWAJ (Sri Chaitanya Junior Kalasala, Telengana), 9th rank: PATEL MANAN BRIJESH (Shree Swaminarayan Secondary School, Gujarat) and 10th rank : SHOURYA AGGARWAL (Hans Raj Model School, Delhi).

Dr. G. Viswanathan said that admissions would be only on merit, based on the marks obtained by the candidates in the VITEEE. The results have been released through the www.vit.ac.in.

Counselling for candidates, who obtained ranks upto 8,000 was held on May 10 and counseling for ranks 8001 to 14,000 was held on May 11 while for those who secured ranks from 14001 to 20000 was held on May 12. The counselling was held simultaneously in the Vellore, Chennai, Bhopal and Amaravati (AP).

Under the G V School Development Programme central and State board toppers would be given 100 percent fee waiver for all the four years. Candidates with ranks upto 50 would be given a 75% tuition fee waiver, Rank 51 to 100 would be given a 50% tuition fee waiver and Rank 101 to 1000 would be given a 25 % tuition fee waiver.

Each one boy and one girl secured top ranks in "Plus2" at district level from state board schools who also appeared for VIT Engineering Entrance Examination will be given 100% fee concession and free boarding and lodging in the hostels of VIT under STARS scheme.

☺☺

NCERT CORNER

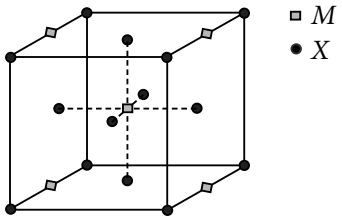
The questions given in this column have been prepared strictly on the basis of NCERT Chemistry. Papers of JEE(Main & Advanced) / NEET / AIIMS / JIPMER are drawn heavily from NCERT books. Practice Hard! All the best!!

1. Common salt obtained from sea-water contains 95% NaCl by mass. The approximate number of molecules present in 10.0 g of the salt is :
(a) 10^{21} (b) 10^{22} (c) 10^{23} (d) 10^{24}

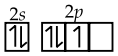
2. Which one of the following statements is not true regarding (+) lactose?
(a) (+)-Lactose, $C_{12}H_{22}O_{11}$ contains 8 –OH groups.
(b) On hydrolysis (+)-lactose gives equal amount of *D*(+)-glucose and *D*(+)-galactose.
(c) (+)-Lactose is a β-glycoside formed by the union of a molecule of *D*(+)-glucose and a molecule of *D*(+)-galactose.
(d) (+)-Lactose is a reducing sugar and does not exhibit mutarotation.

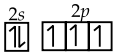
3. A colourless solid (*X*) on heating evolved CO_2 and also gave a white residue, soluble in water. Residue also gave CO_2 when treated with dilute acid. (*X*) is
(a) Li_2CO_3 (b) $CaCO_3$
(c) $Ca(HCO_3)_2$ (d) $NaHCO_3$

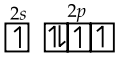
4. A compound M_pX_q has cubic close packing (*ccp*) arrangement of *X*. Its unit cell structure is shown below. The empirical formula of the compound is

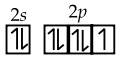


(a) *MX* (b) MX_2 (c) M_2X (d) M_5X_{14}

5. The orbital diagram in which Aufbau principle is violated is
(a) 

(b) 

(c) 

(d) 

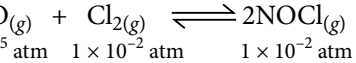
6. On addition of small amount of $KMnO_4$ to concentrated H_2SO_4, a green oily compound is obtained which is highly explosive in nature. Identify the compound from the following.
(a) Mn_2O_7 (b) MnO_2
(c) $MnSO_4$ (d) Mn_2O_3

7. The IUPAC name of the compound,

is
(a) 1,1-dibutyl-2, 3-dimethylbutane
(b) 2, 4, 4-dibutyl-3, 3-dimethylbutane
(c) 5-(1, 2-dimethylpropyl)nonane
(d) 4-butyl-2, 3-dimethyloctane.

8. On the basis of informations given below mark the correct option :
I. In bromoethane and chloroethane mixture, intermolecular interactions of *A*–*A* and *B*–*B* types are nearly same as *A*–*B* type interactions.
II. In ethanol and acetone mixture, *A*–*A* or *B*–*B* types intermolecular interactions are stronger than *A*–*B* type interactions.
III. In chloroform and acetone mixture, *A*–*A* or *B*–*B* types intermolecular interactions are weaker than *A*–*B* type interactions.
(a) Solutions (II) and (III) will follow Raoult's law.
(b) Solution (I) will follow Raoult's law.
(c) Solution (II) will show negative deviation from Raoult's law.
(d) Solution (III) will show positive deviation from Raoult's law.

9. Following reaction occurs at 25°C,



1×10^{-5} atm 1×10^{-2} atm 1×10^{-2} atm

ΔG° for the following reaction is
(a) – 45.65 kJ (b) – 28.53 kJ
(c) – 22.82 kJ (d) – 57.06 kJ

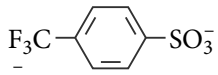
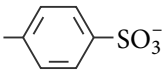
10. Treatment of acetaldehyde with ethyl magnesium bromide and subsequent hydrolysis gives
(a) 1-butanol (b) 2-butanol
(c) 1-propanol (d) *tert*-butanol.

11. The lowest first ionisation enthalpy would be associated with which of the following configurations?
(a) $1s^2\ 2s^2\ 2p^6\ 3s^1$ (b) $1s^2\ 2s^2\ 2p^5$
(c) $1s^2\ 2s^2\ 2p^6$ (d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$

12. What kind of isomerism exists between $[Cr(H_2O)_6]Cl_3$ (violet) and $[Cr(H_2O)_5Cl]Cl_2{\cdot}H_2O$ (greyish-green)?
(a) Linkage isomerism (b) Solvate isomerism
(c) Ionisation isomerism
(d) Coordination isomerism

13. An organic compound weighing 0.15 g gave on Carius estimation, 0.12 g of AgBr. The percentage of Br in the compound will be close to
(At. mass of Ag = 108, Br = 80)
(a) 46.02% (b) 34.04% (c) 3.41% (d) 4.60%

14. Which of the following is the best leaving group (weakest conjugate base)?

(a)  (b) 
(c) $\bar{C}H_3$ (d) OH^-

15. What is the minimum volume of water required to dissolve 1 g of calcium sulphate at 298 K?
(Given : For calcium sulphate, $K_{sp} = 9.1 \times 10^{-6}$)
(a) 3.02 L (b) 2.00 L
(c) 2.56 L (d) 2.43 L

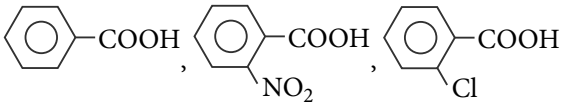
16. Small quantities of solution of compounds *TX*, *TY* and *TZ* are put into separate test tubes containing *X*, *Y* and *Z* solutions. *TX* does not react with any of these. *TY* reacts with both *X* and *Z*. *TZ* reacts with *X*. The decreasing order of oxidation of the anions X^-, Y^-, Z^- is
(a) $Y^- > Z^- > X^-$ (b) $Z^- > X^- > Y^-$
(c) $Y^- > X^- > Z^-$ (d) $X^- > Z^- > Y^-$

17. Which of the following statements are correct about CO_3^{2-}?
I. The hybridisation of central atom is sp^3.
II. Its resonance structures have one C—O single bond and two C═O double bonds.
III. The average formal charge on each oxygen atom is 0.67 units.
IV. All C—O bond lengths are equal.
(a) I and II only (b) I and III only
(c) III and IV only (d) II and IV only

18. Which of the following statements is not correct?
(a) $La(OH)_2$ is less basic than $Lu(OH)_3$.
(b) In lanthanide series, ionic radius of Ln^{3+} ions decreases.
(c) La is actually an element of transition series rather than lanthanoid series.
(d) Atomic radii of Zr and Hf are same because of lanthanoid contraction.

19. A narrow spectrum antibiotic is active against
(a) either gram positive or gram negative bacteria
(b) gram negative bacteria only
(c) single organism or one disease
(d) both gram positive and gram negative bacteria.

20. Increasing order of dissociation constant (K_a) of

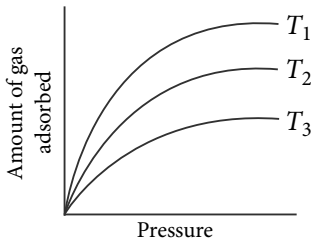


I II III

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

21. From the molecular orbital theory, one can show that the bond order in F_2 molecule is
(a) 2 (b) 1 (c) 3 (d) 4

22. The variation of amount of gas adsorbed per gram of adsorbent with pressure at different temperatures is given in the figure below :



Which of the following is the correct relation?
(a) $T_1 > T_2 > T_3$ (b) $T_2 > T_1 > T_3$
(c) $T_3 > T_2 > T_1$ (d) $T_1 = T_2 = T_3$

23. The correct decreasing order of basic strength of the following species is
H_2O, NH_3, OH^-, NH_2^-
(a) $NH_2^- > OH^- > NH_3 > H_2O$
(b) $OH^- > NH_2^- > H_2O > NH_3$
(c) $NH_3 > H_2O > NH_2^- > OH^-$
(d) $H_2O > NH_3 > OH^- > NH_2^-$

24. The reaction of toluene with Cl_2 in presence of $FeCl_3$ gives *X* and reaction in presence of light gives *Y*. Thus, *X* and *Y* are

(a) X = benzyl chloride, Y = m-chlorotoluene
(b) X = benzal chloride, Y = o-chlorotoluene
(c) X = m-chlorotoluene, Y = p-chlorotoluene
(d) X = o- and p-chlorotoluene, Y = trichloromethyl-benzene

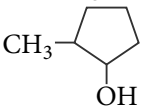
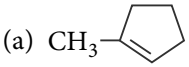
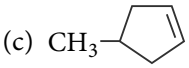
25. The volume of oxygen liberated at NTP from 10 mL of 20 volume H_2O_2 is
(a) 250 mL (b) 300 mL
(c) 150 mL (d) 200 mL

26. In the equation,
$4M + 8CN^- + 2H_2O \xrightarrow{X} 4[M(CN)_2]^- + 4OH^-$,
the metal M and reactant X are respectively
(a) copper, air (b) iron, air
(c) gold, oxygen (d) zinc, oxygen.

27. In the following reaction,
$C_2H_5OC_2H_5 + [H] \xrightarrow{\text{Red P/HI}} 2X + H_2O$
X is
(a) ethane (b) ethylene
(c) butane (d) propane.

28. The standard electrode potential for the half-cell reactions are
$Zn^{2+} + 2e^- \longrightarrow Zn$; $E^\circ = -0.76$ V
$Fe^{2+} + 2e^- \longrightarrow Fe$; $E^\circ = -0.44$ V
The standard e.m.f. of the cell reaction,
$Fe^{2+} + Zn \longrightarrow Zn^{2+} + Fe$ is
(a) –1.20 V (b) +1.20 V
(c) +0.32 V (d) –0.32 V

29. What is the correct order of reactivity of alcohols in the following reaction?
$R—OH + HCl \xrightarrow{ZnCl_2} R—Cl + H_2O$
(a) 1° > 2° > 3° (b) 1° < 2° > 3°
(c) 3° > 2° > 1° (d) 3° > 1° > 2°

30. For the given reaction,

$\xrightarrow[\text{heat}]{H_2SO_4}$ A (major), A is
(a) 
(b)
(c) 
(d)

31. A student forgot to add the reaction mixture to the round bottom flask at 27°C but instead he placed the flask on the flame. After a lapse of time, he realized his mistake, and using a pyrometer he found the temperature of the flask was 477°C. What fraction of air would have been expelled out?
(a) 60% (b) 30% (c) 100% (d) 75%

32. Molar conductivities (Λ_m°) at infinite dilution of NaCl, HCl and CH_3COONa are 126.4, 425.9 and 91.0 S cm^2 mol^{-1} respectively. Λ_m° for CH_3COOH will be
(a) 390.5 S cm^2 mol^{-1} (b) 425.5 S cm^2 mol^{-1}
(c) 180.5 S cm^2 mol^{-1} (d) 290.8 S cm^2 mol^{-1}

33. Which one of the following statements is not true?
(a) pH of drinking water should be between 5.5 – 9.5.
(b) Concentration of D.O. below 6 ppm is good for the growth of fish.
(c) Clean water should have a B.O.D. value of less than 5 ppm.
(d) Oxides of S, N and C are the most widespread air pollutants.

34. In vulcanisation of rubber,
(a) sulphur reacts to form a new compound
(b) sulphur cross-links are introduced
(c) sulphur forms a very thin protective layer over rubber
(d) all statements are correct.

35. What is the correct order of decreasing stability of the following cations?
I. $CH_3 — \overset{+}{C}H — CH_3$
II. $CH_3 — \overset{+}{C}H — OCH_3$
III. $CH_3 — \overset{+}{C}H — CH_2 — OCH_3$
(a) II > I > III (b) II > III > I
(c) III > I > II (d) I > II > III

36. $[AgI]/I^-$ colloidal sol can be coagulated by the addition of a suitable cation. The number of moles of $AgNO_3$, $Pb(NO_3)_2$ and $Fe(NO_3)_3$ respectively required to caugalate 1 mol of $[AgI]/I^-$ is
(a) 1, 1, 1 (b) 1, 2, 3
(c) $1, \frac{1}{2}, \frac{1}{3}$ (d) 6, 3, 2

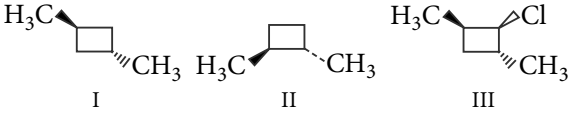
37. Water softening by Clark's process uses
(a) calcium bicarbonate (b) sodium bicarbonate
(c) potash alum (d) calcium hydroxide.

38. Saponification of an ester (A) followed by neutralisation gives a compound (B), which gives violet colouration with $FeCl_3$. The ester (A) is
(a) ethyl salicylate (b) ethyl acetate
(c) ethyl benzoate (d) diethyl phthalate.

39. A solution having volume 'V' at temperature 'T' and pressure 'P' is mixed with other solution with same volume 'V', temperature 'T' and pressure 'P'. The resulting solution after mixing both solutions

has volume 'V', temperature 'T' and pressure
(a) $2P$ (b) $4P$ (c) $P/2$ (d) P

40. Which of the following compounds are chiral?



I II III

(a) Only I and II (b) Only II and III
(c) Only I and III (d) Only III

41. Oxidation states of P in $H_4P_2O_5$, $H_4P_2O_6$ and $H_4P_2O_7$ respectively are
(a) +3, +5, +4 (b) +5, +3, +4
(c) +5, +4, +3 (d) +3, +4, +5

42. $C_3H_6Cl_2$ on reaction with NaOH forms C_3H_6O, which gives yellow precipitate on heating with NaOH and I_2. Thus, $C_3H_6Cl_2$ is
(a) 1,1-dichloropropane (b) 1, 2-dichloropropane
(c) 2,2-dichloropropane (d) 1,3-dichloropropane.

43. For the reactions,
$N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$, $2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$
the equilibrium constants are K_1 and K_2 respectively. What is K for the reaction,

$$NO_{2(g)} \rightleftharpoons \frac{1}{2}N_{2(g)} + O_{2(g)}?$$

(a) $\frac{1}{2K_1K_2}$ (b) $\frac{1}{4K_1K_2}$
(c) $\left[\frac{1}{K_1K_2}\right]^{1/2}$ (d) $\frac{1}{K_1K_2}$

44. Which of the following is the incorrect statement?
(a) All halogens form oxyacids.
(b) All halogens show –1, +1, +3, +5, +7 oxidation states.
(c) Hydrofluoric acid forms KHF_2 and K_2F_2 and attacks glass.
(d) Oxidising power is in order $F_2 > Cl_2 > Br_2 > I_2$.

45. The formation of the oxide ion, $O^{2-}_{(g)}$, from oxygen atom requires first an exothermic and then an endothermic step as shown below :
$O_{(g)} + e^- \longrightarrow O^-_{(g)}$; $\Delta H = -141$ kJ mol^{-1}
$O^-_{(g)} + e^- \longrightarrow O^{2-}_{(g)}$; $\Delta H = +780$ kJ mol^{-1}
Thus, process of formation of O^{2-} in gas phase is unfavourable even though O^{2-} is isoelectronic with neon. It is due to the fact that
(a) oxygen is more electronegative
(b) addition of electron in oxygen results in larger size of the ion
(c) electron repulsion outweighs the stability gained by achieving noble gas configuration
(d) O^- ion has comparatively smaller size than oxygen atom.

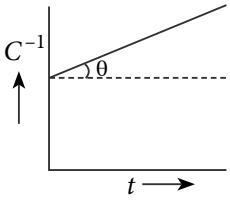
46. Titanium shows magnetic moment of 1.73 B.M. in its compound. What is the oxidation number of Ti in the compound?
(a) +1 (b) +4 (c) +3 (d) +2

47. Heat of formation of acetylene is x J mol^{-1} and that of ethylene is y J mol^{-1}. What is the heat of hydrogenation of acetylene?
(a) $(x - y)$ J mol^{-1} (b) $(x - 2y)$ J mol^{-1}
(c) $(y - 2x)$ J mol^{-1} (d) $(y - x)$ J mol^{-1}

48. Pure benzene freezes at 5.42 °C. A solution of 0.223 g of phenylacetic acid ($C_6H_5CH_2COOH$) in 4.4 g of benzene ($K_f = 5.12$ K kg mol^{-1}) freezes at 4.47 °C. From this observation, one can conclude that
(a) phenylacetic acid exists as such in benzene
(b) phenylacetic acid undergoes partial ionisation in benzene
(c) phenylacetic acid undergoes complete ionisation in benzene
(d) phenylacetic acid dimerises in benzene.

49. If the photon of the wavelength 150 pm strikes an atom and one of its inner bound electron is ejected out with a velocity of 1.5×10^7 m s^{-1}, calculate the energy with which it is bound to the nucleus.
(a) 6.26×10^{-3} eV (b) 12.25×10^{-3} eV
(c) 7.63×10^3 eV (d) 9.11×10^3 eV

50. For a certain reaction, $nA \longrightarrow$ Products, a plot of C^{-1} (where C represents molar concentration of A) *vs* time t is as shown in the figure. Which of the following is not correct?



(a) Rate = $k[A]^2$
(b) Slope, tan θ = Rate constant, k
(c) Intercept on C^{-1} axis = $1/C_0$
(d) Units of rate constant = L^2 mol^{-2} s^{-1}

SOLUTIONS

1. **(c) :** 10 g of the salt will contain = 9.5 g NaCl
1 mole, *i.e.,* 58.5 g of NaCl contains 6.023×10^{23} molecules of NaCl
∴ 9.5 g of NaCl will contain

$$\frac{6.023 \times 10^{23}}{58.5} \times 9.5 \simeq 10^{23} \text{ molecules of NaCl}$$

2. **(d):** (+)-Lactose is a reducing sugar and shows mutarotation.

3. (d): (a) $Li_2CO_3 \xrightarrow{\Delta} \underset{\text{(Soluble in water)}}{Li_2O} + CO_2$

$Li_2O + 2HCl \xrightarrow[\text{(dil.)}]{} 2LiCl + H_2O$

(b) $CaCO_3 \xrightarrow{\Delta} CaO + CO_2\uparrow$

$CaO + H_2O \longrightarrow Ca(OH)_2$

$CaO + 2HCl \longrightarrow CaCl_2 + H_2O$

(c) $Ca(HCO_3)_2 \xrightarrow{\Delta} \underset{\text{(insoluble in } H_2O)}{CaCO_3\downarrow} + H_2O + CO_2\uparrow$

(d) $\underset{X}{2NaHCO_3} \xrightarrow{\Delta} \underset{\substack{\text{white residue}\\ \text{(soluble in water)}}}{Na_2CO_3} + H_2O + CO_2\uparrow$

$Na_2CO_3 + 2HCl \rightleftharpoons 2NaCl + H_2O + CO_2\uparrow$

4. (b): No. of M atoms $= 4 \times \underset{\text{(edge centres)}}{\frac{1}{4}} + \underset{\text{(body centre)}}{1} = 2$

No. of X atoms $= \underset{\text{(corners)}}{8 \times \frac{1}{8}} + \underset{\text{(face-centres)}}{6 \times \frac{1}{2}} = 4$

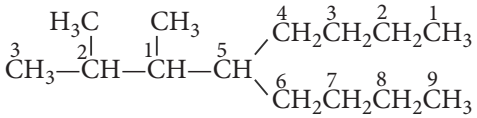
Ratio of $M : X = 2 : 4 = 1 : 2$

or $p : q = 1 : 2$

$\therefore$ Empirical formula $= MX_2$

5. (c)

6. (a): $2KMnO_4 + 2H_2SO_4 \longrightarrow \underset{\text{(Explosive)}}{Mn_2O_7} + 2KHSO_4 + H_2O$

7. (c): 

5-(1, 2-Dimethylpropyl)nonane

8. (b)

9. (a): $2NO_{(g)} + Cl_{2(g)} \rightleftharpoons 2NOCl_{(g)}$

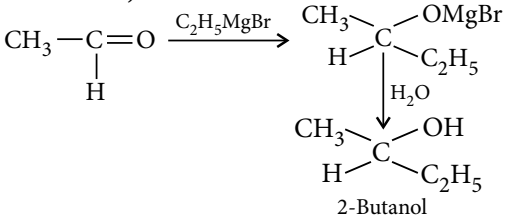
$$K_p = \frac{p^2_{NOCl}}{p^2_{NO} \times p_{Cl_2}} = \frac{(1\times10^{-2})^2}{(1\times10^{-5})^2 \times 1\times10^{-2}}$$

$\Rightarrow K_p = 1 \times 10^8$

$\Delta G^\circ = -2.303\, RT \log K_p$

$= -2.303 \times 8.314 \times 10^{-3} \times 298 \log 10^8$ kJ

$= -45.65$ kJ

10. (b): 

2-Butanol

11. (a): The element which has only one electron in 3*s*-subshell has the lowest *I.E* (among the given configurations).

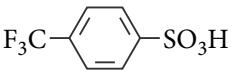
12. (b)

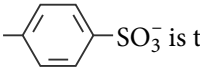
13. (b): Percentage of bromine in the compound

$$= \frac{80}{188} \times \frac{\text{Mass of AgBr formed}}{\text{Mass of substance taken}} \times 100$$

$$= \frac{80}{188} \times \frac{0.12}{0.15} \times 100 = 34.04\%$$

14. (a): If acid is strongest, its conjugate base is the weakest and is the best leaving group and the strongest acid among the given examples is



Thus,  is the best leaving group.

15. (d): $CaSO_{4(s)} \rightleftharpoons Ca^{2+}_{(aq)} + SO^{2-}_{4(aq)}$

If s is the solubility of $CaSO_4$ in mol L^{-1}, then

$K_{sp} = [Ca^{2+}] \times [SO^{2-}_4] = s^2$

or, $s = \sqrt{K_{sp}} = \sqrt{9.1\times10^{-6}} = 3.02 \times 10^{-3}$ mol L^{-1}

$= 3.02 \times 10^{-3} \times 136 = 0.411$ g L^{-1}

($\because$ Molar mass of $CaSO_4 = 136$ g mol^{-1})

Thus, for dissolving 0.411 g of $CaSO_4$, water required = 1 L

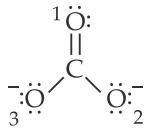
$\therefore$ For dissolving 1 g of $CaSO_4$, water required

$= \frac{1}{0.411}$ L $= 2.43$ L

16. (a): *TX* does not react with any solution. This means that X^- ions are least easily oxidised.

TY reacts with both *X* and *Z*. This means Y^- is oxidized by both *X* and *Z*.

TZ reacts with *X* only. This means Z^- ions are less easily oxidised than Y^- ions. Thus, decreasing order of oxidation of anions X^-, Y^-, Z^- will be, $Y^- > Z^- > X^-$

17. (c): 

Formal charge $= V - (N + B/2)$

Where, V = Number of valence electrons

N = Number of non-bonding valence electrons

B = Number of electrons in covalent bonds with other atoms.

Formal charge on O atom (1) : $6 - 4 - \frac{1}{2} \times 4 = 0$

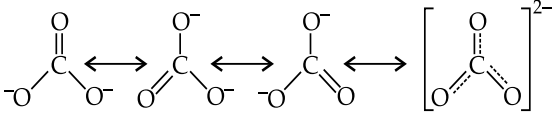
Formal charge on O atom (2) : $6 - 6 - \frac{1}{2} \times 2 = -1$

Formal charge on O atom (3) : $6 - 6 - \frac{1}{2} \times 2 = -1$

Average formal charge on each oxygen atom

$$= \frac{-1+(-1)+0}{3} = -0.67$$

All C — O bonds are equal due to resonance.



Central atom is sp^2 hybridised.

18. (a) **19. (a)** **20. (c)**

21. (b): According to M.O.T., electronic configuration of F_2 : $\sigma 1s^2$, $\sigma^* 1s^2$, $\sigma 2s^2$, $\sigma^* 2s^2$, $\sigma 2p_z^2$, $\pi 2p_x^2 = \pi 2p_y^2$, $\pi^* 2p_x^2 = \pi^* 2p_y^2$

Bond order $= \frac{1}{2}[N_b - N_a] = \frac{1}{2}[10 - 8] = 1$

22. (c): Rate of adsorption decreases with increase in temperature because adsorption is an exothermic process.

23. (a): Due to higher electronegativity of O than N atom, O–H bond is more polar than N – H bond. Hence, O – H is more acidic in nature than N – H bond. Now, NH_2^- and OH^- have negative charge due to which they are more basic than NH_3 and H_2O. Thus, the decreasing order strength is : $NH_2^- > OH^- > NH_3 > H_2O$.

24. (d): CH_3–C$_6$H$_5$ $\xrightarrow[\text{Halogenation}]{Cl_2/FeCl_3}$ CH_3–C$_6$H$_4$–Cl

Toluene

p-Chlorotoluene (*X*) (major product)

+

o-Chlorotoluene (*X*) (minor product)

$\xrightarrow[\text{(Side chain halogenation)}]{Cl_2/h\nu}$ C$_6$H$_5$–CCl_3

Trichloromethyl benzene (*Y*)

25. (d): "20 volume" H_2O_2 means,
1 mL H_2O_2 gives = 20 mL O_2 at NTP
thus, 10 mL of 20 volume H_2O_2 will give = 200 mL O_2 at NTP

26. (c): *M* is gold (Au) and the reaction represents extraction of Au by MacArthur-Forrest cyanide process.

$$4Au + 8CN^- + 2H_2O + O_2 \longrightarrow 4[Au(CN)_2]^- + 4OH^-$$

27. (a): $C_2H_5OC_2H_5 \xrightarrow[\text{Cleavage of ethers}]{\text{Red P/HI}} 2C_2H_5I$

$\xrightarrow[\text{Reduction}]{\text{Red P/HI}} 2C_2H_6$

Ethane

28. (c): Given cell reaction is :

$$Zn + Fe^{2+} \longrightarrow Zn^{2+} + Fe$$

In the above reaction, Zn is being oxidised and Fe^{2+} is being reduced, thus the cell can be represented as,

$$Zn|Zn^{2+}||Fe^{2+}|Fe$$

$E^\circ_{cell} = E^\circ_{Right} - E^\circ_{Left} = E^\circ_{Fe^{2+}/Fe} - E^\circ_{Zn^{2+}/Zn}$
$= (-0.44) - (-0.76) = 0.76 - 0.44 = +0.32$ V

29. (c): The given reaction is nucleophilic substitution reaction and it proceeds with the formation of carbocation.

30. (a): Substituted alkene is more stable.

31. (a): Suppose the number of moles of gas present at 27°C in flask of volume *V* at pressure *P* is n_1, then assuming ideal gas behaviour,

$$PV = n_1 R \times 300 \quad ...(1)$$

suppose n_2 = number of moles at 477°C, then

$$PV = n_2 R \times 750 \quad ...(2)$$

From equations (1) and (2), we get

$$n_2 = \frac{300}{750} \times n_1 = 0.4\, n_1$$

$\therefore$ % of air expelled out = $(1 - 0.4) \times 100 = 60\%$

32. (a): $\Lambda^\circ_{mCH_3COOH} = \Lambda^\circ_{mCH_3COONa} + \Lambda^\circ_{mHCl} - \Lambda^\circ_{mNaCl}$
$= 91.0 + 425.9 - 126.4 = 390.5$ S cm^2 mol^{-1}

33. (b): Concentration of D.O. below 6 ppm is not good for the growth of fish. Fishes die in water, bodies polluted by sewage due to decrease in D.O. concentration below 6 ppm.

34. (b)

35. (a): $CH_3 \rightarrow \overset{+}{C}H \leftarrow CH_3$

(I)
Stabilised by weak +*I*-effect of the two –CH_3 groups

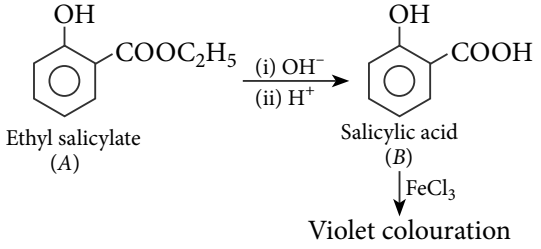
$CH_3-\overset{+}{C}H-\ddot{O}-CH_3$ (II) Stabilised by strong +*R*-effect of the –OCH_3 group

$CH_3-\overset{+}{C}H-CH_2-OCH_3$ (III) Destabilised by –*I*-effect of the –OCH_3 group

Thus, the stability of carbocations decreases in the order : II > I > III.

36. (c) **37. (d)**

38. (a): Hydrolysis product (*B*) of ester gives violet colour with $FeCl_3$, thus *B* is a phenolic compound.



Ethyl salicylate (*A*)

Salicylic acid (*B*)

Violet colouration

39. (d): Total volume = $V_1 + V_2$

Let the total pressure be P and partial pressures will be p_1' and p_2' respectively in the resultant solution.

Applying Boyle's law,

$p_1'(V_1 + V_2) = p_1V_1$ ...(i)

$p_2'(V_1 + V_2) = p_2V_2$ ...(ii)

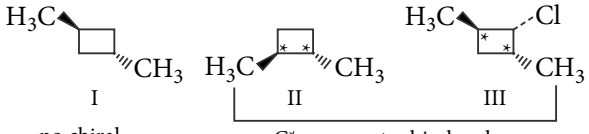
By adding (i) and (ii), we get,

$$p_1' + p_2' = \frac{p_1V_1}{V_1+V_2} + \frac{p_2V_2}{V_1+V_2} = \frac{p_1V_1 + p_2V_2}{V_1+V_2}$$

$p_1 = p_2 = P$ and $V_1 = V_2 = V$

So, $p_1' + p_2' = P$

40. (b):



no chiral carbon

C* represents chiral carbon

Thus, II and III are chiral compounds.

41. (d): $H_4P_2O_5 : 4 + 2x - 10 = 0 \Rightarrow x = +3$

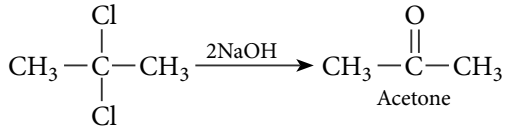
$H_4P_2O_6 : 4 + 2x - 12 = 0 \Rightarrow x = +4$

$H_4P_2O_7 : 4 + 2x - 14 = 0 \Rightarrow x = +5$

42. (c): C_3H_6O gives yellow ppt. on heating with I_2/NaOH (iodoform test) thus, it has $-\overset{\overset{O}{\|}}{C}CH_3$ group.

$-\overset{\overset{O}{\|}}{C}-$ group is formed due to hydrolysis of $-\overset{\overset{Cl}{|}}{\underset{\underset{Cl}{|}}{C}}-$ group.

Thus, $C_3H_6Cl_2$ is



$C_3H_6Cl_2$

2,2-Dichloropropane

Acetone

43. (c): $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$; K_1

$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$; K_2

$NO_{2(g)} \rightleftharpoons \frac{1}{2}N_{2(g)} + O_{2(g)}$; K

$$K_1 = \frac{[NO]^2}{[N_2][O_2]}; \quad K_2 = \frac{[NO_2]^2}{[NO]^2[O_2]}$$

$$K = \frac{[N_2]^{1/2}[O_2]}{[NO_2]} = \sqrt{\frac{[N_2][O_2]}{[NO]^2} \times \frac{[NO]^2[O_2]}{[NO_2]^2}}$$

$$K = \sqrt{\frac{1}{K_1K_2}}$$

44. (b): Fluorine shows only –1 and +1 oxidation states.

45. (c)

46. (c): μ_{eff} value of 1.73 B.M. corresponds to one unpaired electron.

Electronic configuration of Ti = [Ar] $3d^2\ 4s^2$

Electronic configuration of Ti^{3+} = [Ar] $3d^1$

47. (d): $CH \equiv CH + H_2 \longrightarrow CH_2 = CH_2$; ΔH = ?

$\Delta H = \Delta H_{f(CH_2=CH_2)} - \Delta H_{f(CH\equiv CH)} - \Delta H_{f(H_2)}$

$= y - x - 0 = (y - x)$ J mol^{-1}

48. (d): $\Delta T_f = T_f^\circ - T_f = 5.42 - 4.47 = 0.95°C$

Molality of solvent, $m = \frac{0.223}{136} \times \frac{1000}{4.4} = 0.373$ m

(Molar mass of phenylacetic acid = 136 g/mol)

$\Delta T_f = i.\ K_f\ m$

$$i = \frac{\Delta T_f}{K_f m} = \frac{0.95}{5.12 \times 0.373} = 0.497 \simeq 0.5$$

It means phenylacetic acid undergoes dimerisation in benzene.

49. (c): Photon of wavelength = 150 pm = 150×10^{-12} m

Energy of photon (E) = $\frac{hc}{\lambda}$

$$= \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{150 \times 10^{-12}} = 0.1325 \times 10^{-14} \text{ J}$$

$= 13.25 \times 10^{-16}$ J

K.E. of the ejected electron = $\frac{1}{2}mv^2$

$= \frac{1}{2} \times 9.11 \times 10^{-31} \times (1.5 \times 10^7)^2 = 1.025 \times 10^{-16}$ J

Energy with which the electron is bound to the nucleus

$= (13.25 \times 10^{-16} - 1.025 \times 10^{-16})$ J $= 12.225 \times 10^{-16}$ J

$$= \frac{12.225 \times 10^{-16}}{1.602 \times 10^{-19}} \simeq 7.63 \times 10^3 \text{ eV}$$

[$\because 1.602 \times 10^{-19}$ J = 1 eV]

50. (d): For 2nd order reaction,

$$k = \frac{1}{t}\left\{\frac{1}{[A]} - \frac{1}{[A]_0}\right\} \quad \text{or} \quad \frac{1}{[A]} = kt + \frac{1}{[A]_0}$$

Hence, plot of $1/[A]$ *vs* t is linear with slope = k and intercept = $1/[A]_0$. Therefore, (a), (b), (c) are correct. Units of k for 2nd order reaction = L mol^{-1} s^{-1}.

SOLVED PAPER **2017**

Kerala PET

1. Uncertainty principle is valid for
(a) proton
(b) methane
(c) both (a) and (b)
(d) 1 μm sized platinum particles
(e) 1 μm sized NaCl particles.

2. The energy of an electron in the 3*s* orbital (excited state) of H-atom is
(a) –1.5 eV (b) –13.6 eV
(c) –3.4 eV (d) –4.53 eV
(e) 4.53 eV

3. Among the following, the molecule that will have the highest dipole moment is
(a) H_2 (b) HI (c) HBr (d) HCl
(e) HF

4. Which of the following pairs have identical bond order?
(a) CN^- and NO^+ (b) CN^- and O_2^-
(c) CN^- and CN^+ (d) NO^+ and O_2^-
(e) O_2^- and CN^+

5. A gas will approach ideal behaviour at
(a) low temperature and low pressure
(b) low temperature and high pressure
(c) high temperature and low pressure
(d) high temperature and high pressure
(e) low volume and high pressure.

6. Pressure of ideal and real gases at 0 K are
(a) > 0 and 0 (b) < 0 and 0
(c) 0 and 0 (d) > 0 and > 0
(e) 0 and > 0

7. For the process;
$A(l, 0.05\ atm, 32°C) \rightarrow A(g, 0.05\ atm, 32°C)$
The correct set of thermodynamic parameters is
(a) $\Delta G = 0$ and ΔS = –ve
(b) $\Delta G = 0$ and ΔS = +ve
(c) ΔG = +ve and $\Delta S = 0$
(d) ΔG = –ve and $\Delta S = 0$
(e) $\Delta G = 0$ and $\Delta S = 0$

8. Mixing of N_2 and H_2 form an ideal gas mixture at room temperature in a container. For this process, which of the following statements is true?
(a) $\Delta H = 0, \Delta S_{surrounding} = 0, \Delta S_{system} = 0$ and ΔG = –ve
(b) $\Delta H = 0, \Delta S_{surrounding} = 0, \Delta S_{system} > 0$ and ΔG = –ve
(c) $\Delta H > 0, \Delta S_{surrounding} = 0, \Delta S_{system} > 0$ and ΔG = –ve
(d) $\Delta H < 0, \Delta S_{surrounding} > 0, \Delta S_{system} < 0$ and ΔG = –ve
(e) $\Delta H = 0, \Delta S_{surrounding} = 0, \Delta S_{system} < 0$ and ΔG = –ve

9. Which of the following is not true about a catalyst?
(a) Mechanism of the reaction in presence and absence of catalyst could be different.
(b) Enthalpy of the reaction does not change with catalysts.
(c) Catalyst enhances both forward and backward reaction at equal rate.
(d) Catalyst participates in the reaction, but not consumed in the process.
(e) Use of catalyst cannot change the order of the reaction.

10. In the ln *K* vs $\frac{1}{T}$ plot of a chemical process having $\Delta S° > 0$ and $\Delta H° < 0$ the slope is proportional to (where *K* is equilibrium constant)
(a) $-|\Delta H°|$ (b) $|\Delta H°|$
(c) $\Delta S°$ (d) $-\Delta S°$
(e) $\Delta G°$

11. For the process,
$\frac{3}{2}A \rightarrow B$, at 298 K, $\Delta G°$ is 163 kJ mol^{-1}. The composition of the reaction mixture is [*B*] = 1 and [*A*] = 10000. Predict the direction of the reaction and the relation between reaction quotient (*Q*) and the equilibrium constant (*K*).

(a) Forward direction because $Q > K$
(b) Reverse direction because $Q > K$
(c) Forward direction because $Q < K$
(d) Reverse direction because $Q < K$
(e) It is at equilibrium as $Q = K$

12. Solubility product (K_{sp}) of saturated $PbCl_2$ in water is 1.8×10^{-4} mol^3 dm^{-9}. What is the concentration of Pb^{2+} in the solution?
(a) $(0.45 \times 10^{-4})^{1/3}$ mol dm^{-3}
(b) $(1.8 \times 10^{-4})^{1/3}$ mol dm^{-3}
(c) $(0.9 \times 10^{-4})^{1/3}$ mol dm^{-3}
(d) $(2.0 \times 10^{-4})^{1/3}$ mol dm^{-3}
(e) $(2.45 \times 10^{-4})^{1/3}$ mol dm^{-3}

13. The freezing point of equimolal aqueous solutions will be highest for
(a) $C_6H_5NH_3Cl$ (b) $AgNO_3$
(c) $Ca(NO_3)_2$ (d) $La(NO_3)_3$
(e) *D*-fructose.

14. The molality of the 3 M solution of methanol if the density of the solution is 0.9 g cm^{-3} is
(a) 3.73 (b) 3.0
(c) 3.33 (d) 3.1
(e) 3.2

15. Consider a fuel cell supplied with 1 mole of H_2 gas and 10 moles of O_2 gas. If fuel cell is operated at 96.5 mA current, how long will it deliver power? (Assume 1 F = 96500 C/mole of electrons)
(a) 1×10^6 s (b) 0.5×10^6 s
(c) 2×10^6 s (d) 4×10^6 s
(e) 5×10^6 s

16. Consider the equilibrium obtained by electrically connecting zinc-amalgam (Zn(Hg)) and HgO electrodes in mercury cell,
$Zn(Hg) + HgO_{(s)} \rightleftharpoons ZnO_{(s)} + Hg_{(l)}$
Under this equilibrium what is the relation between the potential of the Zn(Hg) and HgO electrodes measured against the standard hydrogen electrode?
(a) Zn(Hg) electrode potential is equal to HgO electrode potential.
(b) Zn(Hg) electrode potential is more than HgO electrode potential.
(c) HgO electrode potential is more than Zn(Hg) electrode.
(d) Cell voltage at above said equilibrium is 1.35 V.
(e) Both (c) and (d).

17. 10 g of $MgCO_3$ decomposes on heating to 0.1 mole CO_2 and 4 g MgO. The per cent purity of $MgCO_3$ is
(a) 24% (b) 44% (c) 54% (d) 74%
(e) 84%

18. The compound $Na_2CO_3.xH_2O$ has 50% H_2O by mass. The value of 'x' is
(a) 4 (b) 5 (c) 6 (d) 7
(e) 8

19. Hybridisation of carbon in CH_3^-
(a) sp^2 (b) sp^3
(c) sp^3d (d) sp^3d^2
(e) sp^2d^3

20. The common features among CO, CN^- and NO_2^+ are
(a) bond order three and isoelectronic
(b) bond order three and weak field ligands
(c) bond order two and π-acceptors
(d) bond order three and π-donors
(e) isoelectronic and strong field ligands.

21. Which of the following is covalent?
(a) NaCl (b) KCl
(c) $BeCl_2$ (d) $MgCl_2$
(e) $CaCl_2$

22. One mole of an unknown compound was treated with excess water and resulted in the evolution of two moles of a readily combustible gas. The resulting solution was treated with CO_2 and resulted in the formation of white turbidity. The unknown compound is
(a) Ca (b) CaH_2
(c) $Ca(OH)_2$ (d) $Ca(NO_3)_2$
(e) $CaSO_4$

23. When potassium is reacted with water, which compound(s) is (are) formed preferentially ?
(a) K_2O (b) KO_2
(c) Both K_2O and KO_2
(d) K_2O_2 (e) K_2O_3

24. Purification of aluminium by electrolytic refining is called
(a) Hall's process (b) Froth floatation process
(c) Baeyer's process (d) Hoope's process
(e) Serpeck's process.

25. Select the most appropriate statement. In BF_3
(a) all the bonds are completely ionic
(b) the B—F bond is partially ionic

(c) B—F bond has partial double bond character
(d) bond energy and bond length data indicates single bond character of the B—F bond
(e) all the bonds are covalent.

26. The inert gas found most abundant in the atmosphere is
(a) He (b) Ne (c) Ar (d) Kr
(e) Xe

27. When MnO_2 is fused with KOH and KNO_3, a coloured compound is formed. Choose the right compound with the appropriate colour.
(a) K_2MnO_4, green (b) $KMnO_4$, purple
(c) Mn_2O_3, brown (d) Mn_3O_4, black
(e) MnO_2, black

28. Identify the case(s) where there is change in oxidation number.
(a) Acidified solution of CrO_4^{2-}
(b) SO_2 gas bubbled through an acidic solution of $Cr_2O_7^{2-}$
(c) Alkaline solution of $Cr_2O_7^{2-}$
(d) Ammoniacal solution of CrO_4^{2-}
(e) Aqueous solution of CrO_2Cl_2 in NaOH.

29. Water gas is produced by
(a) passing steam over red hot coke
(b) passing steam and air over red hot coke
(c) burning coke in excess air
(d) burning coke in limited supply of air
(e) both (a) and (b).

30. The volume of oxygen liberated at STP from 15 mL of 20 volume H_2O_2 is
(a) 100 mL (b) 150 mL
(c) 200 mL (d) 250 mL
(e) 300 mL

31. Corundum is _____ mineral of aluminium.
(a) silicate (b) oxide
(c) double salt (d) sulphate
(e) nitrate

32. The solution which does not produce precipitate when treated with aqueous K_2CO_3 is
(a) $BaCl_2$ (b) $CaBr_2$
(c) $MgCl_2$ (d) Na_2SO_4
(e) $Pb(NO_3)_2$

33. If the boiling point difference between the two liquids is not much then, _____ method is used to separate them.
(a) simple distillation
(b) distillation under reduced pressure
(c) steam distillation
(d) fractional distillation
(e) differential extraction

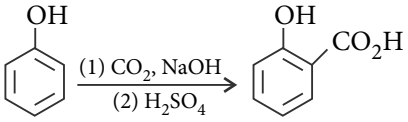
34. Lassaigne's test (with silver nitrate) is commonly used to detect halogens such as chlorine, bromine and iodine but not useful to detect fluorine because the product AgF formed is
(a) volatile (b) reactive
(c) explosive (d) soluble in water
(e) a liquid.

35. Protein is a polymer made of
(a) carbohydrates (b) amino acids
(c) nucleic acids (d) carboxylic acids
(e) polycyclic aromatics.

36. The letter '*D*' in *D*-carbohydrates represents
(a) dextrorotation (b) direct synthesis
(c) configuration (d) mutarotation
(e) optical activity.

37. Phenol is a highly corrosive substance, but its 0.2 per cent solution is used as
(a) antibiotic (b) antiseptic
(c) disinfectant (d) antihistamine
(e) antacid.

38. Name of the following reaction is



(a) Reimer-Tiemann (b) Kolbe-Schmitt
(c) Cannizzaro (d) Gattermann
(e) Gattermann-Koch.

39. *X* and *Y* in the below reaction are _____ and _____, respectively.

$$C_6H_5 - CO_2H + X \xrightarrow{\text{heat}} C_6H_5 - COCl \xrightarrow[\text{quinoline}]{H_2,\ Pd/BaSO_4} Y$$

(a) $SOCl_2$ and C_6H_5CHO
(b) $(COCl)_2$ and $C_6H_5CH_3$
(c) $SOCl_2$ and $C_6H_5CH_3$
(d) $(COCl)_2$ and $C_6H_5CH_2OH$
(e) $SOCl_2$ and $C_6H_5CH_2Cl$

40. The reaction of propene with HBr in presence of peroxide proceeds through the intermediate

(a) $H_3C-\overset{\bullet}{C}H-CH_3$

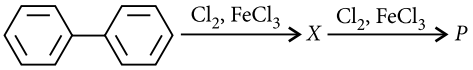
(b) $H_3C-\overset{\bullet}{C}H-CH_2Br$

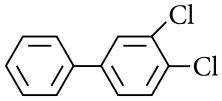
(c) $H_3C-\underset{Br}{\underset{|}{CH}}-\overset{\bullet}{C}H_2$

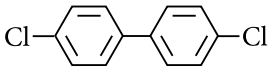
(d) $H_3C-CH_2-\overset{\bullet}{C}H_2$

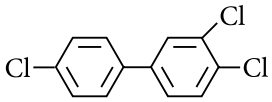
(e) none of the above.

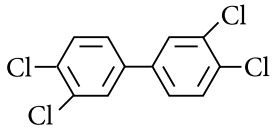
41. The major product *P* formed in the following reaction is

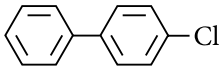


(a) 

(b) 

(c) 

(d) 

(e) 

42. The correct increasing order of the acid strength of acids, butyric acid (I), 2-chlorobutyric acid(II), 3-chlorobutyric acid (III), and 2,2-dichlorobutyric acid (IV) is

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

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

(e) IV < III < II < I

43. Cycloheptatrienyl cation is

(a) non-benzenoid and non-aromatic

(b) non-benzenoid and aromatic

(c) benzenoid and non-aromatic

(d) benzenoid and aromatic

(e) non-benzenoid and anti-aromatic.

44. The correct order of increasing reactivity of the following alkyl halides, $CH_3CH_2CH(Br)CH_3$ (I), $CH_3CH_2CH_2CH_2Br$ (II), $(CH_3)_2CClCH_2CH_3$ (III) and $CH_3CH_2CH_2Cl$ (IV), towards S_N2 displacement is

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

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

(e) I < III < II < IV

45. The strongest base among the following is

(a) amide ion (b) hydroxide ion

(c) trimethylamine (d) ammonia

(e) aniline.

46. The condensation reaction between one equivalent of acetone and two equivalents of benzaldehyde in presence of dilute alkali leads to the formation of

(a) benzalacetophenone

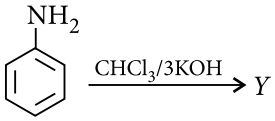
(b) benzylideneacetone

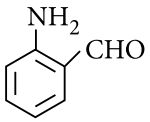
(c) dibenzylideneacetone

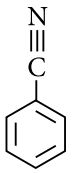
(d) benzoic acid and acetic acid

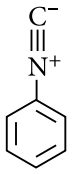
(e) only benzoic acid.

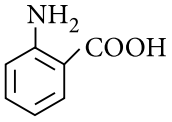
47. The product *Y* for the below reaction is

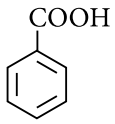


(a) 

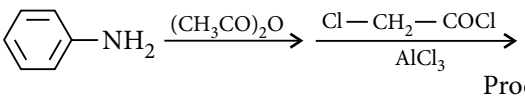
(b) 

(c) 

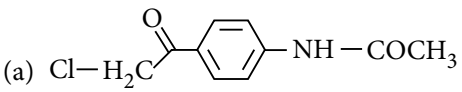
(d) 

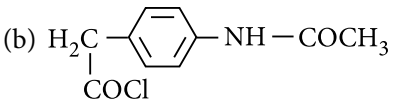
(e) 

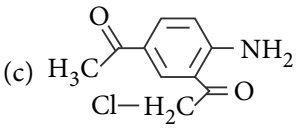
48. The product formed in the following reaction is

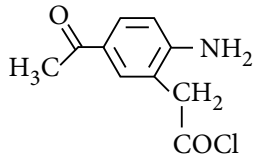


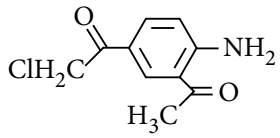
Product

(a) 

(b) 

(c) 

(d) 

(e) 

SOLUTIONS

1. (c) : Uncertainty principle is valid for microscopic particles. As one molecule of methane is considered as a microscopic particle, hence uncertainty principle is also valid for CH_4 molecule.

2. (a) : $E_n = \frac{-13.6}{n^2}$ eV

$= -1.51$ eV ($n = 3$, for $3s$ – orbital)

3. (e) : Greater the difference in electronegativity values of the two atoms forming the bond, higher will be the dipole moment of the molecule. 'F' has highest electronegativity value. Thus, HF will have the highest dipole moment.

4. (a) : Total number of electrons in $CN^- = 6 + 7 + 1 = 14$

Total number of electrons in $NO^+ = 7 + 8 - 1 = 14$

Total number of electrons in $O_2^- = 2 \times 8 + 1 = 17$

Total number of electrons in $CN^+ = 6 + 7 - 1 = 12$

Thus, CN^- and NO^+ have identical bond order because both CN^- and NO^+ contains same number of electrons.

5. (c) : At high temperature and low pressure, the forces of attraction between gas molecules do not exist, then, gas approaches ideal behaviour.

6. (c) : The volume of the gas at 0 K will be zero. This means that gas will not exist, hence pressure will also be zero.

7. (b) : $A(l, 0.05 \text{ atm}, 32°C) \rightarrow A(g, 0.05 \text{ atm}, 32°C)$

Liquid A is changing into gaseous A, thus, randomness is increasing, *i.e.*, entropy change (ΔS) is positive.

$$K_p = \frac{p_{A(g)}}{p_{A(l)}} = \frac{0.05}{0.05} = 1$$

$\Delta G° = -RT \ln K = -RT \ln 1 = 0$

Thus, the system is in equilibrium.

8. (b)

9. (e) : Use of catalyst may change the order of the reaction as the reaction mechanism in presence of catalyst could be different than that in absence of it.

10. (b) : $\Delta S° > 0$

$\Delta H° < 0$

$\Delta G° = \Delta H° - T\Delta S°$ ...(i)

$\Delta G° = -RT \ln K$ ...(ii)

Then, $-RT \ln K = \Delta H° - T\Delta S°$

$$\ln K = \frac{-\Delta H°}{RT} + \frac{\Delta S°}{R}$$

On plotting $\ln K$ vs $\frac{1}{T}$, a straight line graph is obtained with slope equal to $-\frac{\Delta H°}{R}$ or $\frac{|\Delta H°|}{R}$

11. (b) : $\frac{3}{2}A \rightarrow B$, $\Delta G° = 163$ kJ mol^{-1}

Reaction quotient,

$$Q_c = \frac{[B]}{[A]^{3/2}} = \frac{1}{(10,000)^{3/2}} = 10^{-6}$$

$\Delta G° = -RT \ln K_c$

$163 \times 10^3 = -8.314 \times 298 \ln K_c$

$$2.303 \log K_c = -\frac{163 \times 10^3}{8.314 \times 298}$$

$$\log K_c = \frac{-163 \times 10^3}{8.314 \times 298 \times 2.303}$$

$\log K_c = -28.57$

$K_c = 2.69 \times 10^{-29}$

Thus, $Q_c > K_c$

The reaction will therefore move in the backward direction.

12. (a) : Let solubility of $PbCl_2$ be s mol/L

Solubility equilibrium is represented as :

$$\underset{s}{PbCl_2} \rightleftharpoons \underset{s}{Pb^{2+}} + \underset{2s}{2Cl^-}$$

K_{sp} of $PbCl_2 = [Pb^{2+}]\,[Cl^-]^2 = 1.8 \times 10^{-4}$ mol^3 dm^{-9}

$s \times (2s)^2 = 1.8 \times 10^{-4}$ mol^3 dm^{-9}

$4s^3 = 1.8 \times 10^{-4} \Rightarrow s^3 = 0.45 \times 10^{-4}$

$s = (0.45 \times 10^{-4})^{1/3}$ mol dm^{-3}

$\therefore$ Concentration of Pb^{2+} in the solution

$= (0.45 \times 10^{-4})^{1/3}$ mol dm^{-3}

13. (e) : Depression in freezing point, $\Delta T_f = iK_f m$

where, i = van't Hoff factor

K_f = Molal cryoscopic constant, m = molality

Also, $\Delta T_f = T_f^\circ - T_f$

where T_f° = Freezing point of pure solvent

T_f = freezing point of solution
or, $T_f = \Delta T_f^\circ - \Delta T_f$
Lesser the ΔT_f value, higher will be the freezing point of the solution.
$C_6H_5NH_3Cl \rightleftharpoons C_6H_5NH_3^+ + Cl^-$; $i = 2$
$AgNO_3 \rightleftharpoons Ag^+ + NO_3^-$; $i = 2$
$Ca(NO_3)_2 \rightleftharpoons Ca^{2+} + 2NO_3^-$; $i = 3$
$La(NO_3)_3 \rightleftharpoons La^{3+} + 3NO_3^-$; $i = 4$
D-fructose does not ionise, thus $i = 1$
Thus, ΔT_f will be minimum for *D*-fructose, hence, its aqueous solution has highest freezing point.

14. (a) : $m = \dfrac{M \times 1000}{(1000d - M \times M_B)}$

where, M = Molarity
m = Molality, d = Density
M_B = Molal mass of solute
Molar mass of $CH_3OH = 12 + 4 \times 1 + 16$
$= 32 \text{ g mol}^{-1}$
Substituting values in equation, we get

$$m = \frac{3 \times 1000}{1000 \times 0.9 - 3 \times 32} = \frac{3000}{900 - 96} = 3.73 \text{ m}$$

15. (c) : In $H_2 - O_2$ fuel cell, net reaction is
$2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(l)}$
Since, the cell is supplied with 1 mole of H_2 gas and 10 moles of O_2, H_2 is the limiting reagent. Thus, 1 mole of H_2 reacts with 0.5 mole of O_2,

$$H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)} \; ; \; n = 2e^-$$

$Q = nF$ and $Q = I \times t$
Thus, $2 \times 96500 = 96.5 \times 10^{-3} \times t$

$$t = \frac{2 \times 96500}{96.5 \times 10^{-3}} = 2 \times 10^6 \text{ s}$$

16. (a)

17. (e) : $MgCO_3 \longrightarrow MgO + CO_2$
10 g 4 g 0.1 mole
Molar mass of $MgCO_3 = 24 + 12 + 3 \times 16$
$= 84 \text{ g mol}^{-1}$
Molar mass of $MgO = 24 + 16 = 40 \text{ g mol}^{-1}$
Molar mass of $CO_2 = 12 + 2 \times 16 = 44 \text{ g mol}^{-1}$
40 g of MgO is obtained from 84 g of $MgCO_3$
$\therefore$ 4 g of MgO will be obtained from

$$\frac{84}{40} \times 4 \text{ g of } MgCO_3 = 8.4 \text{ g of } MgCO_3$$

$$\% \text{ purity of } MgCO_3 = \frac{8.4}{10} \times 100 = 84\%$$

18. (c) : Molar mass of $Na_2CO_3 = 2 \times 23 + 12 + 3 \times 16$
$= 106 \text{ g mol}^{-1}$
Molar mass of $H_2O = 2 \times 1 + 16 = 18 \text{ g mol}^{-1}$
Now, $Na_2CO_3.xH_2O$ has 50% H_2O by mass.

$$\therefore \quad \frac{50}{100}(106 + 18x) = 18x$$

$$53 + 9x = 18x$$
$$x = 5.888 \simeq 6$$

19. (b) : Carbon has sp^3 hybridisation in CH_3^-.

20. (a) : **Note :** Read NO_2^+ as NO^+ in the question.
Total no. of electrons in CO = 6 + 8 = 14
Total no. of electrons in CN^- = 6 + 7 + 1 = 14
Total no. of electrons in NO^+ = 7 + 8 – 1 = 14
Molecular orbital configuration for each will be same, *i.e.*,
$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

$$\text{Bond order} = \frac{N_b - N_a}{2} = \frac{10 - 4}{2} = 3$$

21. (c) : $BeCl_2$ is a covalent compound, whereas all others are ionic compounds.

22. (b) : Calcium hydride (CaH_2) on reaction with water evolves two moles of hydrogen and calcium hydroxide.

$$\underset{\text{Calcium hydride}}{CaH_{2(s)}} + \underset{\text{Water}}{2H_2O_{(l)}} \longrightarrow \underset{\text{Calcium hydroxide}}{Ca(OH)_{2(aq.)}} + \underset{\text{Hydrogen}}{2H_{2(g)}}$$

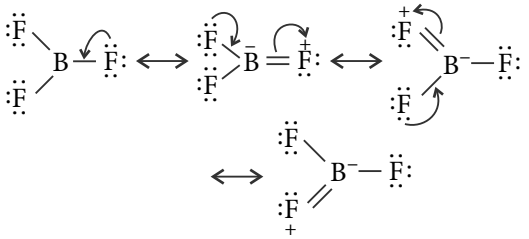
$$Ca(OH)_{2(aq)} + CO_{2(g)} \longrightarrow \underset{\text{Calcium carbonate (white turbidity)}}{CaCO_{3(s)}} + H_2O_{(g)}$$

23. (a) : $\underset{\text{Potassium}}{2K} + \underset{\text{Water}}{2H_2O} \longrightarrow \underset{\text{Potassium hydroxide}}{2KOH} + \underset{\text{Hydrogen}}{H_2}$

$$2KOH + 2K \xrightarrow{400\text{-}500\ ^\circ C} 2K_2O + H_2$$

24. (d) : Baeyer's process, Hall's process and Serpeck's process are used for the extraction of aluminium. The aluminium obtained is further purified by Hoope's electrolytic refining method.

25. (c, e) : Resonating structures of BF_3 are



All bonds in BF_3 are covalent in nature.

26. (c) : Argon is the most abundant noble gas (0.934% by volume).

27. (a) : When MnO_2 is fused with KOH in the presence of oxidising agent such as potassium nitrate (KNO_3), a green coloured compound, potassium manganate, (K_2MnO_4) is formed.

$$MnO_2 + 2KOH + KNO_3 \longrightarrow \underset{\text{(Green)}}{K_2MnO_4} + KNO_2 + H_2O$$

28. (b) : (a) $2\overset{+6}{Cr}O_4^{2-} + 2H^+ \longrightarrow \overset{+6}{Cr_2}O_7^{2-} + H_2O$

(b) $\overset{+6}{Cr_2}O_7^{2-} + 2H^+ + 3SO_2 \longrightarrow \overset{+3}{Cr_2}(SO_4)_3 + H_2O$

(c) $\overset{+6}{Cr_2}O_7^{2-} + 2OH^- \longrightarrow 2\overset{+6}{Cr}O_4^{2-} + H_2O$

(d) Ammoniacal solution of CrO_4^{2-} is $(NH_4)_2CrO_4$.

(e) $\overset{+6}{Cr}O_2Cl_2 + 4NaOH \longrightarrow Na_2\overset{+6}{Cr}O_4 + 2H_2O + 2NaCl$

29. (a) : Water gas is a mixture of carbon monoxide and hydrogen. It is synthesise by passing steam over red hot coke at 1000 °C.

$$\underset{\text{Red hot coke}}{C} + \underset{\text{Steam}}{H_2O} \longrightarrow \underbrace{H_2 + CO}_{\text{Water gas}}$$

30. (e) : 1 L of 20 volume H_2O_2 liberates 20 L of O_2.

$\therefore$ 15 mL of 20 volume H_2O_2 will liberate

$$= \frac{20 \times 1000}{1000} \times 15 \text{ mL } O_2 = 300 \text{ mL } O_2$$

31. (b) : Corundum is aluminium oxide (Al_2O_3).

32. (d) : $K_2CO_3 + BaCl_2 \longrightarrow \underset{\text{White ppt.}}{BaCO_3\downarrow} + 2KCl$

$K_2CO_3 + CaBr_2 \longrightarrow \underset{\text{White ppt.}}{CaCO_3\downarrow} + 2KBr$

$K_2CO_3 + MgCl_2 \longrightarrow \underset{\text{White ppt.}}{MgCO_3\downarrow} + 2KCl$

$K_2CO_3 + Na_2SO_4 \longrightarrow \underset{\text{(Soluble)}}{Na_2CO_3} + K_2SO_4$

$K_2CO_3 + Pb(NO_3)_2 \longrightarrow \underset{\text{White ppt.}}{PbCO_3\downarrow} + 2KNO_3$

33. (d) : If the boiling points of the two liquids of the mixture are close to each other, then fractional distillation method is used to separate them.

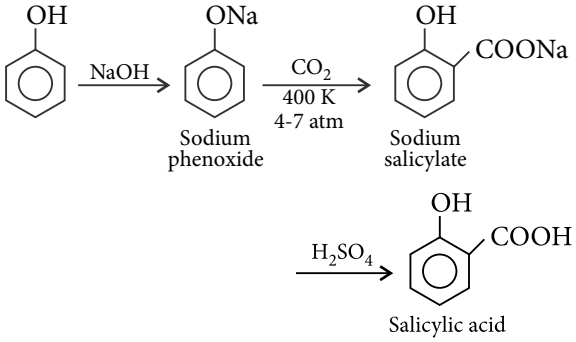
34. (d) : Lassaigne's test is not used to detect fluorine in the organic compound as the product formed during this test, *i.e.*, AgF is highly soluble in water and does not precipitate.

35. (b) : Proteins are the condensation polymers of α-amino acids.

36. (c) : The letter '*D*' in *D*-carbohydrates represents configuration. A monosaccharide is assigned *D*-configuration if the —OH group at the last chiral carbon lies towards right hand side.

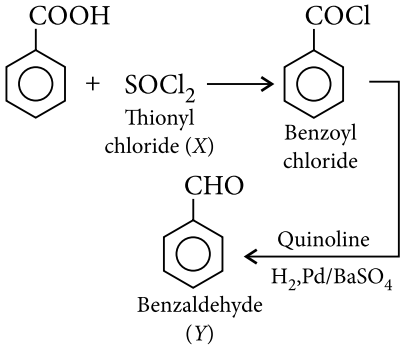
37. (b) : 0.2% solution of phenol acts as an antiseptic and its 1% solution acts as a disinfectant.

38. (b) :

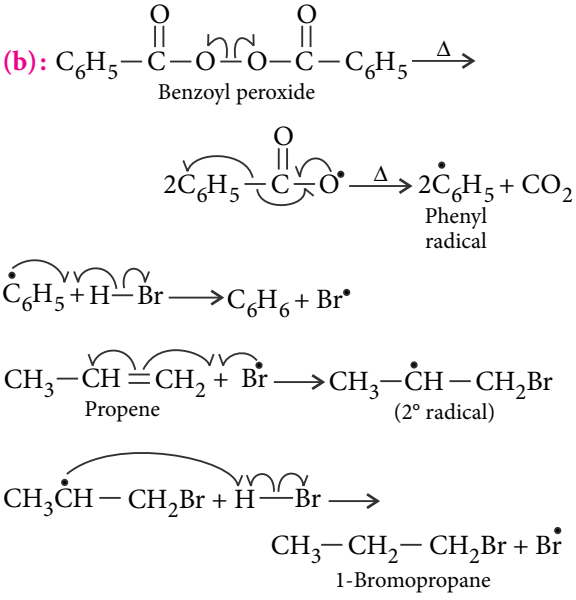


The reaction is called Kolbe-Schmitt reaction.

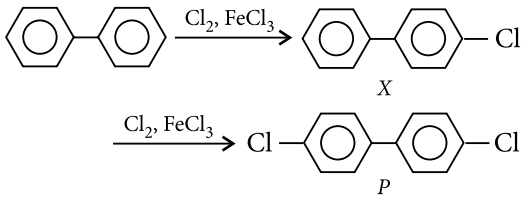
39. (a) :



40. (b) :



41. (b):



42. (c):

$CH_3CH_2CH_2COOH$; $CH_3-\underset{\underset{Cl}{|}}{CH}-COOH$

Butyric acid (I)

2-Chlorobutyric acid (II)

$CH_3-\underset{\underset{Cl}{|}}{CH}-CH_2-COOH$;

3-Chlorobutyric acid (III)

$CH_3-CH_2-\underset{\underset{Cl}{|}}{\overset{\overset{Cl}{|}}{C}}-COOH$

2,2-Dichlorobutyric acid (IV)

Electron withdrawing groups increase the acidic strength of carboxylic acids due to $-I$ effect. Greater the number of such groups, greater is the acid strength. Also, inductive effect decreases with distance.

Then, order of increasing acid strength is

I < III < II < IV

43. (b): Cycloheptatrienyl cation is :

It is aromatic compound, *i.e.*, it has $(4n + 2)\ \pi e^-s$ and is planar. Then, it obeys Huckel's rule of aromaticity. It is non-benzenoid compound.

44. (b): Reactivity order of alkyl halides towards S_N2 reaction follows the order :

Methyl halide > 1° > 2° > 3°

Also, better the leaving groups, higher is the reactivity. Br^- is a better leaving group than Cl^-.

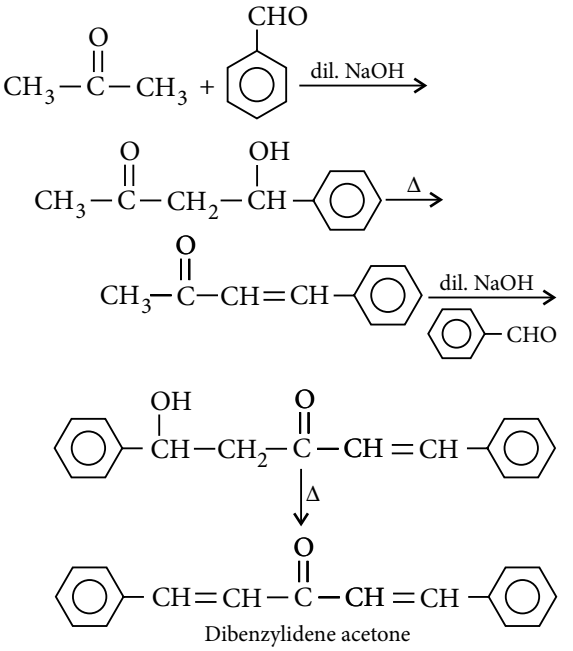
Thus, reactivity order towards S_N2 reaction is

$(CH_3)_2\underset{\underset{Cl}{|}}{C}-CH_2CH_3$ (III) < $CH_3CH_2\underset{\underset{Br}{|}}{CH}-CH_3$ (I)

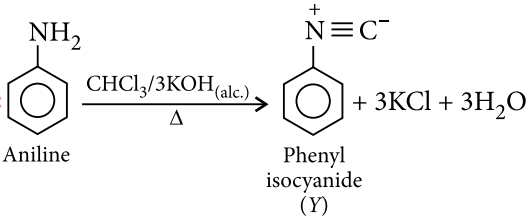
< $CH_3CH_2CH_2Cl$ (IV) < $CH_3CH_2CH_2CH_2Br$ (II)

45. (a)

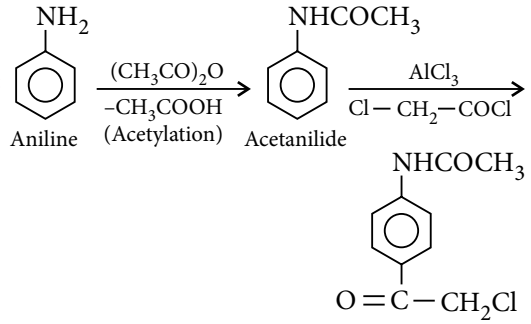
46. (c): Crossed aldol condensation takes place between one equivalent of acetone and two equivalents of benzaldehyde in presence of dilute alkali dibenzylidene acetone is formed.



47. (c):



48. (a):



CONCEPT **MAP**

ACID-BASE TITRATIONS

Titrations have wide applications in food industry, medical field as well as in automotive industry. In medical, it is used to determine proper concentration of anaesthetics and to measure glucose level in the blood. In automotive, it is used during production of biodiesel fuel.

Class XI

Class XII

EXTRACTION OF SOME METALS

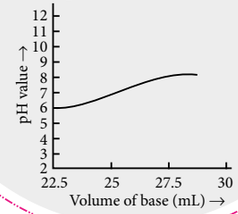
Technological development for extraction of metals from low grade ores is an emerging and important area due to depletion of high grade ore resources. Hydrometallurgy, in principle, can provide viable technical options for processing lean ores.

CONCEPT **MAP**

Titration Curves

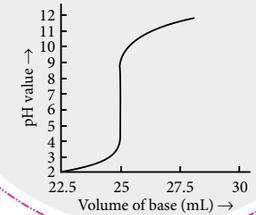
Weak acid-Weak base

In the titration of CH_3COOH with NH_4OH the pH at the equivalence point lies between 6.5-7.5 but no sharp change in pH is observed in these titrations. Thus, no simple indicator can be used for the detection of the equivalence point.



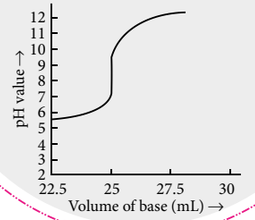
Strong acid-Strong base

In the titration of HCl with NaOH , the equivalence point lies in the pH range of 4-10. Thus, methyl orange (pH range 3.2-4.5), methyl red (pH range 4.2-6.3) and phenolphthalein (pH range 8.3-10) will be the suitable indicators.



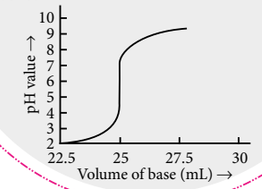
Weak acid-Strong base

In the titration of CH_3COOH with NaOH, the equivalence point lies between the pH range 7.5-10. Hence, phenolphthalein (pH range 8.3-10) will be the suitable indicator.



Strong acid-Weak base

In the titration of HCl with NH_4OH, the pH at equivalence point lies between the pH range 4-6.5.Thus, methyl orange (pH range 3.1-4.4) or methyl red (pH range 4.2-6.3) will be the suitable indicators.



Important Terms

- *Titration* is the measurement of the volume of a solution of one reactant that is required to react completely with a measured amount of another reactant.
- The solution which is to be titrated is called *titrate*.
- The solution with which the titration is to be done is called the *titrant*.
- The substance usually added into the solution taken in the titration flask to detect the equivalence point is called an *indicator*. The *equivalence point* is the ideal point for the completion of titration, *i.e.*, it is the exact point in a titration when moles of one titrant becomes equal to the moles of the substance being titrated.
- The *end point* is the point at which the indicator just changes its colour. End point indicates that equivalence point has been reached.
- The point at which there is a sudden change in pH when a very small amount of the titrant is added to the titrate is called *point of inflection*.
- The curve between pH values of the solution and the volume of titrant added as the titration proceeds is called a *titration curve*.
- The determination of concentration of bases by titration with a standard acid is called *acidimetry*.
- The determination of concentration of acids by titration with a standard base is called *alkalimetry*.

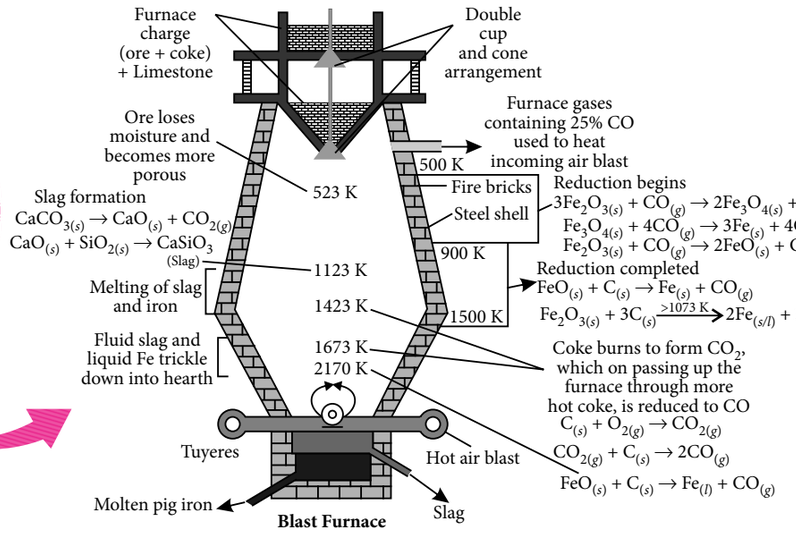
Types of Indicators

- *Self indicator* : A substance is said to be self indicator if it itself acts as an indicator in titration *e.g.*, potassium permanganate ($KMnO_4$) and oxalic acid $(COOH)_2$.
- *External indicator* : In some redox titrations, the end point is detected with the help of a substance which is not added to the solution being titrated but used outside the titrating system, *e.g.*, potassium ferricyanide.
- *Internal indicator* : The substance or reagents which are added to the solution in the conical flask or beaker during the titration to find out the end point, *e.g.*, phenolphthalein, methyl orange, starch solution, etc.

Iron (Fe)

(Pig iron)

- **Concentration :** The crushed ore is concentrated by gravity separation and froth floatation process (for sulphide ores).
- **Calcination :** Ore is heated strongly in the presence of a limited supply of air in a reverberatory furnace. Sulphide ores are roasted to their oxides.
- **Smelting :** Calcined ore is smelted in a blast furnace.



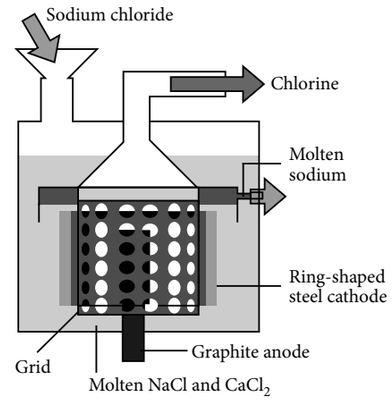
Sodium (Na)

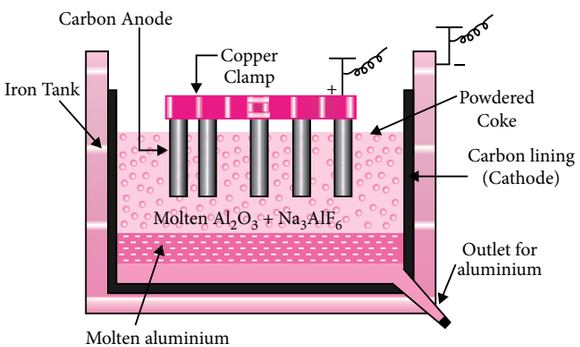
(Down's process)

- The oxides of highly electropositive metals like Na, K, Mg, Al requires very high temperature for reduction.
- These metals are extracted by the electrolysis of their oxides, hydroxides or chlorides in fused state.
- A small amount of some other salt is added to lower the fusion temperature or to increase the conductivity or both.
- Electrolysis of fused mixture of NaCl and $CaCl_2$:

Cathode : $Na^+ + e^- \rightarrow Na_{(l)}$

Anode : $Cl^- \rightarrow \frac{1}{2}Cl_{2(g)} + e^-$





Aluminium (Al)

(Hall – Heroult process)

- Process of obtaining aluminium by electrolysis of a mixture of purified alumina, cryolite and fluorspar.

Purified alumina is obtained by calcination of bauxite ore ($Al_2O_3.xH_2O$).

Electrolytic reactions involved :

Cathode : $Al^{3+}_{(melt)} + 3e^- \rightarrow Al_{(l)}$

Anode : $C_{(s)} + O^{2-}_{(melt)} \rightarrow CO_{(g)} + 2e^-$

$C_{(s)} + 2O^{2-}_{(melt)} \rightarrow CO_{2(g)} + 4e^-$

EXAM PREP

Useful for Medical/Engg. Entrance Exams

1. Choose the correct match from the following.
(a) Emulsion-smoke (b) Gel-butter
(c) Aerosol-hair cream (d) Sol-whipped cream

2. Given table shows that the bond dissociation energies (E_{diss}) for single covalent bonds of carbon (C) atoms with elements *A*, *B*, *C* and *D*. Which of these elements has the smallest atoms?

Bond	E_{diss} (kJ mol^{-1})
C – *A*	240
C – *B*	328
C – *C*	276
C – *D*	485

(a) *A* (b) *B* (c) *C* (d) *D*

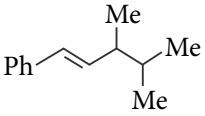
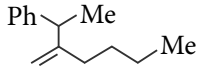
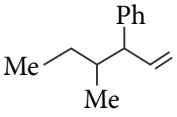
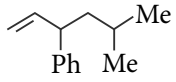
3. Consider the following reactions of two metals *A* and *B* :

$ACl_2 + BCl_2 \longrightarrow ACl_4 + B\downarrow$
(Excess)

$BO \xrightarrow{Heat} B + 1/2O_2$

An ore of *B* is
(a) cinnabar (b) azurite
(c) galena (d) siderite.

4. Which of the following is *s*-butylphenylvinyl methane?

(a) 
(b) 
(c) 
(d) 

5. In which of the following pairs, both the hydrides are not of the same type?
(a) LaH_3, TiH_2 (b) CH_4, H_2S
(c) NaH, CaH_2 (d) BaH_2, SiH_4

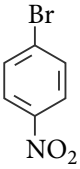
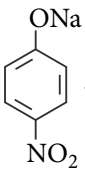
6. Which of the following molecules has two types of F*X*F angles (*X* = S, Xe, C)?
(a) SF_4 (b) XeF_4 (c) SF_6 (d) CF_4

7. Ammonia under a pressure of 15 atm at 27 °C is heated to 347 °C in a closed vessel in the presence of a catalyst. Under the conditions, NH_3 is partially decomposed according to the equation,

$2NH_3 \rightleftharpoons N_2 + 3H_2$

The vessel is such that the volume remains constant whereas pressure increases to 50 atm. What is the percentage of NH_3 actually decomposed?
(a) 65% (b) 61.3%
(c) 62.5% (d) 64%

8. Which of the following is a correct set of reactants for the preparation of 1-methoxy-4-nitrobenzene?

(*P*)  + CH_3ONa (*Q*)  + CH_3Br

(a) *P* (b) *Q*
(c) Both *P* and *Q* (d) None of these

9. The value of maximum percentage of available chlorine of bleaching powder ($CaOCl_2 \cdot H_2O$) is
(a) 35 (b) 40 (c) 45 (d) 49

10. For the given hypothetical reaction mechanism,

$A \xrightarrow{I} B \xrightarrow{II} C \xrightarrow{III} D \xrightarrow{IV} E$

the data is given as :

Species formed	Rate of its formation
B	0.002 mol/h per mole of *A*
C	0.030 mol/h per mole of *B*
D	0.011 mol/h per mole of *C*
E	0.120 mol/h per mole of *D*

The rate determining step for the reaction is

(a) step I (b) step II
(c) step III (d) step IV.

11. Based on lattice energy and other facts, which one of the following alkali metal chlorides is expected to have highest melting point?

(a) LiCl (b) NaCl (c) KCl (d) RbCl

12. A solution containing one mole per litre of each $Cu(NO_3)_2$, $AgNO_3$, $Hg_2(NO_3)_2$ and $Mg(NO_3)_2$, is being electrolysed by using inert electrodes. The values of standard electrode potentials in volts (reduction potentials) are Ag^+/Ag = +0.80, $Hg_2^{2+}/2Hg$ = +0.79, Cu^{2+}/Cu = +0.34, Mg^{2+}/Mg = – 2.37. The sequence of deposition of metals on the cathode is

(a) Ag, Hg, Cu, Mg (b) Mg, Cu, Hg, Ag
(c) Ag, Hg, Cu (d) Cu, Hg, Ag

13. In a reaction vessel, 100 g H_2 and 100 g Cl_2 are mixed and suitable conditions are provided for the following reaction,

$$H_{2(g)} + Cl_{2(g)} \xrightarrow{h\nu} 2HCl_{(g)}$$

Quantum yield of this reaction, ϕ is 10^5.
The limiting reagent in this reaction is

(a) H_2 (b) Cl_2
(c) both (a) and (b) (d) cannot be predicted.

14. 8 g of a radioactive substance is reduced to 0.5 g after 1 hour. The $t_{1/2}$ of the radioactive substance is

(a) 15 min (b) 30 min
(c) 45 min (d) 10 min

15. An alkane with molecular formula, C_6H_{14} reacts with chlorine in the presence of light and heat to give two constitutionally isomeric monochlorides of molecular formula, $C_6H_{13}Cl$. What will be the starting alkane?

(a) *n*-Hexane (b) 2,2-Dimethylbutane
(c) 2,3-Dimethylbutane (d) 3-Methylpentane

16. Which of the following reactions is correctly related to extraction of Pb from galena?

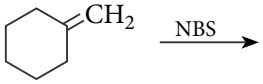
(a) Galena $\xrightarrow{\text{Froth floatation}}$ Ore $\xrightarrow[\text{with air}]{\text{Roasting}}$ Roasted ore $\xrightarrow{\text{Heating with PbS}}$ Pb

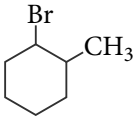
(b) Galena $\xrightarrow[\text{separation}]{\text{Magnetic}}$ Ore $\xrightarrow[\text{with air}]{\text{Roasting}}$ Roasted ore $\xrightarrow[\text{by carbon}]{\text{Reduction}}$ Pb

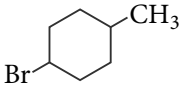
(c) Galena $\xrightarrow[\text{by NaCN}]{\text{Leaching}}$ Ore $\xrightarrow{\text{Zn}}$ Pb

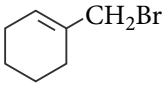
(d) Galena $\xrightarrow{\text{Froth floatation}}$ Ore $\xrightarrow[\text{reduction}]{\text{Electrolytic}}$ Pb

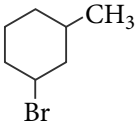
17. What will be the product in the following reaction?



(a) 

(b) 

(c) 

(d) 

18. In chromite ore, the oxidation number of iron and chromium are respectively

(a) +3, +2 (b) +3, +6
(c) +2, +6 (d) +2, +3

19. For an octahedral complex, which of the following *d*-electron configurations will give maximum CFSE?

(a) High spin d^6 (b) Low spin d^5
(c) Low spin d^4 (d) High spin d^7

20. 0.395 g of an organic compound by Carius method for the estimation of S gave 0.582 g of $BaSO_4$. What is the percentage of S in the compound?

(a) 20.23% (b) 35.62%
(c) 12.24% (d) 40.65%

21. Correct decreasing order of reactivity in Williamson ether synthesis of the following is

I. Me_3CCH_2Br II. $CH_3CH_2CH_2Br$
III. $CH_2=CHCH_2Cl$ IV. $CH_3CH_2CH_2Cl$

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

22. Air contains 20% oxygen by volume. What will the theoretical volume of air which will be required for burning completely 500 m^3 of acetylene gas? (All volumes are measured under the same conditions of temperature and pressure.)

(a) 1250 m^3 (b) 6250 m^3
(c) 1550 m^3 (d) 5250 m^3

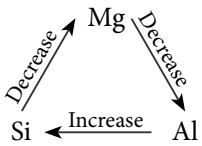
23. Oxidation of acetaldehyde with selenium dioxide gives

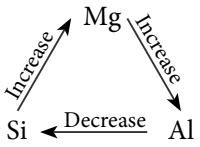
(a) ethanoic acid (b) methanoic acid
(c) glyoxal (d) oxalic acid.

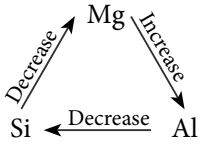
24. How long would it take a radiowave of frequency, 6×10^3 s^{-1} to travel from Mars to the Earth, a distance of 8×10^7 km?
(a) 2 min 66 s (b) 4 min 26 s
(c) 3 min 22 s (d) 5 min 44 s

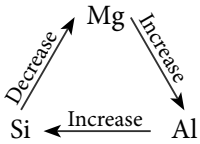
25. Proteins are found to have two different types of secondary structures *viz.* α-helix and β-pleated sheet structure. α-Helix strucutre of protein is made up of
(a) peptide bonds
(b) van der Waals forces
(c) hydrogen bonds
(d) dipole-dipole interactions.

26. Select correct systematic diagram which is related to second *I.E.* of Mg, Al, Si.

(a) 

(b) 

(c) 

(d) 

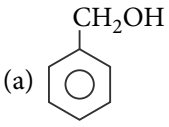
27. An aqueous solution of glucose is made by dissolving 10 g of glucose ($C_6H_{12}O_6$) in 90 g of water at 303 K. If the vapour pressure of pure water at 303 K is 32.8 mm Hg, what would be the vapour pressure (in mm Hg) of the solution?
(a) 32.8 (b) 35.5 (c) 31.8 (d) 32.44

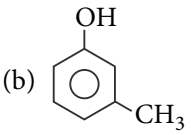
28. Which of the following statements is not correct?
(a) Some disinfectants can be used as antiseptic at low concentration.
(b) Sulphadiazine is a synthetic antibacterial.
(c) Pheromones provide chemical means of establishing communication.
(d) Norethindrone is a pheromone.

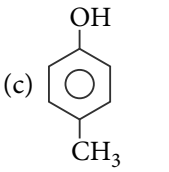
29. Which of the following is in accordance to inert pair effect?
(i) $SnCl_2$ acts as a reducing agent.
(ii) $SnCl_4$ acts as an oxidising agent.
(iii) SnO_2 is amphoteric.
(iv) PbO_2 is an oxidant.
(v) CCl_2 is unstable but $PbCl_2$ is stable.
(a) (i), (iv), (v)
(b) (iv), (v)
(c) (i), (ii), (iii), (iv) and (v)
(d) (i), (ii) and (iii)

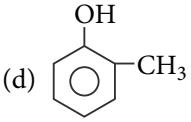
30. A mineral of titanium (perovskite) is found to contain calcium ions at the corners, oxygen atoms at the face centres and titanium atoms at the centre of the cube. The oxidation state of titanium in the mineral will be
(a) +1 (b) +3 (c) +4 (d) +2

31. Compound $A(C_7H_8O)$ is insoluble in $NaHCO_3$ solution but dissolves in sodium hydroxide and gives a characteristic colour with aqueous ferric chloride solution. When treated with bromine, *A* forms compound *B* with molecular formula, $C_7H_5OBr_3$. Give the structural formula of *A*.

(a) 

(b) 

(c) 

(d) 

32. Highest oxidation state of manganese in fluoride is +4 (MnF_4) but highest oxidation state in oxides is +7 (Mn_2O_7) because
(a) fluorine is more electronegative than oxygen
(b) fluorine does not possess *d*-orbitals
(c) fluorine stabilises lower oxidation state
(d) in covalent compounds fluorine can form single bond only while oxygen forms double bond.

33. Which of the following chemicals are used to manufacture methyl isocyanate that caused "Bhopal Gas Tragedy"?
(i) Methylamine (ii) Phosgene
(iii) Phosphine (iv) Dimethylamine
(a) (i) and (ii) (b) (iii) and (iv)
(c) (i) and (iii) (d) (ii) and (iv)

34. In the solvolysis of 3-methyl-3-bromohexane, which of the following statements is wrong?
(a) It involves carbocation intermediate.
(b) The intermediate involves sp^2-carbon.
(c) The rate of reaction depends upon 3-methyl-3-bromohexane concentration.
(d) It involves inversion of configuration.

35. If two molecules each of *A* and *B* have mass 100 kg and 64 kg respectively and rate of diffusion of *A* is 12×10^{-3}, then the value rate of diffusion of *B* is

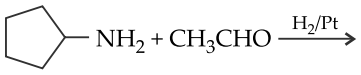
(a) 15×10^{-3} (b) 64×10^{-3}
(c) 5×10^{-3} (d) 46×10^{-3}

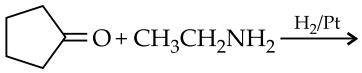
36. What will be the correct order for the wavelengths of absorption in the visible region for the following $[Ni(NO_2)_6]^{4-}$, $[Ni(NH_3)_6]^{2+}$, $[Ni(H_2O)_6]^{2+}$?

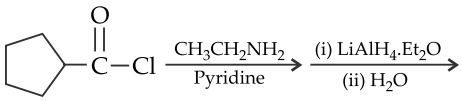
I II III

(a) I > II > III (b) III > II > I
(c) II > I > III (d) III > I > II

37. Which of the following reactions does not give *N*-ethyl cyclopentyl amine as a major product?

(a) 

(b) 

(c) 

(d) 

38. The entropy change involved in the isothermal reversible expansion of 2 moles of an ideal gas from a volume of 10 dm^3 to a volume of 100 dm^3 at 27 °C is

(a) 35.8 J mol^{-1} K^{-1} (b) 32.3 J mol^{-1} K^{-1}
(c) 42.3 J mol^{-1} K^{-1} (d) 38.3 J mol^{-1} K^{-1}

39. Which of the following is not true for low density polythene?

(a) Tough
(b) Hard
(c) Poor conductor of electricity
(d) Highly branched structure

40. The Nobel prize in Chemistry in 2005 was awarded for the work

(a) concerning the reduction of hazardous wastes in creating new chemicals
(b) concerning the formation and decomposition of ozone
(c) concerning the recycling of CFCs
(d) concerning the climate change.

41. Critical temperature values of H_2O, NH_3, CO_2 and O_2 are 647 K, 405.6 K, 304.10 K and 154.2 K respectively. If the cooling starts from 500 K to their critical temperature, the gas that liquefies first is

(a) H_2O (b) NH_3 (c) CO_2 (d) O_2

42. Which of the following reactions of glucose can be explained by its cyclic structure?

(a) Glucose forms pentaacetate.
(b) Glucose reacts with hydroxyl amine to form an oxime.
(c) Pentaacetate of glucose does not react with hydroxyl amine.
(d) Glucose is oxidised by nitric acid to gluconic acid.

43. Which of the following lanthanides shows II and III common oxidation states?

(a) La (b) Nd (c) Ce (d) Eu

44. E_1, E_2 and E_3 are the emf values of the following three galvanic cells respectively :

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

Which of the following is correct ?

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

45. Polyethylene glycol is used in the preparation of which type of detergents?

(a) Cationic detergents (b) Anionic detergents
(c) Non-ionic detergents (d) Soaps

46. K_p/K_c for the reaction,

$CO_{(g)} + \frac{1}{2} O_{2(g)} \rightleftharpoons CO_{2(g)}$ will be

(a) 1 (b) RT
(c) $1/\sqrt{RT}$ (d) $(RT)^{1/2}$

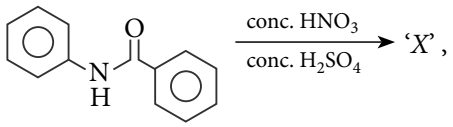
47. The best explanation for the solubility of MnS in dil. HCl is that

(a) solubility product of $MnCl_2$ is less than that of MnS
(b) concentration of Mn^{2+} is lowered by the formation of complex ions with chloride ions
(c) concentration of sulphide ions is lowered by oxidation to free sulphur
(d) concentration of sulphide ions is lowered by formation of the weak acid H_2S.

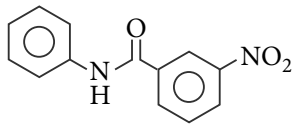
48. A 0.02 M solution of pyridinium hydrochloride has pH = 3.44. The value of the ionisation constant of pyridine, is

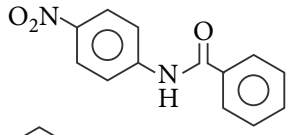
(a) 1.5×10^{-8} (b) 1.5×10^{-7}
(c) 1.5×10^{-9} (d) 1.5×10^{-10}

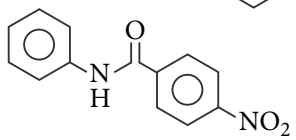
49. In the following reaction,

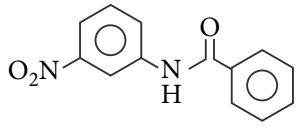


The structure of major product '*X*' will be

(a) 

(b) 

(c) 

(d) 

50. Given the following thermochemical equations :

(i) $S_{(rhombic)} + O_{2(g)} \longrightarrow SO_{2(g)}$, $\Delta H = -297.5$ kJ mol^{-1}

(ii) $S_{(monoclinic)} + O_2 \longrightarrow SO_{2(g)}$, $\Delta H = -300.0$ kJ mol^{-1}

What is the value of ΔH (in kJ mol^{-1}) for the transformation of one gram atom of rhombic sulphur into monoclinic sulphur?

(a) 2.5 (b) 3.9 (c) –2.5 (d) –3.9

SOLUTIONS

1. **(b)**

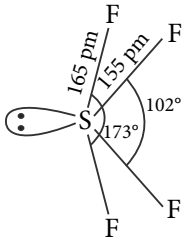
2. **(d):** Bond dissociation energy decreases with increase in size of atoms forming the bonds. So, element *D* has smallest atoms.

3. **(a):** $SnCl_2 + HgCl_2 \longrightarrow SnCl_4 + Hg$
(Excess) (*B*)
$HgO \longrightarrow Hg + 1/2O_2$
Cinnabar (HgS) is an ore of Hg.

4. **(c)**

5. **(d):** LaH_3, TiH_2 : Metallic or interstitial hydrides
CH_4, H_2S : Covalent or molecular hydrides
NaH, CaH_2 : Ionic hydrides
BaH_2 : Ionic hydride
SiH_4 : Covalent or molecular hydride.

6. **(a):**



In SF_4, FSF bond angles are 173° and 102°.

7. **(b):**

	$2NH_3 \rightleftharpoons$	N_2	+ $3H_2$
Initial moles	a	0	0
Moles at equilibrium	$(a - 2x)$	x	$3x$

Initial pressure of 'a' mole of NH_3 = 15 atm at 27° C
The pressure of 'a' mole of NH_3 = p atm at 347 °C

$\therefore \quad \frac{15}{300} = \frac{p}{620}$

$\therefore \quad p = 31$ atm

At constant volume and at a given temperature 347°C, mole $\propto$ pressure

$a \propto 31$ (before equilibrium)

$a + 2x \propto 50$ (after equilibrium)

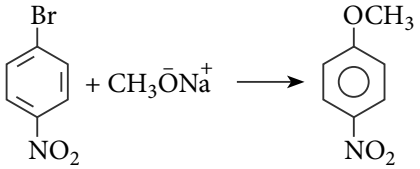
$\therefore \quad \frac{a+2x}{a} = \frac{50}{31}$

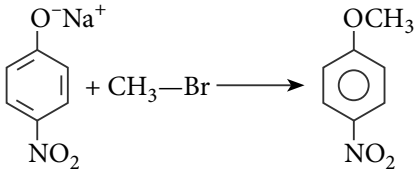
$\therefore \quad x = \frac{19}{62}a$

$\therefore \quad$ % of NH_3 decomposed $= \frac{2x}{a} \times 100$

$= \frac{2 \times 19a}{62 \times a} \times 100 = 61.29\%$

8. **(c):** Aromatic halides cannot be used in Williamson ether synthesis. However, if strong electron withdrawing group at *ortho* and *para*-positions are present then synthesis may take place, *e.g.*,





9. (d) : $\underset{145\text{ g}}{CaOCl_2 \cdot H_2O} \longrightarrow \underset{71\text{ g}}{Cl_2}$

% of available chlorine $= \frac{71}{145} \times 100 = 49$

10. (a) : As step I is the slowest, hence, it is the rate determining step.

11. (b) : On the basis of lattice energy, the melting point of alkali metal chlorides is expected to decrease down the alkali metals group as lattice energy decreases with the increase of the atomic number. However, LiCl has covalent character due to very small size of Li^+ ion. Hence, melting point of NaCl is highest amongst the given alkali metal chlorides.

12. (c) : A cation having highest reduction potential will be reduced first and so on. However, Mg^{2+} in aqueous solution will not be reduced as $E^\circ_{Mg^{2+}/Mg} < E^\circ_{H_2O/\frac{1}{2}H_2+OH^-}$. Thus, water would be reduced instead of Mg^{2+}.

13. (b) : $H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$

Moles of $H_{2(g)} = \frac{100}{2} = 50$

Moles of $Cl_{2(g)} = \frac{100}{71} = 1.04$

As H_2 and Cl_2 reacts in 1 : 1 mole ratio, hence Cl_2 is a limiting agent as it is present in lesser amount.

14. (a) : $N_0 = 8$ g, $N_t = 0.5$ g and $t = 1$ hr $= 60$ min

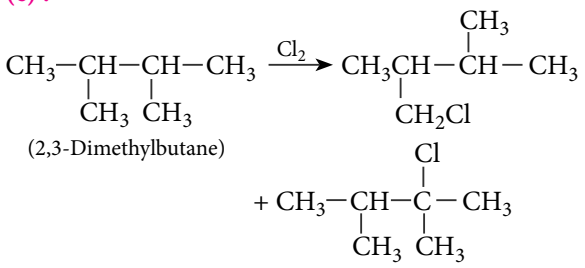
$$t = \frac{2.303 \times t_{1/2}}{0.693} \log \frac{N_0}{N_t} \qquad \left(\because k = \frac{0.693}{t_{1/2}}\right)$$

$$60 = \frac{2.303 \times t_{1/2}}{0.693} \log \frac{8}{0.5}$$

$$60 = \frac{2.303 \times t_{1/2}}{0.693} \times 1.204$$

$\Rightarrow \quad t_{1/2} = 14.99 \simeq 15$ min

15. (c) :

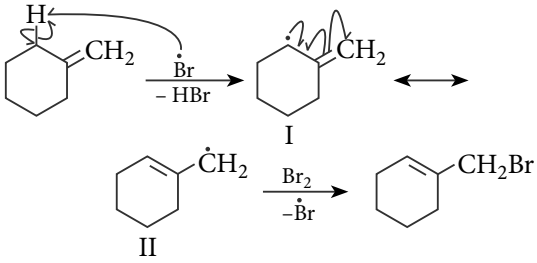


16. (a) : $\underset{\text{(Galena)}}{PbS} \xrightarrow{\text{Froth floatation}} \underset{\text{(Galena)}}{\text{Concentrated PbS}}$

$$PbS + \frac{3}{2}O_2 \xrightarrow{\Delta} PbO + SO_2$$

$$2PbO + PbS \xrightarrow{\Delta} 3Pb + SO_2\uparrow$$

17. (c) : Mechanism of allylic bromination is



Since endocyclic (within ring) double bond (as in radical, II) is more stable than exocyclic (outside ring) double bond (as in radical I), therefore, initially formed less stable free radical (I) gets converted into the more stable free radical (II) which then reacts with Br_2 to give the product.

18. (d) : Chromite ore is $FeCr_2O_4$.

Oxidation state of Fe in $FeCr_2O_4$ is +2.

Let oxidation state of Cr be x in $FeCr_2O_4$.

$2 + 2x + 4(-2) = 0$

$2x = 6 \quad \Rightarrow \quad x = 3$

19. (b) : (a) High spin d^6 ; $t_{2g}^4 e_g^2$

CFSE $= (+0.6 \times 2 - 0.4 \times 4)\Delta_o = -0.4\ \Delta_o$

(b) Low spin d^5 ; t_{2g}^5

CFSE $= (+0.6 \times 0 - 0.4 \times 5)\Delta_o = -2.0\ \Delta_o$

(c) Low spin d^4 ; t_{2g}^4

CFSE $= (+0.6 \times 0 - 0.4 \times 4)\Delta_o = -1.6\ \Delta_o$

(d) High spin d^7 ; $t_{2g}^5 e_g^2$

CFSE $= (+0.6 \times 2 - 0.4 \times 5)\Delta_o = -0.8\ \Delta_o$

Magnitude of CFSE is maximum for low spin d^5 complex.

20. (a) : 233 g of $BaSO_4$ contains = 32 g of S

$\therefore$ 0.582 g of $BaSO_4$ will contain $= \frac{32}{233} \times 0.582$

$= 0.0799$ g of S

% S $= \frac{0.0799}{0.395} \times 100 = 20.23\%$

21. (c) : C—Br bond is weaker than C—Cl bond, therefore, alkyl bromide (II) reacts faster than alkyl chlorides (III) and (IV). Since $CH_2{=}CH—$ is electron withdrawing while $CH_3CH_2—$ is electron donating, therefore, $—CH_2$ in III has more +ve charge than in IV.

$$CH_2=CH \xleftarrow{\delta+} CH_2-Cl$$
III

$$CH_3-CH_2 \xrightarrow{+\delta\delta} CH_2-Cl$$
IV

In other words, nucleophilic attack occurs faster on III than on IV. Further, since Williamson synthesis occurs by S_N2 mechanism, therefore, due to steric hindrance, neopentyl bromide (I) is the least reactive. Thus, the decreasing order of reactivity is : II > III > IV > I

22. (b): $2C_2H_2 + 5O_2 \longrightarrow 4CO_2 + 2H_2O$

C_2H_2	O_2	CO_2	H_2O
2 vol.	5 vol.	4 vol.	2 vol.
1 vol	5/2 vol	2 vol	1 vol
500 m^3	5/2×500 m^3	2×500 m^3	1 × 500 m^3
500 m^3	1250 m^3	1000 m^3	500 m^3

Thus, 1250 m^3 oxygen is required for burning 500 m^3 of acetylene. But the percentage of oxygen in air is 20% only.

$\therefore$ Volume of air required = $1250 \times \frac{100}{20} = 6250\ m^3$

23. (c)

24. (b): All radiations in vacuum travel with the same speed, *i.e.*, $3 \times 10^8\ m\ s^{-1}$

Distance to be travelled from Mars to the Earth $= 8 \times 10^7\ km = 8 \times 10^7 \times 10^3\ m$ ($1\ km = 10^3\ m$)

$\therefore$ Time taken = $\frac{8\times10^7\times10^3}{3\times10^8} = 2.66 \times 10^2\ s$

$= 4\ min\ 26\ s$

25. (c)

26. (c) :

Mg^+	Al^+	Si^+
$3s^1$	$3s^2$	$3p^1$

Order of second *I.E.* is $Al^+ > Si^+ > Mg^+$

27. (d): According to Raoult's law, vapour pressure of the solution contanining non-volatile solute :

$p = p_A^\circ x_A$

where, p_A° = vapour pressure of pure water and x_A is the mole fraction of water.

p_A° = = 32.8 mm Hg

Moles of water = $\frac{90}{18} = 5$

Moles of glucose = $\frac{10}{180} = 0.0556$

Mole fraction of water, $x_A = \frac{5.0}{5.0+0.0556} = 0.989$

Vapour pressure of solution = 32.8 × 0.989

= 32.44 mm Hg

28. (d): Norethindrone is not a pheromone. It is a progestin hormone. It is used for treating certain menstrual and uterine problems.

29. (b): Inert pair effect explains the stability of +2 oxidation state in lower elements of carbon family.

30. (c) : No. of Ca atoms per unit cell

= 8 (corners) × $\frac{1}{8} = 1$

O atoms per unit cell = 6 (face centres) × $\frac{1}{2} = 3$

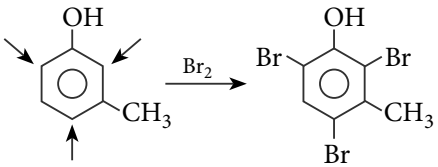
Ti atoms per unit cell = 1

$\therefore$ Formula of mineral = $CaTiO_3$

Suppose oxidation state of Ti is *x*,

$+2 + x + 3(-2) = 0$ or $x = +4$

31. (b): Compound *A* gives characteristic colour with $FeCl_3$ solution, so it has a phenolic group . *A* forms tribromoproduct, thus it is *meta*-cresol.



m-cresol (*A*) $(C_7H_5OBr_3)$ (*B*)

32. (d)

33. (a) : $CH_3NH_2 + COCl_2 \xrightarrow{-2HCl} CH_3-N=C=O$

Methyl amine Phosgene Methyl isocyanate

34. (d): S_N2 mechanism involves retention of configuration.

35. (a) : $m_A = \left(\frac{100}{2}\right)$ kg/molecule

$m_B = \left(\frac{64}{2}\right)$ kg/molecule

Rate of diffusion, $r_A = 12 \times 10^{-3}$ and r_B = ?

According to Graham's law of diffusion,

$$\frac{r_A}{r_B} = \sqrt{\frac{d_B}{d_A}} = \sqrt{\frac{M_B}{M_A}}$$

M_B and M_A are molar masses of *B* and *A* respectively.

$$\Rightarrow \frac{r_A}{r_B} = \sqrt{\frac{(m_B \times N_A)}{(m_A \times N_A)}}$$

$$\frac{r_A}{r_B} = \sqrt{\frac{(64/2)}{(100/2)}} = \sqrt{\frac{64}{100}} = \frac{8}{10} = 0.8$$

or $\frac{12\times10^{-3}}{r_B} = 0.8 \Rightarrow r_B = 15\times10^{-3}$

36. (b): The order of ligand strength in the spectrochemical series is

$H_2O < NH_3 < NO_2^-$

Energy absorbed will be in the order :

$[Ni(H_2O_6)]^{2+} < [Ni(NH_3)_6]^{2+} < [Ni(NO_2)_6]^{4-}$

Since $\lambda \propto 1/E$ ($E = hc/\lambda$), the wavelengths of light absorbed will be in the order :

$Ni(H_2O)_6]^{2+} > [Ni(NH_3)_6]^{2+} > [Ni(NO_2)_6]^{4-}$

37. (c)

38. (d): For isothermal reversible expansion of an ideal gas,

$$\Delta S = nR \ln \frac{V_2}{V_1} = 2 \times 8.314 \times 2.303 \log \frac{100}{10}$$

$= 38.3 \text{ J mol}^{-1} \text{ K}^{-1}$

39. (b)

40. (a): Nobel prize in Chemistry in 2005 was awarded to Yves Chauvin, Robert H. Grubbs and Richard R. Schrock for the development of the metathesis method in organic chemistry which represents a great step forward for green chemistry, reducing potentially hazardous wastes through smarter production.

41. (b): Since the cooling starts from 500 K, so water is not under consideration. As it is much easier to achieve 405.6 K from 500 K so, NH_3 will get liquefied first.

42. (c): Due to absence of free —OH group at C_1, cyclic structure of glucose pentaacetate cannot revert to open chain aldehyde form and hence, cannot form an oxime.

43. (d)

44. (b): $$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n}\log\left[\frac{Zn^{2+}}{Cu^{2+}}\right]$$

$$E_1 = E^\circ_{cell} - \frac{0.0591}{2}\log\frac{0.1}{1}$$

$$= E^\circ_{cell} + \frac{0.0591}{2}$$

$$E_2 = E^\circ_{cell} - \frac{0.0591}{2}\log\frac{1}{1} = E^\circ_{cell}$$

$$E_3 = E^\circ_{cell} - \frac{0.0591}{2}\log\frac{1}{0.1} = E^\circ_{cell} - \frac{0.0591}{2}$$

$\therefore \quad E_1 > E_2 > E_3$

45. (c)

46. (c): $K_p/K_c = (RT)^{\Delta n_g} = (RT)^{-1/2}$

47. (d): It is a characteristic property of group IV radicals, concentration of sulphide ions is lowered by formation of the weak acid, H_2S.

48. (c): $C_6H_5N^+HCl^- + H_2O \rightleftharpoons C_6H_5N^+HOH^- + HCl$

(Solution is acidic due to hydrolysis)

As this is a salt of strong acid and weak base, hence,

$$pH = 7 - \frac{1}{2}(pK_b + \log C)$$

$$3.44 = 7 - \frac{pK_b}{2} - \frac{\log 0.02}{2}$$

$pK_b = 8.82 = -\log K_b$

$\log K_b = -8.82 = \bar{9}.18$

$K_b = \text{antilog } \bar{9}.18 = 1.5 \times 10^{-9}$

49. (b): $-\ddot{\underset{\underset{H}{|}}{N}}-$ group due to $+R$ (or $+M$) effect is always *o*- and *p*-directing in nature while $-\underset{|}{C}=O$ is a *meta*-director. $-\ddot{\underset{\underset{H}{|}}{N}}-$ group has precedence over $-\underset{|}{C}=O$ group.

50. (a): Given :

$S_{(rhombic)} + O_{2(g)} \longrightarrow SO_{2(g)}$; $\Delta H = -297.5 \text{ kJ mol}^{-1}$ ...(i)

$S_{(monoclinic)} + O_{2(g)} \longrightarrow SO_{2(g)}$; $\Delta H = -300.0 \text{ kJ mol}^{-1}$ ...(ii)

On substracting equation (ii) from equation (i), we get

$S_{(rhombic)} \longrightarrow S_{(monoclinic)}$,

$\Delta H = -297.5 - (-300.0) = 2.5 \text{ kJ mol}^{-1}$

$\Delta H = +2.5 \text{ kJ mol}^{-1}$

Thus, for the transformation of one gram atom of rhombic sulphur into monoclinic sulphur, 2.5 kJ mol^{-1} of heat is absorbed.

WBJEE SOLVED PAPER 2017

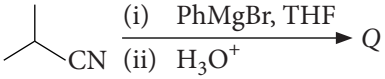
CATEGORY-I (Q. 1 to Q. 30)

Only one answer is correct. Correct answer will fetch full marks 1. Incorrect answer or any combination of more than one answer will fetch –1/4 marks. No answer will fetch 0 marks.

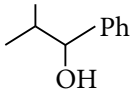
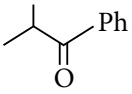
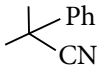
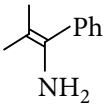
1. ADP and ATP differ in the number of
(a) phosphate units (b) ribose units
(c) adenine base (d) nitrogen atom.

2. The compound that would produce a nauseating smell/odour with a hot mixture of chloroform and ethanolic potassium hydroxide is
(a) $PhCONH_2$ (b) $PhNHCH_3$
(c) $PhNH_2$ (d) PhOH

3. For the reaction below,



the structure of the product *Q* is

(a) 
(b) 
(c) 
(d) 

4. You are supplied with 500 mL each of 2 N HCl and 5 N HCl. What is the maximum volume of 3 M HCl that you can prepare using only these two solutions?
(a) 250 mL (b) 500 mL
(c) 750 mL (d) 1000 mL

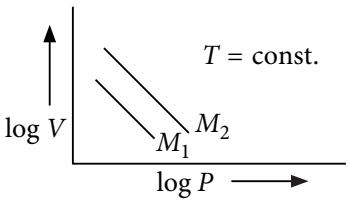
5. Which one of the following corresponds to a photon of highest energy?
(a) $\lambda = 300$ nm (b) $\nu = 3 \times 10^8\ s^{-1}$
(c) $\bar{\nu} = 30\ cm^{-1}$ (d) $E = 6.626 \times 10^{-27}$ J

6. Assuming the compounds to be completely dissociated in aqueous solution, identify the pair of the solutions that can be expected to be isotonic at the same temperature.
(a) 0.01 M Urea and 0.01 M NaCl
(b) 0.02 M NaCl and 0.01 M Na_2SO_4
(c) 0.03 M NaCl and 0.02 M $MgCl_2$
(d) 0.01 M Sucrose and 0.02 M glucose

7. How many faradays are required to reduce 1 mol of $Cr_2O_7^{2-}$ to Cr^{3+} in acid medium?
(a) 2 (b) 3 (c) 5 (d) 6

8. Equilibrium constants for the following reactions at 1200 K are given :
$2H_2O_{(g)} \rightleftharpoons 2H_{2(g)} + O_{2(g)}$; $K_1 = 6.4 \times 10^{-8}$
$2CO_{2(g)} \rightleftharpoons 2CO_{(g)} + O_{2(g)}$; $K_2 = 1.6 \times 10^{-6}$
The equilibrium constant for the reaction
$H_{2(g)} + CO_{2(g)} \rightleftharpoons CO_{(g)} + H_2O_{(g)}$ at 1200 K will be
(a) 0.05 (b) 20 (c) 0.2 (d) 5.0

9.



For same mass of two different ideal gases of molecular weights M_1 and M_2, plots of log *V* vs log *P* at a given constant temperature are shown. Identify the correct option.
(a) $M_1 > M_2$
(b) $M_1 = M_2$
(c) $M_1 < M_2$
(d) Can be predicted only if temperature is known

10. Which of the following has the dimension of ML^0T^{-2}?
(a) Coefficient of viscosity
(b) Surface tension
(c) Vapour pressure
(d) Kinetic energy

11. If the given four electronic configurations
(i) $n = 4, l = 1$ (ii) $n = 4, l = 0$
(iii) $n = 3, l = 2$ (iv) $n = 3, l = 1$
are arranged in order of increasing energy, then the order will be
(a) (iv) < (ii) < (iii) < (i)
(b) (ii) < (iv) < (i) < (iii)
(c) (i) < (iii) < (ii) < (iv)
(d) (iii) < (i) < (iv) < (ii)

12. Which of the following sets of quantum numbers represents the 19th electron of Cr ($Z = 24$) ?
(a) $\left(4, 1, -1+\frac{1}{2}\right)$ (b) $\left(4, 0, 0, +\frac{1}{2}\right)$
(c) $\left(3, 2, 0, -\frac{1}{2}\right)$ (d) $\left(3, 2, -2, +\frac{1}{2}\right)$

13. 0.126 g of an acid is needed to completely neutralise 20 mL 0.1 N NaOH solution. The equivalent weight of the acid is
(a) 53 (b) 40 (c) 45 (d) 63

14. In a flask, the weight ratio of $CH_{4(g)}$ and $SO_{2(g)}$ at 298 K and l bar is 1 : 2. The ratio of the number of molecules of $SO_{2(g)}$ and $CH_{4(g)}$ is
(a) 1 : 4 (b) 4 : 1 (c) 1 : 2 (d) 2 : 1

15. $C_6H_5F^{18}$ is a F^{18} radio-isotope labelled organic compound. F^{18} decays by positron emission. The product resulting on decay is
(a) $C_6H_5O^{18}$ (b) $C_6H_5Ar^{19}$
(c) $B^{12}C_5H_5F$ (d) $C_6H_5O^{16}$

16. Dissolving NaCN in de-ionized water will result in a solution having
(a) pH < 7 (b) pH = 7
(c) pOH = 7 (d) pH > 7

17. Among Me_3N, C_5H_5N and MeCN (Me = methyl group), the electronegativity of N is in the order
(a) MeCN > C_5H_5N > Me_3N
(b) C_5H_5N > Me_3N > MeCN
(c) Me_3N > MeCN > C_5H_5N
(d) electronegativity is same in all.

18. The shape of XeF_5^- will be
(a) square pyramid
(b) trigonal bipyramidal
(c) planar
(d) pentagonal bipyramid.

19. The ground state magnetic property of B_2 and C_2 molecules will be
(a) B_2 paramagnetic and C_2 diamagnetic
(b) B_2 diamagnetic and C_2 paramagnetic
(c) both are diamagnetic
(d) both are paramagnetic.

20. The number of unpaired electrons in $[NiCl_4]^{2-}$, $Ni(CO)_4$ and $[Cu(NH_3)_4]^{2+}$ respectively are
(a) 2, 2, 1 (b) 2, 0, 1 (c) 0, 2, 1 (d) 2, 2, 0

21. Which of the following atoms should have the highest 1st electron affinity?
(a) F (b) O (c) N (d) C

22. $PbCl_2$ is insoluble in cold water. Addition of HCl increases its solubility due to
(a) formation of soluble complex anions like $[PbCl_3]^-$
(b) oxidation of Pb(II) to Pb (IV)
(c) formation of $[Pb(H_2O)_6]^{2+}$
(d) formation of polymeric lead complexes.

23. Of the following compounds, which one is the strongest Bronsted acid in a aqueous solution?
(a) $HClO_3$ (b) $HClO_2$ (c) HOCl (d) HOBr

24. The correct basicity order of the following lanthanide ions is
(a) $La^{3+} > Lu^{3+} > Ce^{3+} > Eu^{3+}$
(b) $Ce^{3+} > Lu^{3+} > La^{3+} > Eu^{3+}$
(c) $Lu^{3+} > Ce^{3+} > Eu^{3+} > La^{3+}$
(d) $La^{3+} > Ce^{3+} > Eu^{3+} > Lu^{3+}$

25. When $BaCl_2$ is added to an aqueous salt solution, a white precipitate is obtained. The anion among CO_3^{2-}, SO_3^{2-} and SO_4^{2-} that was present in the solution can be
(a) CO_3^{2-} but not any of the other two
(b) SO_3^{2-} but not any of the other two
(c) SO_4^{2-} but not any of the other two
(d) any of them.

26. In the IUPAC system, $PhCH_2CH_2CO_2H$ is named as
(a) 3-phenylpropanoic acid
(b) benzylacetic acid
(c) carboxyethyl benzene
(d) 2-phenylpropanoic acid.

27. The isomerisation of 1-butyne to 2-butyne can be achieved by treatment with
(a) hydrochloric acid
(b) ammoniacal silver nitrate
(c) ammoniacal cuprous chloride
(d) ethanolic potassium hydroxide.

28. The correct order of acid strengths of benzoic acid (X), peroxybenzoic acid (Y) and p-nitrobenzoic acid (Z) is

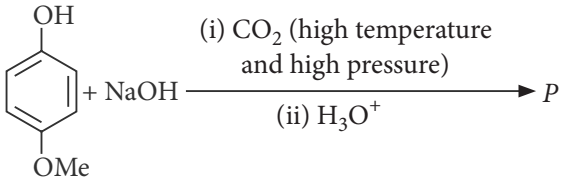
(a) $Y > Z > X$ (b) $Z > Y > X$

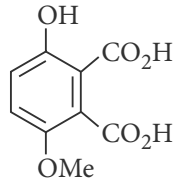
(c) $Z > X > Y$ (d) $Y > X > Z$

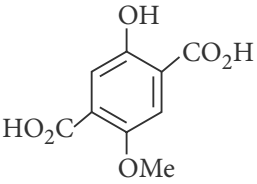
29. The yield of acetanilide in the reaction (100% conversion) of 2 moles of aniline with 1 mole of acetic anhydride is

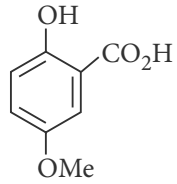
(a) 270 g (b) 135 g (c) 67.5 g (d) 177 g

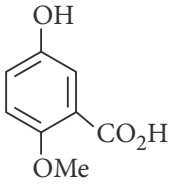
30. The structure of the product P of the following reaction is



(a) 

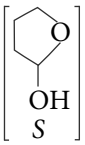
(b) 

(c) 

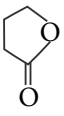
(d) 

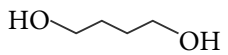
CATEGORY-II (Q. 31 to Q. 35)

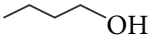
Only one answer is correct. Correct answer will fetch full marks 2. Incorrect answer combination of more than one answer will fetch –1/2 marks. No answer will fetch 0 marks.

31. Reduction of the lactol S  with sodium borohydride gives

(a) 

(b) 

(c) 

(d) 

32. What will be the normality of the salt solution obtained by neutralizing x mL y (N) HCl with y mL x (N) NaOH, and finally adding $(x + y)$ mL distilled water?

(a) $\frac{2(x+y)}{xy}$ N (b) $\frac{xy}{2(x+y)}$ N

(c) $\left(\frac{2xy}{x+y}\right)$ N (d) $\left(\frac{x+y}{xy}\right)$ N

33. In a close-packed body-centred cubic lattice of potassium, the correct relation between the atomic radius (r) of potassium and the edge length (a) of the cube is

(a) $r = \frac{a}{\sqrt{2}}$ (b) $r = \frac{a}{\sqrt{3}}$

(c) $r = \frac{\sqrt{3}}{2}a$ (d) $r = \frac{\sqrt{3}}{4}a$

34. Which of the following solutions will turn violet when a drop of lime juice is added to it?

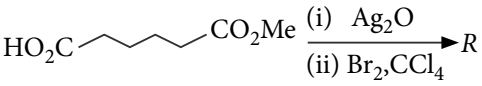
(a) A solution of NaI

(b) A solution mixture of KI and $NaIO_3$

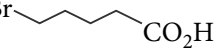
(c) A solution mixture of NaI and KI

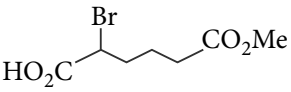
(d) A solution mixture of KIO_3 and $NaIO_3$

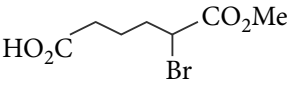
35. The reaction sequence given below gives product R.

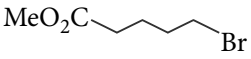


The structure of the product R is

(a) 

(b) 

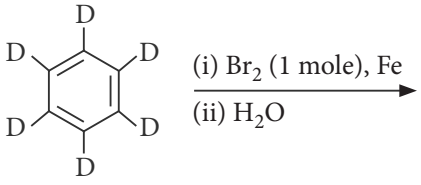
(c) 

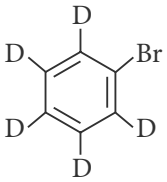
(d) 

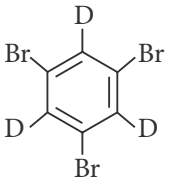
CATEGORY-III (Q. 36 to Q. 40)

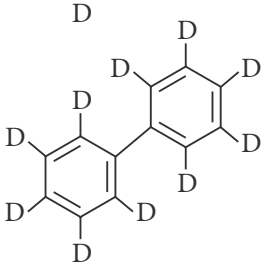
One or more answer(s) is (are) correct. Correct answer(s) will fetch marks 2. Any combination containing one or more incorrect answer will fetch 0 marks. Also no answer will fetch 0 marks. If all correct answers are not marked and also no incorrect answer is marked then score = 2 × number of correct answers marked ÷ actual number of correct answers.

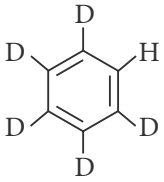
36. The major product(s) obtained from the following reaction of 1 mole of hexadeuteriobenzene is/are



(a) 

(b) 

(c) 

(d) 

37. Identify the correct statement(s).
The findings from the Bohr model for H-atom are
(a) angular momentum of the electron is expressed as integral multiples of $\frac{h}{2\pi}$
(b) the first Bohr radius is 0.529 Å
(c) the energy of the n^{th} level, E_n is proportional to $\frac{1}{n^2}$
(d) the spacing between adjacent levels increases with increase in 'n'

38. During electrolysis of molten NaCl, some water is added, what will happen?
(a) Electrolysis will stop.
(b) Hydrogen will be evolved.
(c) Some amount of caustic soda will be formed.
(d) A fire is likely.

39. The role of fluorspar, which is added in small quantities in the electrolytic reduction of alumina dissolved in fused cryolite is
(a) as a catalyst
(b) to make fused mixture conducting
(c) to lower the melting temperature of the mixture
(d) to decrease the rate of oxidation of carbon at anode.

40. The reduction of benzenediazonium chloride to phenyl hydrazine can be accomplished by
(a) $SnCl_2$, HCl (b) Na_2SO_3
(c) CH_3CH_2OH (d) H_3PO_2

SOLUTIONS

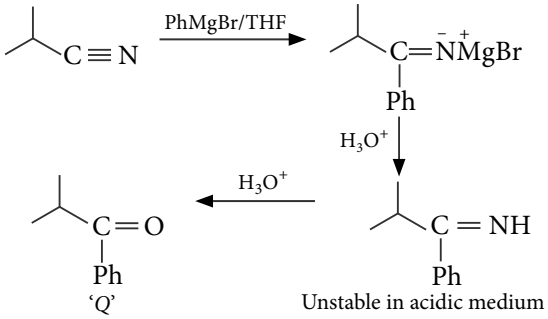
1. (a) : ADP is adenosine diphosphate and it has two phosphate groups while ATP in adenosine triphosphate and it has three phosphate groups. Thus, ATP and ADP differ in number of phosphate units.

2. (c) : 1° aliphatic/aromatic amines react with chloroform in presence of alcoholic KOH to give isocyanides which have nauseating smell/odour.

$$Ph-NH_2 \xrightarrow[KOH\,(alc.)]{CHCl_3} Ph-N\rightleftarrows C$$

This reaction is known as carbylamine reaction.

3. (b):



4. (c) : Maximum volume of 3 M HCl solution can be prepared by taking 500 mL of 2 N HCl and some volume of 5 N HCl (let x mL).
For HCl, Molarity = Normality
So, $N_1V_1 + N_2V_2 = N_3V_3$
$500 \times 2 + x \times 5 = (x + 500) \times 3$
($\because$ Volume of 3 M solution formed = 500 mL + x mL)
$\therefore$ $1000 + 5x = 3x + 1500$
$2x = 500$; $x = 250$ mL
Thus, maximum volume of 3 M solution formed = 500 + 250 = 750 mL

5. (a) : (a) $\lambda = 300\ nm = 300 \times 10^{-9}\ m$

$$E = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{300\times10^{-9}}$$

$= 6.626 \times 10^{-19}$ J
(b) $\nu = 3 \times 10^8\ s^{-1}$
$E = h\nu = 6.626 \times 10^{-34} \times 3 \times 10^8$
$= 1.9878 \times 10^{-25}$ J
(c) $\bar{\nu} = 30\ cm^{-1} = 30 \times 10^2\ m^{-1}$
$E = hc\bar{\nu} = 6.626 \times 10^{-34} \times 3 \times 10^8 \times 30 \times 10^2$
$= 5.9634 \times 10^{-22}$J
(d) $E = 6.626 \times 10^{-27}$J

6. (c) : For isotonic solutions, $\pi_1 = \pi_2$
where, π = osmotic pressure = $iCRT$

As the given solutions are at same temperature thus,

$i_1C_1RT = i_2C_2RT$

(a) For urea : $i_1 = 1$; $C_1 = 0.01$ M

For NaCl : $i_2 = 2$; $C_2 = 0.01$ M

$1 \times 0.01 \times RT \neq 2 \times 0.01 \times RT$ (not isotonic)

(b) For NaCl : $i_1 = 2$; $C_1 = 0.02$ M

For Na_2SO_4 : $i_2 = 3$; $C_2 = 0.01$ M

$2 \times 0.02 \times RT \neq 3 \times 0.01 \times RT$ (not isotonic)

(c) For NaCl : $i_1 = 2$; $C_1 = 0.03$ M

For $MgCl_2$: $i_2 = 3$; $C_2 = 0.02$ M

$2 \times 0.03 \times RT = 3 \times 0.02 \times RT$

$0.06\ RT = 0.06\ RT$

Thus, these solutions are isotonic.

(d) For sucrose : $i_1 = 1$; $C_1 = 0.01$ M

For glucose : $i_2 = 1$; $C_2 = 0.02$ M

$1 \times 0.01 \times RT \neq 1 \times 0.02 \times RT$ (not isotonic)

7. (d): In acidic medium,

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

Thus, $n = 6$

Hence, 6 F charge is required to reduce 1 mol of $Cr_2O_7^{2-}$ to Cr^{3+} in acidic medium.

8. (d): Given :

$2H_2O_{(g)} \rightleftharpoons 2H_{2(g)} + O_{2(g)}$; $K_1 = 6.4 \times 10^{-8}$ ...(i)

$2CO_{2(g)} \rightleftharpoons 2CO_{(g)} + O_{2(g)}$; $K_2 = 1.6 \times 10^{-6}$ ...(ii)

Required equation is :

$H_{2(g)} + CO_{2(g)} \rightleftharpoons CO_{(g)} + H_2O_{(g)}$; $K = ?$

By reversing equation (i) and by multiplying it with 1/2, we get

$$H_{2(g)} + \tfrac{1}{2}O_{2(g)} \rightleftharpoons H_2O_{(g)}\ ;\ K_1' = \sqrt{\frac{1}{6.4\times10^{-8}}} \quad ...(iii)$$

And by multiplying equation (ii) with 1/2, we get

$$CO_{2(g)} \rightleftharpoons CO_{(g)} + \frac{1}{2}O_{2(g)}\ ;\ K_2' = \sqrt{1.6\times10^{-6}} \quad ...(iv)$$

By adding equations (iii) and (iv), we get

$H_{2(g)} + CO_{2(g)} \rightleftharpoons CO_{(g)} + H_2O_{(g)}$; $K' = K_1' \times K_2'$

$$K' = \sqrt{\frac{1.6\times10^{-6}}{6.4\times10^{-8}}} = \sqrt{25} = 5$$

9. (a): For ideal gases,

$$PV = nRT = \frac{w}{M}RT \qquad (\because\ n = w/M)$$

For same mass of gases and at constant temperature wRT is constant (K).

$$\therefore \quad PV = \frac{K}{M}$$

Taking log both sides, we get

$$\log P + \log V = \log \frac{K}{M}$$

$$\log V = -\log P + \log \frac{K}{M}$$

Comparing this with straight line equation,

$y = mx + c$

For ideal gas 1, $(\text{Intercept})_1 = \log \frac{K}{M_1}$

For ideal gas 2, $(\text{Intercept})_2 = \log \frac{K}{M_2}$

$$\therefore \quad \log \frac{K}{M_2} > \log \frac{K}{M_1} \qquad \text{(from graph)}$$

$$\text{or} \quad \frac{K}{M_2} > \frac{K}{M_1} \quad \Rightarrow M_1 > M_2$$

10. (b): Surface tension $\gamma = \frac{F}{l}$

$F \Rightarrow M^1L^1T^{-2}$; $l = M^0L^1T^0$

$$\gamma = \frac{M^1L^1T^{-2}}{M^0L^1T^0} = M^1L^0T^{-2}$$

11. (a): (i) $n = 4$, $l = 1$ $\Rightarrow$ 4p-orbital

(ii) $n = 4$, $l = 0$ $\Rightarrow$ 4s-orbital

(iii) $n = 3$, $l = 2$ $\Rightarrow$ 3d-orbital

(iv) $n = 3$, $l = 1$ $\Rightarrow$ 3p-orbital

Increasing order of energy as per $(n + l)$ rule :

$3p < 4s < 3d < 4p$

(iv) (ii) (iii) (i)

12. (b): Electronic configuration of

Cr (24) : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$

So, 19th electron is present in 4s-orbital.

For 4s – orbital,

$n = 4$, $l = 0$, $m = 0$, $s = \pm 1/2$

13. (d): Equivalents of acid = Equivalents of base

$$= \frac{NV}{1000} = \frac{0.1\times20}{1000} = 2\times10^{-3}$$

$$\text{No. of gram equivalents} = \frac{\text{Mass}}{\text{Equivalent Mass}}$$

$$2 \times 10^{-3} = \frac{0.126}{\text{Equivalent Mass}}$$

$$\text{Equivalent mass} = \frac{0.126}{2\times10^{-3}} = \frac{126}{2} = 63$$

14. (c) : Let mass of $CH_{4(g)}$ = 1 g

Number of moles of $CH_4 (n_{CH_4}) = \frac{1}{16}$

Number of molecules of $CH_{4(g)} = \frac{1}{16} \times N_A$

Let the mass of $SO_{2(g)}$ = 2 g

Number of moles of $SO_{2(g)}$ $(n_{SO_2}) = \frac{2}{64}$

Number of molecules of $SO_{2(g)} = \frac{2}{64} \times N_A$

Ratio of number of molecules of $SO_{2(g)}$: number of molecules of $CH_{4(g)}$

$$\frac{2}{64} \times N_A : \frac{1}{16} \times N_A \Rightarrow \frac{1}{32} : \frac{1}{16} \Rightarrow 1:2$$

15. (a) : Positron emission :

$${}_9F^{18} \rightarrow {}_8E^{18} + {}_{+1}e^0$$

atomic number 8 is for oxygen.

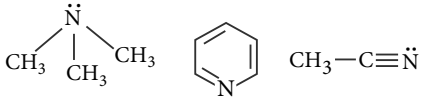
Thus, ${}_8E^{18}$ is ${}_8O^{18}$, $C_6H_5O^{18}$ will be the product after positron emission.

16. (d): Hydrolysis of NaCN,

$$NaCN + H_2O \rightleftharpoons \underset{\text{Strong base}}{NaOH} + \underset{\text{Weak acid}}{HCN}$$

Hence, the resulting solution will be basic; pH > 7.

17. (a) : Me_3N ; C_5H_5N ; MeCN



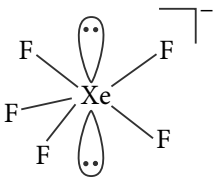
Hybridisation of N atom : sp^3 sp^2 sp

As the % *s*-character increases, electronegativity increases.

∴ Electronegativity order is :

$sp > sp^2 > sp^3 \Rightarrow$ MeCN > C_5H_5N > Me_3N

18. (c) : XeF_5^- is sp^3d^3 hybridised with 2 lone pairs.



Geometry : Pentagonal bipyramid

Shape : Pentagonal planar

19. (a) : B_2 molecule :

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1 \approx \pi 2p_y^1$

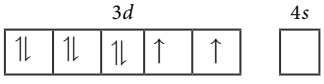
(Two unpaired electrons hence, paramagnetic)

C_2 molecule :

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 \approx \pi 2p_y^2$

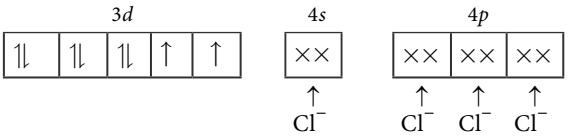
No unpaired electron hence, diamagnetic.

20. (b): In $[NiCl_4]^{2-}$, Ni is in +2 oxidation state.

Ni^{2+} : $[Ar]3d^8 4s^0$ 

Cl^- is a weak field ligand, thus pairing of electrons does not take place.

$[NiCl_4]^{2-}$:

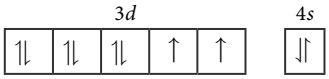


sp^3 hybridisation

Unpaired electrons = 2

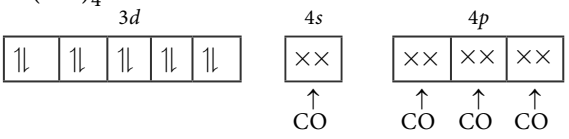
In $Ni(CO)_4$, Ni is in zero oxidation state.

Ni : $[Ar]\ 3d^8\ 4s^2$



CO is strong field ligand and causes pairing of electron of 4*s* to 3*d*.

$Ni(CO)_4$:



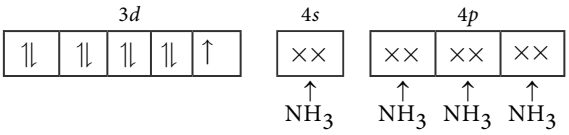
sp^3 hybridisation

Unpaired electron = 0

In $[Cu(NH_3)_4]^{2+}$, Cu is in +2 oxidation state.

Cu^{2+} : $[Ar]\ 3d^9 4s^0$

$[Cu(NH_3)_4]^{2+}$:



sp^3 hybridisation

Unpaired electron = 1

21. (a) : Order of electron affinity : F > O > C > N

22. (a) : Addition of chloride ions to a suspension of $PbCl_2$ gives rise to soluble complex ions as shown :

$$PbCl_{2(s)} + Cl^- \longrightarrow [PbCl_3]^-_{(aq)}$$

$$PbCl_2(s) + 2Cl^- \longrightarrow [PbCl_4]^{2-}_{(aq)}$$

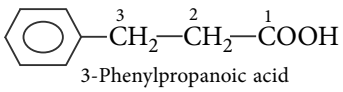
23. (a) : Higher the oxidation state of central atom, higher will be its electronegativity and hence, higher will be acidic strength.

$$\underset{}{\overset{+5}{HClO_3}} > \overset{+3}{HClO_2} > \overset{+1}{HClO}$$

HOBr is least acidic due to lesser electronegativity of Br.

24. (d)

25. (d): $BaCO_3$, $BaSO_3$ and $BaSO_4$ are all white precipitates in aqueous solution.

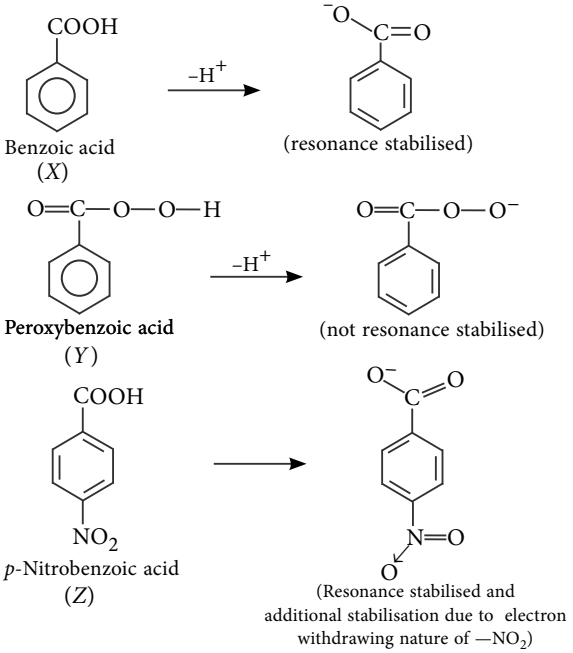
26. (a) : 

3-Phenylpropanoic acid

27. (d): On heating with alcoholic KOH or $NaNH_2$ in inert solvent, the triple bond of 1-alkyne is shifted towards the centre to form an isomeric 2-alkyne.

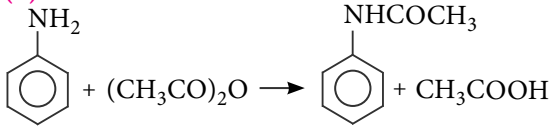
$$\underset{\text{1-Butyne}}{CH_3CH_2C{\equiv}CH} \xrightarrow[\Delta]{\text{Alc. KOH}} \underset{\text{2-Butyne}}{CH_3{-}C{\equiv}C{-}CH_3}$$

28. (c): The acidic strength depends upon the stabilisation of negative charge developed due to the donation of H^+ ion.



Hence, acidic strength order is $Z > X > Y$.

29. (b):

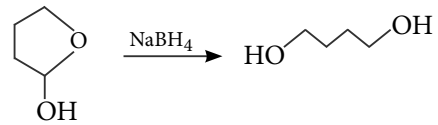


Init. moles :	2	1	0	0
After reaction :	1	0	1	1

1 mole of acetanilide = 135 g

30. (c)

31. (c):



32. (b):

	$HCl + NaOH \longrightarrow$		$NaCl + H_2O$	
meq. added	xy	xy	0	0
meq. left	0	0	xy	xy

$$\text{Normality} = \frac{\text{Number of meq.}}{\text{Volume of solution(in mL)}}$$

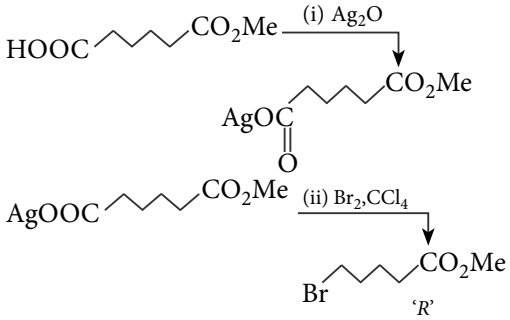
$$= \frac{xy}{(x+y)+(x+y)} = \frac{xy}{2(x+y)}\,N$$

33. (d): For *bcc*, $4r = \sqrt{3}\,a$

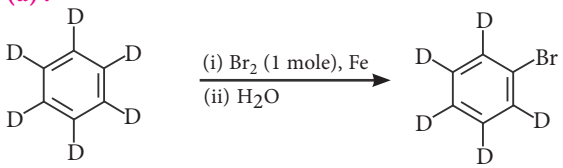
$$r = \frac{\sqrt{3}}{4}a$$

34. (b): $5I^- + IO_3^- + \underset{\text{(from lime juice)}}{6H^+} \longrightarrow \underset{\text{violet}}{3I_2} + 3H_2O$

35. (d): The given reaction is Hunsdiecker's reaction.



36. (a):



37. (a, b, c)

38. (b, c, d): During electrolysis of molten NaCl :

Reaction at cathode : $Na^+ + e^- \longrightarrow Na$; Reaction at anode : $Cl^- \longrightarrow \frac{1}{2}Cl_2 + e^-$

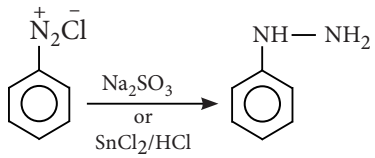
By adding some water,

$$Na + H_2O \longrightarrow NaOH + \frac{1}{2}H_2$$

A fire is likely to take place due to vigorous reaction of sodium with water.

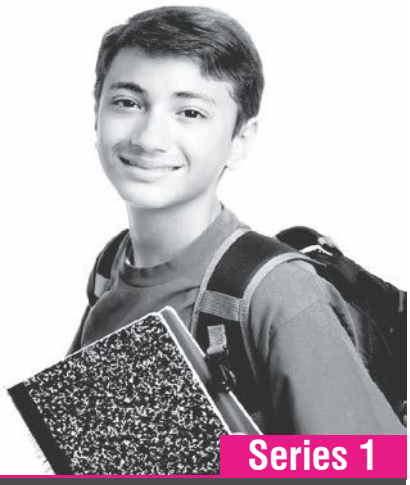
39. (b, c)

40. (a, b):



Benzenediazonium chloride forms phenylhydrazine with Na_2SO_3 and mild reducing agents such as $SnCl_2$/HCl while benzenediazonium chloride upon reduction with hypophosphorous acid (H_3PO_2) or ethanol at room temperature gives benzene.

ACE YOUR WAY CBSE XII



Series 1

CHAPTERWISE PRACTICE PAPER : THE SOLID STATE | SOLUTIONS

Time Allowed : 3 hours | Maximum Marks : 70

GENERAL INSTRUCTIONS

(i) All questions are compulsory.
(ii) Question no. 1 to 5 are very short answer questions and carry 1 mark each.
(iii) Question no. 6 to 10 are short answer questions and carry 2 marks each.
(iv) Question no. 11 to 20 are also short answer questions and carry 3 marks each.
(v) Question no. 21 is a value based question and carries 4 marks.
(vi) Question no. 22 to 24 are long answer questions and carry 5 marks each.
(vii) Use of log tables if necessary, use of calculators is not allowed.

1. Why is glass considered a supercooled liquid?
2. What is the effect of pressure on the solubility of gas in polar solvent?
3. How will you distinguish between crystal lattice and unit cell?
4. What is a semipermeable membrane?
5. What is the coordination number of each type of ions in a rock-salt type crystal structure?
6. When water and nitric acid are mixed together, a rise in temperature is observed. What type of azeotropic mixture is obtained?
7. Explain the following :
   (i) Diamond and solid rhombic sulphur both are covalent solids but the latter has very low melting point than the former.
   (ii) A cubic lattice has end-centred unit cell.
8. The freezing point of a solution having 50 cm^3 of ethylene glycol in 50 g water is found to be – 34 °C. Calculate the density of ethylene glycol, assuming ideal behaviour.
   (K_f for water = 1.86 K kg mol^{-1})

OR

Determine the osmotic pressure of a solution prepared by dissolving 25 mg of K_2SO_4 in 2 L of water at 25 °C, assuming that it is completely dissociated.

9. Examine the given defective crystal :

A^+	B^-	A^+	B^-	A^+
B^-	○	B^-	A^+	B^-
A^+	B^-	A^+	○	A^+
B^-	A^+	B^-	A^+	B^-

   Answer the following questions :
   (i) What type of stoichiometric defect is shown by the crystal?
   (ii) How is the density of the crystal affected by this defect?
   (iii) What type of ionic substances show such defect?
10. An aqueous solution of 2% non-volatile solute exerts a pressure of 1.004 bar at the normal boiling point of the solvent. What is the molecular mass of the solute?

11. Answer the following :

(i) A compound formed by elements *A* and *B* crystallises in the cubic structure where *A* atoms are at the corners of the cube and *B* atoms are at the centre of the cube. What is the formula of the compound?

(ii) In chromium (III) chloride, $CrCl_3$, the chloride ions have *ccp* (cubic close packing) arrangement and Cr (III) ions are present in octahedral holes. What fraction of the octahedral holes is occupied? What fraction of the total number of holes is occupied?

12. Answer the following :

(i) Which of the two, molarity or molality, is a better way to express the concentration of a solution and why?

(ii) Explain why melting point of a substance is an index of its purity.

(iii) Ether and spirit give a cooling sensation on rubbing on the skin. Why?

13. Aluminium crystallises in a cubic close packed structure with radius 125 pm. Then,

(i) what is the edge length of the unit cell?

(ii) how many unit cells are there in 1 cm^3 of aluminium?

OR

(i) *X*-ray diffraction studies shows that the edge length of unit cell of NaCl is 0.56 nm. The density of NaCl was found to be 2.16 g/cc. What type of defect is present in the solid? Calculate the percentage of Na^+ and Cl^- ions missing.

(ii) What happens when a ferromagnetic or antiferromagnetic or ferrimagnetic solid is heated?

14. Amongst the following compounds, identify which are insoluble, partially soluble and highly soluble in water.

(i) Phenol **(ii)** Toluene

(iii) Formic acid **(iv)** Ethylene glycol

(v) Chloroform **(vi)** Pentanol

15. Answer the following :

(i) Give one similarity and one difference between metallic and ionic crystals.

(ii) Why are ionic solids hard and brittle?

16. The boiling point elevation of 0.30 g acetic acid in 100 g benzene is 0.0633 K. Calculate the molar mass of acetic acid. What conclusion can you draw about the molecular state of the solute in the solution? (Given: K_b for benzene = 2.53 K kg mol^{-1})

17. An element crystallises in *fcc* lattice having edge length 400 pm. Calculate the maximum diameter of atom which can be placed in interstitial site without distorting the structure.

18. How many millilitres of 0.1 M HCl are required to react completely with 1 g mixture of Na_2CO_3 and $NaHCO_3$ containing equimolar amounts of both?

19. In a face centred lattice of *X* and *Y*, *X* atoms are present at the corners while *Y* atoms are at face centres.

(a) What is the formula of the compound?

(b) What would be the formula of the compound if

(i) one of the *X* atoms is missing from a corner in each unit cell,

(ii) one of the *X* atoms from a corner is replaced by *Z* atom (also monovalent)?

20. Vapour pressures of chloroform ($CHCl_3$, 119.5 g mol^{-1}) and dichloromethane (CH_2Cl_2, 85 g mol^{-1}) at 298 K are 200 mmHg and 415 mmHg respectively. Calculate

(a) vapour pressure of the solution prepared by mixing 25.5 g of $CHCl_3$ and 40 g of CH_2Cl_2 at 298 K and

(b) mole fraction of each component in vapour phase.

21. In terms of band theory, what is the difference between

(i) a conductor and an insulator

(ii) a conductor and a semiconductor?

22. The degree of dissociation of $Ca(NO_3)_2$ in dilute aqueous solution containing 7.0 g of the salt per 100 g of water at 100 °C is 70%. If vapour pressure of water at 100 °C is 760 mm, calculate the vapour pressure of the solution.

23. Once Avneesh, a student of class XII, visited a hill station with his younger sister Chhavi. During their visit, they saw some people were scattering some salts on the icy roads. Chhavi asked him the reason for this. Based on the above paragraph answer the following questions :

(i) What did Avneesh explain Chhavi?

(ii) What values are shown by Avneesh?

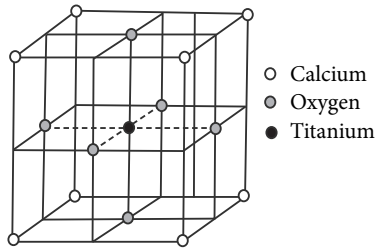
(iii) What could be the salts used for this purpose?

(iv) What are colligative properties?

24. Answer the following :

(i) Non-stoichiometric cuprous oxide, Cu_2O can be prepared in the laboratory. In this oxide, copper to oxygen ratio is slightly less than 2 : 1. Can you account for the fact that this substance is a *p*-type semiconductor?

(ii) Perovskite, a mineral containing calcium, oxygen and titanium crystallises in the given cubic unit cell.



What is the formula of perovskite and what is the oxidation number of titanium in perovskite?

OR

Answer the following :

(i) Calculate the packing efficiency of a metal for a simple cubic lattice.

(ii) Silver crystallises in face centred cubic unit cell. Each side of this unit cell has a length of 400 pm. Calculate the radius of the silver atom. (Assume that the atom just touch each other on the diagonal across the face of the unit cell, that is each face atom is touching the four corner atoms).

25. Answer the following :

(i) What happens when red blood corpuscles (RBC) are placed in

(a) 0.5% NaCl solution

(b) 1% NaCl solution?

(ii) A binary solution of two volatile liquids A and B in which mole fraction of A is x_A, is reported to have total vapour pressure equal to P mbar. P is defined by the relation,

$P = 255 - 120\ x_A$

What are the values of p°_A and p°_B?

OR

1.22 g of benzoic acid is dissolved in

(a) 100 g of acetone (K_b for acetone = 1.7 K kg mol^{-1}) and

(b) 100 g of benzene (K_b = 2.6 K kg mol^{-1}). The elevations in boiling points ΔT_b is 0.17 °C and 0.13 °C respectively.

(i) What are molar masses of benzoic acids in two solvents?

(ii) What do you deduce out of it in terms of structure of benzoic acid?

26. Answer the following :

(i) Analysis shows that nickel oxide has the formula $Ni_{0.98}O_{1.00}$. What fractions of nickel exist as Ni^{2+} and Ni^{3+} ions?

(ii) Why does ZnO appear golden yellow at high temperature?

(iii) Fe_3O_4 is ferrimagnetic at room temperature and becomes paramagnetic at 850 K.

OR

Answer the following :

(i) Given reason :

(a) Why is Frenkel defect found in AgCl?

(b) What is the difference between phosphorus doped and gallium doped silicon semiconductors?

(ii) Why are solids incompressible ?

(iii) Give significance of a lattice point.

SOLUTIONS

1. Glass is considered as a supercooled liquid because glass is an amorphous solid and has tendency to flow very slowly like liquids.

2. Solubility of a gas in polar solvent increases with increase in pressure and is governed by Henry's law.

3. The smallest three dimensional repeating portion of a space lattice which when repeated in different directions produces the complete crystal lattice is called a unit cell.

4. A membrane through which only small particles of solvent like water can pass but bigger particles of solute cannot pass is called semipermeable membrane.

5. In a rock-salt type crystal structure, the coordination number of cation and anion is 6.

6. Since a rise in temperature is observed when water and nitric acid are mixed together, the mixture is showing negative deviation from Raoult's law. Maximum boiling azeotropes are obtained by liquid mixtures showing negative deviation.

7. **(i)** Diamond is a three dimensional network covalent solid having very strong intermolecular forces whereas rhombic sulphur has one dimensional covalent network with puckered eight membered rings (S_8) held together by weak van der Waals' forces.

(ii) In an end-centred unit cell, particles are located at the corners and at the center of any two opposite faces.

8. Amount of ethylene glycol,

$$w_2 = \frac{M_2 \times \Delta T_f \times w_1}{K_f \times 1000} = \frac{62 \times 34 \times 50}{1.86 \times 1000} = 56.67 \text{ g}$$

(As, molar mass of ethylene glycol is 62 g mol^{-1})

$$\text{Density, } d = \frac{\text{Mass}}{\text{Volume}} = \frac{56.67}{50} = 1.13 \text{ g cm}^{-3}$$

OR

K_2SO_4 dissolved = 25 mg = 0.025 g
Volume of solution = 2 L
T = 25 °C = 25 + 273 K = 298 K
Molar mass of $K_2SO_4 = 2 \times 39 + 32 + 4 \times 16$
$= 174 \text{ g mol}^{-1}$
K_2SO_4 dissociates completely as
$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$
i.e., ions produced = 3 ($\therefore$ $i = 3$)

$$\therefore \quad \pi = iCRT = i\frac{n}{V}RT = i \times \frac{w}{M} \times \frac{1}{V}RT$$

$$\pi = 3 \times \frac{0.025}{174} \times \frac{1}{2} \times 0.0821 \times 298 = 5.27 \times 10^{-3} \text{ atm}$$

9. (i) Schottky defect
(ii) Density of the crystal decreases.
(iii) This defect is shown by ionic substances in which the cations and anions are of almost similar sizes, *e.g.*, NaCl, KBr, CsCl, etc.

10. Vapour pressure of pure water at its boiling point (p^o)
$= 1 \text{ atm} = 1.013 \text{ bar}$
Vapour pressure of solution (p_s) = 1.004 bar
Let mass of solution be 100 g, then,
Mass of solute (w_2) = 2 g
Mass of solvent (w_1) = 100 – 2 = 98 g
By Raoult's law for dilute solution,

$$\frac{p^o - p_s}{p_s} = \frac{n_2}{n_1} = \frac{w_2 / M_2}{w_1 / m_1} = \frac{w_2}{m_2} \times \frac{M_1}{w_1}$$

$$\frac{1.013 - 1.004}{1.004} = \frac{2}{M_2} \times \frac{18}{98}$$

$$M_2 = \frac{2 \times 18}{98 \times 8.96 \times 10^{-3}} = 40.998 \simeq 41 \text{ g mol}^{-1}$$

11. (i) An atom at the corner of a cube is shared by 8 unit cells and hence, contributes only $1/8^{th}$ to a particular unit cell.

$$\therefore \quad \text{No. of } A \text{ atoms in the unit cell} = 8 \times \frac{1}{8} = 1$$

An atom at the centre of cube belongs only to one unit cell.
$\therefore$ Number of B atoms in the unit cell = $1 \times 1 = 1$
Therefore, formula of the compound is AB.
(ii) In *ccp* arrangement, each chloride ion would have one octahedral void and two tetrahedral voids associated with it.
Number of octahedral voids with 3 chloride ions = 3
Number of tetrahedral voids with 3 chloride ions
$= 3 \times 2 = 6$
Total number of voids with 3 chloride ions = 9
Number of octahedral voids occupied by Cr (III) = 1
Fraction of octahedral voids occupied = 1/3
Fraction of total number of voids occupied = 1/9

12. (i) Molarity of a solution is the number of moles of the solute dissolved per litre of the solution. The volume changes with temperature, *i.e.,* molarity changes with change in temperature. However, molality is independent of temperature as it is the number of moles of the solute dissolved per kg of the solvent and mass does not vary with temperature. Thus, it is better to express concentration in terms of molality.
(ii) The presence of impurity reduces the melting point of a substance, *i.e.,* greater the impurity, lesser is the melting point. Hence, melting point is taken as an index of purity of a substance.
(iii) Ether and spirit are highly volatile. When rubbed on skin, they absorb heat energy from the body and evaporate. Due to loss of heat energy, cooling sensation is observed on the skin.

13. (i) For cubic closed packed structure,
Edge length, $a = 2\sqrt{2}\,r = 2\sqrt{2} \times 125$ pm
$= 250\sqrt{2}$ pm $= 353.55$ pm $= 353.55 \times 10^{-12}$ m
$= 353.55 \times 10^{-10}$ cm
(ii) Volume of 1 unit cell = $(353.55 \times 10^{-10})^3 \text{ cm}^3$
$= 4.4193 \times 10^{-23} \text{ cm}^3$

$4.4193 \times 10^{-23} \text{ cm}^3 = 1$ unit cell

$$\therefore \quad 1 \text{ cm}^3 = \frac{1}{4.4193 \times 10^{-23}}$$

$= 2.263 \times 10^{22}$ unit cells

OR

(i) Density of the NaCl

$$\rho = \frac{Z \times M}{a^3 \times N_A} = \frac{4 \times 58.5}{(0.56 \times 10^{-7})^3 \times 6.023 \times 10^{23}}$$

$= 2.212$ g/cc

Observed density is less than theoretical density, hence, the solid has Schottky defect.

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

$$Z = \frac{(0.56 \times 10^{-7})^3 \times 2.16 \times 6.023 \times 10^{23}}{58.5} = 3.905$$

Number of missing formula units = 4 – 3.905
$= 0.095$
Percentage of missing formula units

$$= \frac{0.095}{4} \times 100 = 2.375\%$$

$\therefore$ % of Na^+ ions missing = 2.375 %

% of Cl^- ions missing = 2.375 %

(ii) Ferromagnetic, anti-ferromagnetic and ferri magnetic solids become paramagnetic on heating above a certain temperature. It is due to randomisation of spins of unpaired electrons.

14. (i) Partially soluble because phenol has polar —OH group and non-polar — C_6H_5 group.

(ii) Insoluble because toluene is non-polar while water is polar.

(iii) Highly soluble because formic acid can form hydrogen bonds with water.

(iv) Highly soluble because ethylene glycol can form hydrogen bonds with water.

(v) Insoluble because chloroform is an organic liquid.

(vi) Partially soluble because —OH group is polar but the large hydrocarbon part (— C_5H_{11}) is non-polar.

15. (i) The difference between metallic crystal and ionic crystal is that the constituent particles in metallic crystals are positively charged metal ions immersed in a sea of mobile electrons while in ionic solids, the constituent particles are cations and anions.

The similarity between metallic crystal and ionic crystal is that both metallic as well as ionic solids have high melting points.

(ii) Ionic solids are hard because in ionic solids, ions are held together by strong electrostatic forces of attractions and thus, the ions are closely packed in the lattice. These are brittle as, when sufficient force is applied on an ionic crystal, the ions with similar charges come close due to displacement and repel each other and then, the crystal shatters.

16. $M_2 = \dfrac{K_b \times w_2 \times 1000}{\Delta T_b \times w_1} = \dfrac{2.53 \times 0.30 \times 1000}{0.0633 \times 100}$

$\approx 120 \text{ g mol}^{-1}$

Molar mass of CH_3COOH = 60 g/mol

$$i = \frac{M_{2(\text{calculated})}}{M_{2(\text{observed})}} = \frac{60}{120} = \frac{1}{2} = 0.5$$

As i = 0.5, therefore the solute (acetic acid) is dimerised in benzene.

17. In a cubic crystal system, there are two types of voids known as octahedral and tetrahedral voids. If r_1 is the radius of void and r_2 is the radius of atom in close packing then,

$\left(\dfrac{r_1}{r_2}\right)_{\text{octahedral}} = 0.414$ and $\left(\dfrac{r_1}{r_2}\right)_{\text{tetrahedral}} = 0.225$

The above radius ratio values indicate that octahedral void has larger radius hence, for maximum diameter of atom to be present in interstital space,

$r_1 = 0.414\ r_2$

Also, in *fcc*, $r_2 = \dfrac{a}{2\sqrt{2}}$

Diameter required = $2r_1 = 2 \times r_2 \times 0.414$

$$= \frac{a}{2\sqrt{2}} \times 2 \times 0.414 = \frac{400 \times 0.414}{\sqrt{2}} \approx 117 \text{ pm}$$

18. Let mass of Na_2CO_3 and $NaHCO_3$ in the mixture be x g and $(1 - x)$ g respectively.

Molar mass of Na_2CO_3 = 106 g/mol

Molar mass of $NaHCO_3$ = 84 g/mol

Number of moles of Na_2CO_3 = Number of moles of $NaHCO_3$

$$\frac{x}{106} = \frac{(1-x)}{84}$$

On solving, $x \approx 0.5579$

Thus, number of moles of Na_2CO_3

= Number of moles of $NaHCO_3 = 5.263 \times 10^{-3}$

During the process of neutralisation, following reactions take place :

$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2\uparrow$

$NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2\uparrow$

Number of moles of HCl required

= 2 × number of moles of Na_2CO_3

+ number of moles of $NaHCO_3$

$= 2 \times 5.263 \times 10^{-3} + 5.263 \times 10^{-3} \approx 0.0158$

Molarity may be given as,

$$M = \frac{n_B \times 1000}{V} \quad (n_B = \text{Number of moles of solute})$$

$$V = \frac{n_B \times 1000}{M} = \frac{0.0158 \times 1000}{0.1} = 158 \text{ mL}$$

19. (a) No. of X atoms in the unit cell = 8 × 1/8 = 1

No. of Y atoms in the unit cell = 6 × 1/2 = 3

Formula = XY_3

(b) (i) If one X atom is missing, no. of X atoms in the unit cell = 7/8

No. of Y atoms in the unit cell = 3

Formula = $X_{7/8}Y_3$ or X_7Y_{24}

(ii) No. of X atoms in the unit cell = 7/8

No. of Z atoms in the unit cell = 1/8

No. of Y atoms in the unit cell = 3

Formula = $X_{7/8}Y_3Z_{1/8}$ or $X_7Y_{24}Z$

20. (a) $P_{total} = p_1^\circ x_1 + p_2^\circ x_2 = p^\circ_{CHCl_3} x_{CHCl_3} + p^\circ_{CH_2Cl_2} x_{CH_2Cl_2}$

Component	Amount	No. of moles	Mole fraction
$CHCl_3$	25.5 g	$\frac{25.5}{119.5} = 0.2134$	$x_{CHCl_3} = \frac{n_{CHCl_3}}{n_{Total}} = 0.312$
CH_2Cl_2	40 g	$\frac{40}{85} = 0.4706$	$x_{CH_2Cl_2} = 1 - x_{CHCl_3} = 0.688$

Vapour pressure due to $CHCl_3$,

$p_{CHCl_3} = p^\circ_{CHCl_3} x_{CHCl_3} = 200 \times 0.312 = 62.4$ mmHg

Vapour pressure due to CH_2Cl_2,

$p_{CH_2Cl_2} = 415 \times 0.688 = 285.52$ mmHg

Total vapour pressure = 62.4 + 285.52

= 347.92 mmHg

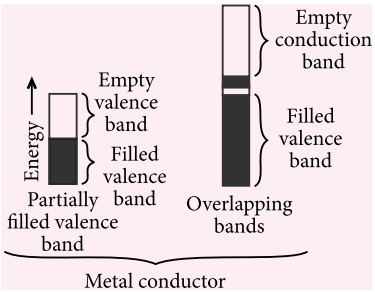
(b) Thus, mole fraction of $CHCl_3$ in vapour phase,

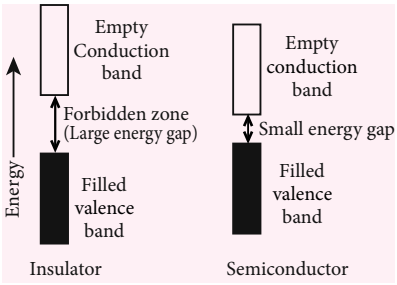
$$y_{CHCl_3} = \frac{p_{CHCl_3}}{P_{Total}} = \frac{62.4}{347.92} = 0.179$$

Mole fraction of CH_2Cl_2 in vapour phase,

$y_{CH_2Cl_2} = 1 - 0.1794 = 0.8205$

21. (i) In metals, conductivity strongly depends upon the number of valence electrons available in an atom. The atomic orbitals of metal atoms form molecular orbitals which are so close in energy to each other. This set of molecular orbital is called a band. If this band is partially filled or it overlaps with the higher energy unoccupied conduction band, then electrons can flow easily under an applied electric field and the metal behaves as a conductor.





If the gap between the filled valence band and the unoccupied conduction band is large, electrons cannot jump into it and such a substance behaves as an insulator.

(ii) If the gap between the valence band and conduction band is small, some electrons may jump from valence band to the conduction band. Such a substance shows some conductivity and behaves as a semiconductor. Electrical conductivity of semiconductors increases with increase in temperature, since more electrons can jump to the conduction band. Silicon and germanium show this type of behaviour and are called intrinsic semiconductors. Conductors have no forbidden band.

22. Calcium nitrate dissociates as :

$Ca(NO_3)_2 \longrightarrow Ca^{2+} + 2NO_3^-$

Since one molecule dissociates into three particles, therefore, $n = 3$

Degree of dissociation (α) = 70% or 0.7

Now, $\alpha = \frac{i-1}{n-1}$ or $0.7 = \frac{i-1}{3-1}$

or $i - 1 = 2 \times 0.7 = 1.4$ or $i = 1.4 + 1 = 2.4$

Now, relative lowering of vapour pressure is given as

$$\frac{p_A^\circ - p_A}{p_A^\circ} = i \cdot \frac{w_B / M_B}{w_A / M_A}$$

$$\therefore \quad \frac{760 - p_A}{760} = 2.4 \times \frac{7 \times 18}{100 \times 164}$$

or $760 - p_A = 2.4 \times \frac{7 \times 18 \times 760}{100 \times 164} = 14.01$

$\therefore \quad p_A = 760 - 14.01 = 745.99$ mm ≈ 746 mm

23. (i) Avneesh explained Chhavi that when salts are scattered on icy roads, the ice starts melting as salts lower the freezing point of water. Thus, roads become clear.

(ii) Knowledge and awareness are the values shown by Avneesh.

(iii) NaCl and $CaCl_2$ can be used for melting snow on roads.

(iv) The properties of ideal solutions which depend only on the number of particles of the solute (molecules or ions) dissolved in a definite amount of the solvent and do not depend on the nature of the solute are called colligative properties.

24. (i) In Cu_2O, the ratio is less than 2 : 1, which shows that some cuprous, Cu^+ ions have been replaced by cupric (Cu^{2+}) ions. Thus, to maintain electrical neutrality, every two Cu^+ ions will be replaced by one Cu^{2+} ion, therefore, creating a hole. As conduction is due to the presence of these positive holes, hence, it is a *p*-type semiconductor.

(ii) Calcium is present at the corners,
Hence, number of calcium atoms = $1/8 \times 8 = 1$
Oxygen is present at face-centres,
hence, number of oxygen atoms = $1/2 \times 6 = 3$
Titanium is present at the body centre hence, number of titanium atom = 1
Thus, perovskite has formula $CaTiO_3$.
Let oxidation number of Ti be x.
$2 + x - 6 = 0 \Rightarrow x = +4$
Thus, oxidation number of Ti in $CaTiO_3 = +4$

OR

(i) Packing efficiency $= \dfrac{Z \times \frac{4}{3}\pi r^3}{a^3} \times 100$

For a simple cubic lattice, $a = 2r$ and $Z = 1$

$\therefore$ Packing efficiency $= \dfrac{1 \times \frac{4}{3}\pi r^3}{(2r)^3} \times 100 = 52.4\%$

(ii) For *fcc*, $r = \dfrac{a}{2\sqrt{2}}$, $a = 400$ pm,

$\therefore \quad r = \dfrac{400}{2\sqrt{2}} = \dfrac{400}{2\sqrt{2}} \times \dfrac{\sqrt{2}}{\sqrt{2}} = \dfrac{400\sqrt{2}}{4} = 100\sqrt{2}$

$\Rightarrow \quad r = 100 \times 1.414 = 141.4$ pm

25. (i) (a) The cells will swell or even burst due to haemolysis because 0.5% NaCl solution is hypotonic w.r.t. salt concentration in blood plasma.
(b) The cells will shrink due to plasmolysis, because 1% solution of NaCl is hypertonic w.r.t. salt concentration in blood plasma.
(ii) $P_{Total} = 255 - 120\, x_A$
For pure A, $x_A \rightarrow 1$, $P_{Total} \rightarrow p^\circ_A$
Substituting in the given equation, we get
$p^\circ_A = 255 - 120 \times 1 = 135$ mbar
For pure, B, $x_B \rightarrow 1$; $x_A = \rightarrow 0$ and $P_{Total} \rightarrow p^\circ_B$
Substituting in given equation, we get
$p^\circ_B = 255 - 120 \times 0 = 255$ mbar

OR

(a) (i) $\Delta T_b = K_b m = K_b \dfrac{w_B}{M_B \times w_A \text{ (in kg)}}$

Let molar mass of benzoic acid be M_B and M'_B in acetone and benzene respectively. In acetone :

$0.17 = \dfrac{1.7 \times 1.22 \times 1000}{M_B \times 100} \Rightarrow M_B = 122$ g mol^{-1}

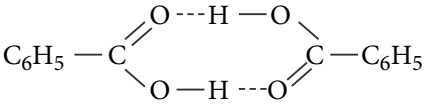
In benzene : $0.13 = \dfrac{2.6 \times 1.22 \times 1000}{M'_B \times 100}$

$M'_B = \dfrac{2.6 \times 1.22 \times 1000}{0.13 \times 100} = 244$ g mol^{-1}

(ii) Calculated molar mass of benzoic acid (C_6H_5COOH) = 72 + 5 + 12 + 32 + 1 = 122 g mol^{-1}
van't Hoff factor, $i = \dfrac{\text{Calculated molar mass}}{\text{Observed molar mass}}$
In acetone, $i = 122/122 = 1$
Thus, benzoic acid remains as such in acetone.

Structure in acetone : $C_6H_5-C(=O)-O-H$

In benzene, $i = 122/244 = 0.5$
Thus, benzoic acid dimerises in benzene.
Structure in benzene :



Dimerisation

26. (i) $Ni_{0.98}O_{1.0}$
Let number of Ni^{2+} be x.
Then, number of Ni^{3+} will be $0.98 - x$.
Total charge on the compound must be zero, thus,
$2x + 3(0.98 - x) - 2 = 0$; $2x + 2.94 - 3x - 2 = 0$
$-x = -0.94$ or $x = 0.94$

% of $Ni^{2+} = \dfrac{0.94}{0.98} \times 100 = 96\%$

$\therefore$ % of $Ni^{3+} = (100 - 96)\% = 4\%$

(ii) When ZnO is heated, it loses oxygen as :

$ZnO \xrightarrow{\text{Heat}} Zn^{2+} + \frac{1}{2}O_2 + 2e^-$

The Zn^{2+} ions get trapped in the interstitial sites and electrons are trapped in the neighbouring interstitial sites to maintain electrical neutrality. This results in metal excess defect. Due to the presence of electrons in the interstitial void the colour is yellow.
(iii) Due to randomisation of spins at high temperature ferrimagnetic Fe_3O_4 becomes paramagnetic at 850 K.

OR

(i) (a) Due to small size of Ag^+ ion, it can fit into interstitial sites.
(b) Silicon doped with phosphorus forms *n*-type semiconductors whereas, silicon doped with gallium form *p*-type semiconductors.
(ii) Solids are incompressible as the constitutent particles of a solid are very closely packed and the intermolecular distances are very small. On applying high pressure on a solid, it will not compress rather it will deform.
(iii) Lattice point represents the constituent particles of a crystalline solid (as points). These constituent particles may be atoms, molecules or ions.

CHEMISTRY MUSING

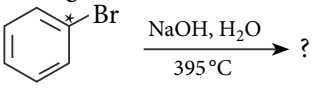
PROBLEM SET 47

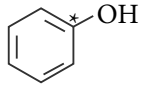
Chemistry Musing was started from August '13 issue of Chemistry Today. The aim of Chemistry Musing is to augment the chances of bright students preparing for JEE (Main and Advanced) / NEET / AIIMS / JIPMER with additional study material. In every issue of Chemistry Today, 10 challenging problems are proposed in various topics of JEE (Main and Advanced) / NEET. The detailed solutions of these problems will be published in next issue of Chemistry Today.
The readers who have solved five or more problems may send their solutions. The names of those who send atleast five correct solutions will be published in the next issue. We hope that our readers will enrich their problem solving skills through "Chemistry Musing" and stand in better stead while facing the competitive exams.

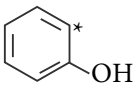
JEE MAIN/NEET

1. For the reactions,
$NO_3^- \longrightarrow NO_2$ (acidic medium); $E° = 0.790$ V
$NO_3^- \longrightarrow NH_2OH$ (acidic medium); $E° = 0.731$ V,
the pH at which the above two half reactions will have same E values is (Assume the concentrations of all the species to be unity.)
(a) 2.19 (b) 1.19 (c) 4.02 (d) 7.12

2. Which of the following products are obtained during the reaction?



(a) 

(b) 

(c) Both (a) and (b) (d) No reaction

3. Which of the following reactions is correctly related to the extraction of magnesium from sea water?

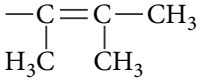
(a) Sea water $\xrightarrow{Na_2CO_3}$ $MgCO_3$ $\xrightarrow{\text{Calcination}}$ MgO $\xrightarrow[\text{reduction}]{\text{Carbon}}$ Mg

(b) Sea water $\xrightarrow[\text{water}]{\text{Lime}}$ $Mg(OH)_2$ $\xrightarrow{HCl_{(aq)}}$ $MgCl_2 \cdot 6H_2O$ $\xrightarrow[\text{With excess of dry } HCl_{(g)}]{\Delta}$ $MgCl_2$ (Anhyd.) $\xrightarrow[\text{in molten condition}]{\text{Electrolysis}}$ Mg

(c) Sea water $\xrightarrow{\text{Drying}}$ Sea salt $\xrightarrow{\text{Electrolysis}}$ Mg

(d) Sea water $\xrightarrow{Ca(OH)_2}$ $Mg(OH)_2$ $\xrightarrow{HCl_{(aq)}}$ $MgCl_2$ Solution $\xrightarrow[\text{in aq. solution}]{\text{Electrolysis}}$ Mg

4. 0.45 g of a dibasic organic acid upon combustion produced 0.44 g of CO_2 and 0.09 g of H_2O. 0.76 g of its silver salt when ignited gave 0.54 g of pure silver. The formula of the acid is
(a) CH_3COOH (b) $(COOH)_2$
(c) HCOOH (d) $(CHCOOH)_2$

5. For which of the following compounds ΔH of hydrogenation will be least negative?
(a) $CH_2{=}CH_2$ (b) $CH_3{-}CH{=}CH{-}CH_3$
(c) $CH_3{-}CH{=}CH_2$
(d) 

JEE ADVANCED

6. The vapour pressure of 0.01 m solution of a weak base BOH in water at 20°C is 17.536 mm. What is the K_b value for base? (Aqueous tension at 20°C is 17.540 mm and assuming molality and molarity to be same.)
(a) 9.74×10^{-4} (b) 10.02×10^{-6}
(c) 3.42×10^{-8} (d) 1.09×10^{-4}

COMPREHENSION

$KO_2 + S \xrightarrow{\Delta} A \xrightarrow{CaCl_2} B$ (ppt.)
$B \xrightarrow[\text{heating}]{\text{Carbon, strong}} C + D_{(g)}$
$C \xrightarrow{\text{dil. HCl}} E_{(g)}$ (turns lead acetate paper black)

$Ca + H_2 \xrightarrow{\Delta} F$ (Solid)
$F + CaCl_2 \xrightarrow{\Delta} G$ (Solid)
$G + H_2O \longrightarrow Ca(OH)_2 + H_{(g)}$

7. As per given sequence of reaction, B is
(a) CaS (b) $CaSO_4$ (c) CaO (d) $KCaCl_3$

8. As per given sequence of reaction, H is
(a) HCl (b) CaHCl (c) Cl_2 (d) H_2

INTEGER VALUE

9. Total number of the following compounds which give benzoin condensation reaction is
Benzaldehyde, *p*-Dimethylaminobenzaldehyde, Acetaldehyde, Phenylglyoxal, 2,6-Dimethylbenzaldehyde, Acetone

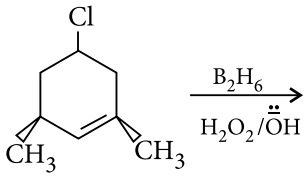
10. The total number of acidic radicals which produce volatile product with dil. HCl is
SO_4^{2-}, I^-, NO_2^-, NO_3^-, SO_3^{2-}, HCO_3^-

CONCEPT BOOSTER

Hello, future of my country!! Hope, you all are doing well. As a friend I am always there beside you so that I can make your journey easy. This article contains some beautiful, conceptual and knowledge enhancing problems which will help you to strengthen your grip over CHEMISTRY. ALL THE VERY BEST. HAPPY LEARNING!

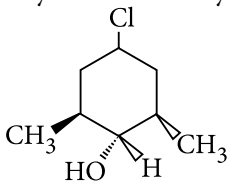
*Arunava Sarkar

1.

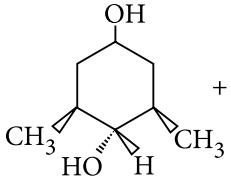


Identify the most likely product.

(a)

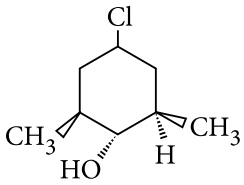


(b)



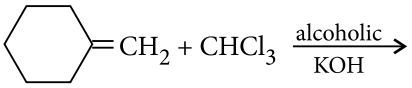
+ HCl

(c)



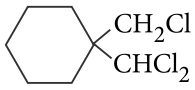
(d) None of these

2.



Identify the major product.

(a)



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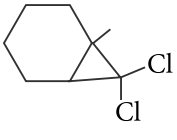
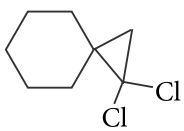


(c)



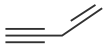
(d) None of these

3. Which one among the following will have highest dipole moment?

(1)

(2)

(3)

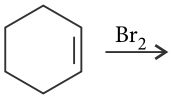


(4) =C=C=

(a) 1 (b) 2

(c) 3 (d) 4

4. What configurations are found in the product(s) of the reaction below?



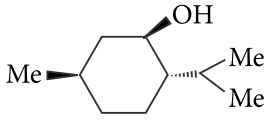
(a) 1*S*, 2*S* only

(b) 1*R*, 2*S* only

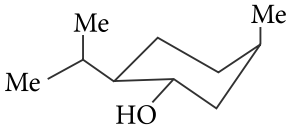
(c) 1*R*, 2*R* only

(d) an equal mixture of 1*R*, 2*R* and 1*S*, 2*S*

5. The most stable conformation of the molecule shown below is correctly represented by



(a)



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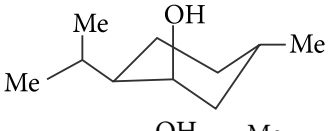
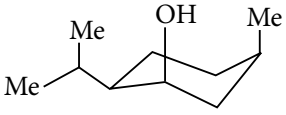
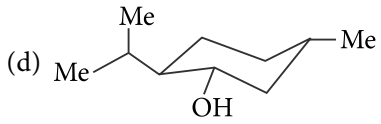
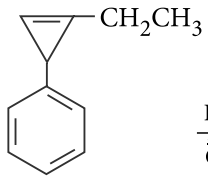


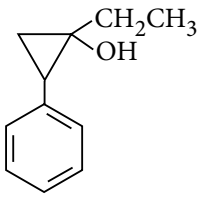
(c)

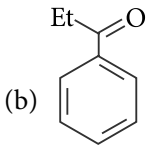


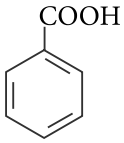
*Institute of Chemistry (IOC)- Asansol, Durgapur, Dhanbad, Burdwan, Kolkata, Jamshedpur, Bokaro, Patna

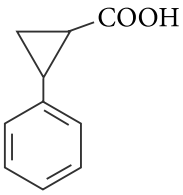
(d) 

6. 

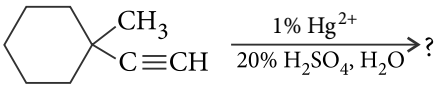
(a) 

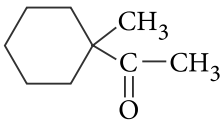
(b) 

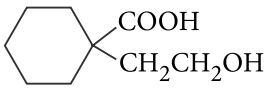
(c) 

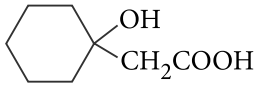
(d) 

7. Identify the product in the following case :



(a) 

(b) 

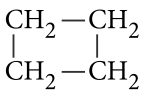
(c) 

(d) None of these

8. $CH_2=CH-CH=CH_2 \xrightarrow[180°C]{Br_2}$?

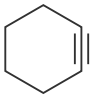
(a) $\underset{Br}{CH_2}-\underset{Br}{CH}-CH=CH_2$

(b) $\underset{Br}{CH_2}-CH=CH-\underset{Br}{CH_2}$

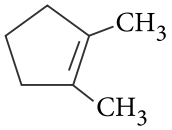
(c) 

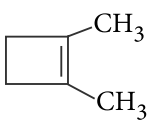
(d) None of these

9. $A \xrightarrow{OsO_4/NaIO_4}$ Hexanedial. Identify *A*.

(a) 

(b) 

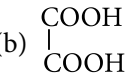
(c) 

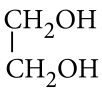
(d) 

10. Identify the final product in the following sequence of reactions.

$HC\equiv CH \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} \xrightarrow{Zn/CH_3COOH}$

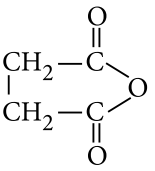
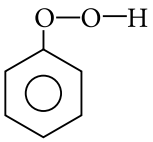
(a) CHO — CHO

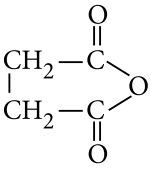
(b) 

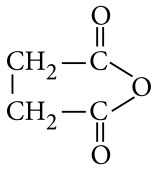
(c) 

(d) $CH_3-CH<^{OAc}_{OAc}$

11. $X \xleftarrow[773\ K]{O_2/V_2O_5}$  $\xrightarrow[588\ K]{O_2/V_2O_5} Y$; 'X' and 'Y' are :

(a)  ; 

(b)  ; $CO_2 + H_2O$

(c) $CO_2 + H_2O$; 

(d) None of these

12. $CH_3-C\equiv C-H \xrightarrow[25°C]{KMnO_4/\ddot{O}H} X \xrightarrow[slow]{[O]} Y$

Identify 'X' and 'Y'.

(a) $X = CH_3-\underset{OH}{\underset{|}{C}}=\underset{OH}{\underset{|}{CH}}$; $Y = CH_3-\underset{O}{\underset{||}{C}}-\underset{O}{\underset{||}{C}}-H$

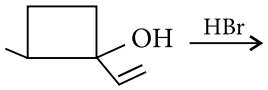
(b) $X = CH_3-\underset{O}{\underset{||}{C}}-\underset{O}{\underset{||}{COH}}$; $Y = CH_3-\underset{COOH}{\underset{|}{CH}}-OH$

(c) $X = CH_3-\underset{O}{\underset{||}{C}}-\underset{O}{\underset{||}{COH}}$; $Y = HCOOH$

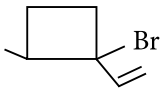
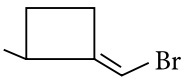
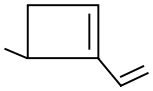
(d) None of these

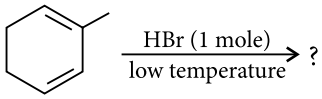
13. $CH_3-C\equiv C-CH_3$ → (H_2, Pd-$BaSO_4$) → I; (Br_2/CS_2) → II; (Br_2/CS_2) → (H_2, Pd-$BaSO_4$)

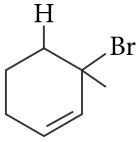
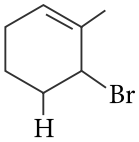
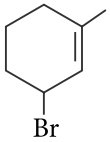
(a) I and II are identical.
(b) I and II are enantiomers.
(c) I and II are diastereomers.
(d) I and II are conformational isomers.

14. 

Identify the product.

(a) 
(b) 
(c) 
(d) None of these

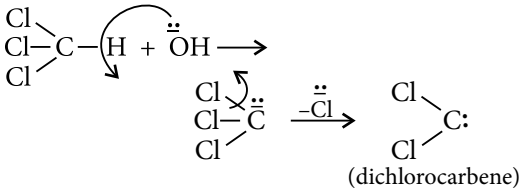
15. 

(a) 
(b) 
(c) 
(d) None of the above

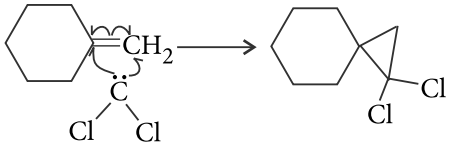
SOLUTIONS

1. (c) : We've seen the mechanism of HBO reaction. Here, overall H_2O addition takes place according to anti Markownikoff's rule.

∴ the correct option is (c).

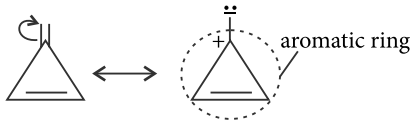
2. (c) : 
(dichlorocarbene)

So, addition of dichlorocarbene will take place across the double bond.



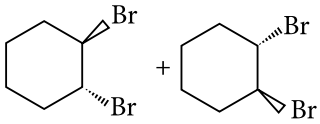
∴ Option (c) is correct.

3. (b) : Understandable fact is dipole moment will be maximum there where bond opening creates something extraordinarily stable structure. This is possible with structure 2.

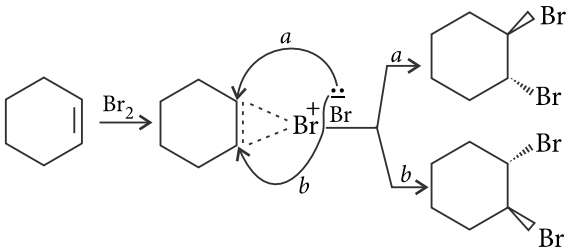


So, answer is (b).

4. (d) : Br_2 addition is anti in nature.



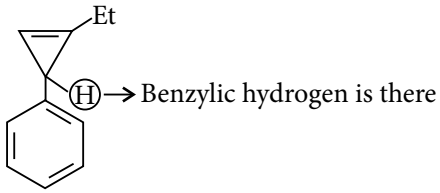
This is because :



So, it is equal mixture of 1*R*, 2*R* and 1*S*, 2*S*.

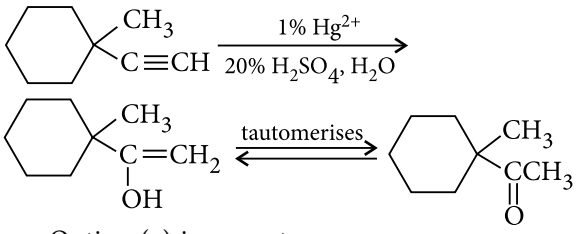
∴ Correct option is (d).

5. (d) : The conformation which gives all the groups in the equatorial positions will be most stable. Therefore, correct option is (d).

6. (c) : 

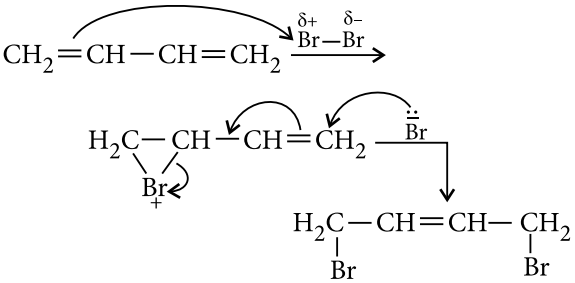
So, it undergoes oxidation to give benzoic acid. Doesn't matter what other groups are present. It will give benzoic acid.

7. (a) : It is the hydration of alkyne. Add water across the triple bond.



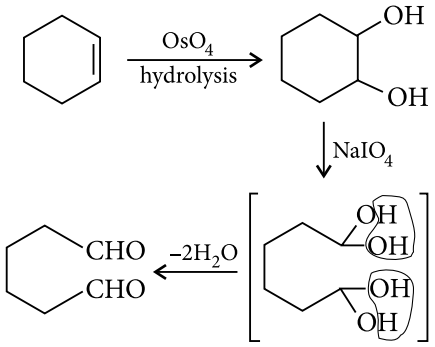
∴ Option (a) is correct.

8. (b) : Reaction is thermodynamically controlled. 1,4-addition product will be formed.



∴ Option (b) is correct.

9. (b):



∴ Correct option is (b).

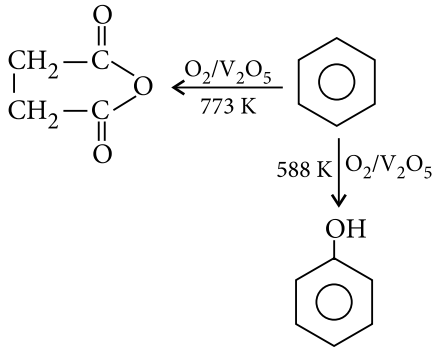
10. (c): $HC \equiv CH \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} \underset{CHO}{\overset{CHO}{|}}$

$\xrightarrow[(proton\ supplier)]{Zn\ (for\ reduction)} \underset{CH_2OH}{\overset{CH_2OH}{|}}$

Zn transfers electron.

∴ Correct option is (c).

11. (d):



∴ Correct option is (d).

12. (d): $CH_3-C\equiv C-H \xrightarrow[25°C]{KMnO_4 / \ddot{O}H}$

$CH_3-\underset{O}{\overset{}{C}}-\underset{O}{\overset{}{C}}-OH \xrightarrow[slow]{[O]} CH_3COOH$

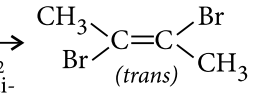
∴ Correct option is (d).

13. (a): $CH_3-C\equiv C-CH_3 \xrightarrow[Syn\ addition]{H_2,\ Pd\text{-}BaSO_4}$

$CH_3-\underset{H}{\overset{}{C}}=\underset{H}{\overset{}{C}}-CH_3 \xrightarrow[anti\ addition]{Br_2/CS_2}$ Racemic mixture (I) (CAR rule)

(*cis*)

$CH_3-C\equiv C-CH_3 \xrightarrow[CS_2]{Br_2}$ anti-addition



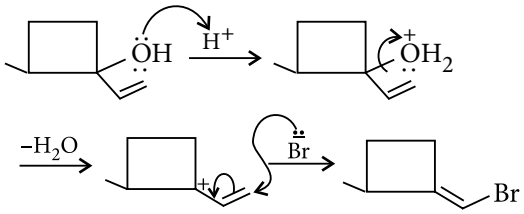
(*trans*)

$\xrightarrow[syn\ addition]{H_2,\ Pd\text{-}BaSO_4}$ Racemic mixture (II) (TSR rule)

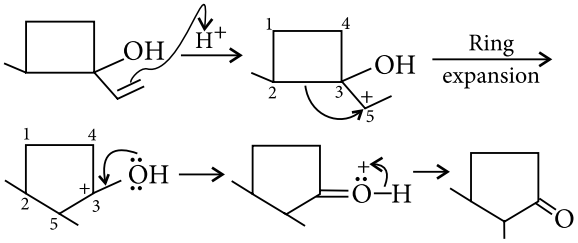
So, I and II are identical.

∴ Option (a) is correct.

14. (d):

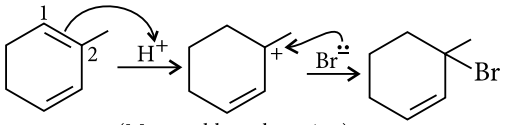


You might be thinking the reaction to happen in this way. But you'll understand your mistake if you see the following path :



So, you can understand that here not only a large ring is being obtained but also a thermodynamically more stable $>C=O$ bond is being established.

15. (a):



(More stable carbocation)

At low temperature, 1,2-addition product will be formed.

◈◈

MPP-2 CLASS XII ANSWER KEY

1. (c)	**2.** (d)	**3.** (c)	**4.** (d)	**5.** (d)
6. (b)	**7.** (c)	**8.** (c)	**9.** (d)	**10.** (a)
11. (b)	**12.** (c)	**13.** (c)	**14.** (c)	**15.** (b)
16. (c)	**17.** (b)	**18.** (a)	**19.** (c)	**20.** (b,c)
21. (a,c,d)	**22.** (a,d)	**23.** (a,c)	**24.** (4)	**25.** (6)
26. (5)	**27.** (b)	**28.** (a)	**29.** (d)	**30.** (c)

ADVANCED CHEMISTRY BLOC

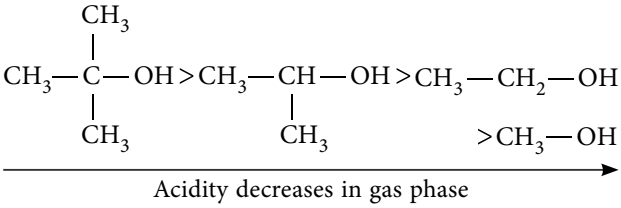
(ACIDIC STRENGTH, AN ANALYSIS)

Mk C R ayO id sh

"An electronegative atom raises the acidity of carboxylic acids". It's a very common sentence. For example, $Cl-CH_2COOH$ is more acidic than CH_3COOH.

One quite interesting trend is that the interchange of atoms with different electronegativities does not necessarily yield the expected results. For example, examine the acidities of various halogenated acetic acids. The most acidic is iodoacetic acid ($I-CH_2-COOH$) and the least acidic is fluoroacetic acid ($F-CH_2-COOH$). Similarly, of the substituted methanes, the most acidic is iodomethane (CH_3I) and the least acidic is fluoromethane (CH_3F). This can be understood on the grounds that iodine is more polarisable than fluorine, being better able to accept and spread out the increase in electron density than the smaller harder fluorine in the absence of any solvent to mediate the charge. This happens to be gas phase acidity. Measurement of acidity in water, in many instances although show a very different order. In fact, although surprising at first glance, chloroform ($CHCl_3$) is more acidic than fluoroform (CHF_3) in water by a factor of 10^7, again because of polarisable chlorine.

Another interesting and important trend is :



Larger the size of the alkyl group, more is the acidity. Once again polarisation is found to be important. Larger the alkyl group, the better it can accept the increase in electron density upon heterolysis of the $O-H$ bond. Interestingly, the exact reverse order of acidity is found in solution, where methanol is the strongest acid.

Effect of solvents

Organic solvents generally lower acidity whereas polar solvents increase acidity.

Electrostatic interactions influence acidity

The second pK_a of a dicarboxylic acid is higher than the first pK_a due to formation of a dianion with the associated electrostatic repulsion.

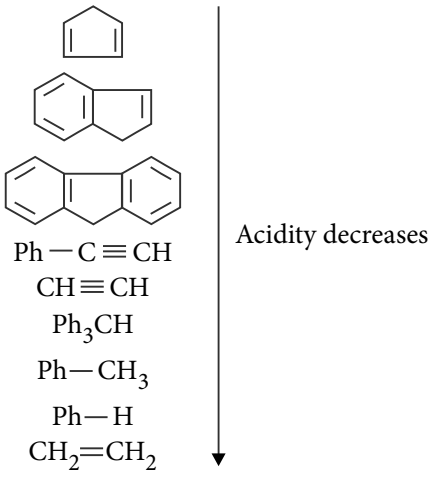
Dispersal of charge

As you have seen above, *t*-butyl alcohol is more acidic than ethanol in gas phase because the negative charge on the oxygen of corresponding alkoxide of *t*-butyl alcohol is easily dispersed on large number of alkyl groups. This explains the stability of conjugate base.

What if the acid itself is carrying charge? For example, NH_4^+, $CH_3\overset{+}{N}H_3$ and $(CH_3)_2\overset{+}{N}H_2$. In a same line of argument as you have seen for alkoxide, we expect the charge is more stabilised when we have more alkyl groups. That's what exactly we find. NH_4^+ is more acidic than $CH_3\overset{+}{N}H_3$ and which in turn is more acidic than $(CH_3)_2\overset{+}{N}H_2$. With more alkyl groups and more dispersal of charge, $(CH_3)_2\overset{+}{N}H_2$ does not feel like donating a proton.

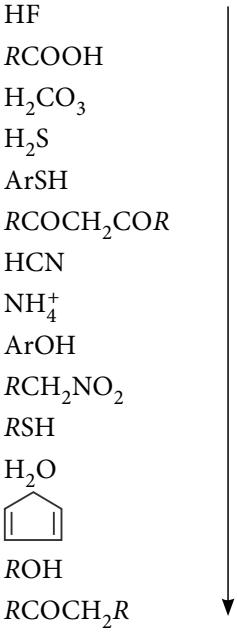
Acidity of some hydrocarbons

Based on data,



Substituent effects on the strength of Bronsted acids

Based on data,



Acid - Base equilibrium

As per Bronsted theory, equilibrium position of acid-base favours weaker acids and weaker bases.

For example,

$$\underset{\text{Acid-1}}{HCl} + \underset{\text{Base-1}}{H_2O} \rightleftharpoons \underset{\text{Acid-2}}{H_3O^+} + \underset{\text{Base-2}}{Cl^-}$$

If you see the reaction from the reverse side, H_3O^+ is the acid and Cl^- is the base. The equilibrium lies largely towards right as H_3O^+ is weaker acid than HCl and Cl^- is a weaker base than H_2O.

$$CH \equiv CH + 2NaOH \rightleftharpoons \overset{+}{Na}\overline{C} \equiv \overline{C}\overset{+}{Na} + 2H_2O$$

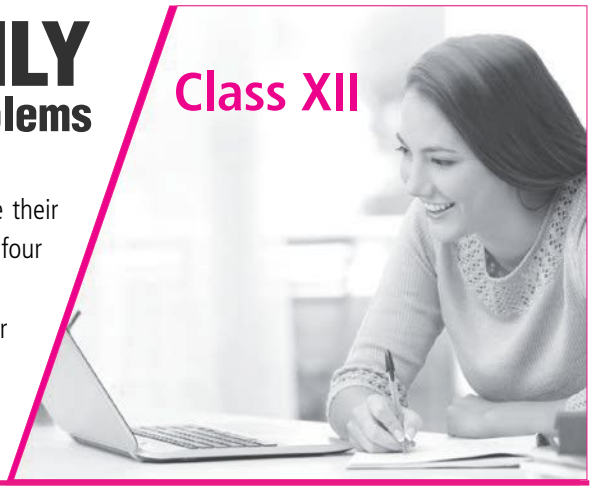
H_2O is a stronger acid than acetylene. Thermodynamics does not like to see strong acids are formed at the cost of weak acids in the medium. But

$$CH \equiv CH + AgNO_3 + NH_4OH \longrightarrow \underset{\text{ppt.}}{AgC \equiv CAg\downarrow} + NH_4NO_3 + H_2O$$

Don't you see this is a product favoured reaction; H_2O is formed at the expense of acetylene. This is because $AgC \equiv CAg$ is a precipitate. As it runs out of the medium, the reaction shifts towards right following Le Chatelier's principle.

MPP-2 MONTHLY Practice Problems

Class XII



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer.
Self check table given at the end will help you to check your readiness.

Electrochemistry | Chemical Kinetics

Total Marks : 120 **Time Taken : 60 Min.**

NEET / AIIMS

Only One Option Correct Type

1. If the volume of the vessel in which the reaction, $2NO + O_2 \longrightarrow 2NO_2$ is occurring is diminished to $1/3^{rd}$ of its initial volume, then the rate of reaction will be increased by
(a) 3 times (b) 9 times
(c) 27 times (d) 36 times.

2. For the cell, $Zn \mid Zn^{2+}(1\ M) \parallel Cu^{2+}(1\ M) \mid Cu$, E°_{cell} is 1.10 V, $E^\circ_{Cu^{2+}/Cu}$ = 0.34 V and for the cell, $Cu \mid Cu^{2+}(1\ M) \parallel Ag^+(1\ M) \mid Ag$, $E^\circ_{cell} = 0.46$ V hence, E°_{cell} of the cell $Zn \mid Zn^{2+}(1\ M) \parallel Ag^+(1\ M) \mid Ag$ is
(a) – 0.40 V (b) + 0.04 V
(c) + 0.30 V (d) + 1.56 V

3. If the rate of a reaction is increased by 81 times when the temperature is raised by 40 K, then the temperature coefficient is
(a) 1 (b) 2
(c) 3 (d) 4

4. The standard electrode potential values of the elements *A*, *B* and *C* are 0.68, – 2.50 and – 0.50 V respectively. The order of their reducing powers is
(a) $C > B > A$ (b) $A > C > B$
(c) $A > B > C$ (d) $B > C > A$

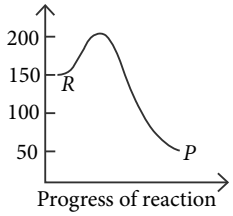
5. For the reaction,
$3BrO^- \longrightarrow BrO_3^- + 2Br^-$
in alkaline aqueous solution, the value of the second order (in BrO^-) rate constant at 80°C in the rate law for $-\Delta[BrO^-]/\Delta t$ was found to be 0.056 L mol^{-1} s^{-1}. The correct statement out of the following is
(a) rate constant is 0.019 L mol^{-1} s^{-1} when rate law is $\frac{\Delta[BrO_3^-]}{\Delta t}$
(b) $\frac{3}{2}\frac{\Delta[BrO^-]}{\Delta t} = \frac{[Br^-]}{\Delta t}$
(c) rate constant is 0.037 L mol^{-1} s^{-1} when rate law is $\frac{\Delta[Br^-]}{\Delta t}$
(d) both (a) and (c).

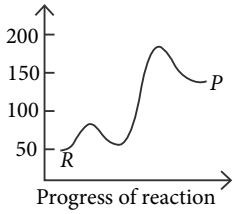
6. $Cu^+_{(aq)}$ is unstable in solution and undergoes simultaneous oxidation and reduction according to the reaction :
$2Cu^+_{(aq)} \rightleftharpoons Cu^{2+}_{(aq)} + Cu_{(s)}$
What will be the value of E° for the reaction?
(Given : $E^\circ_{Cu^{2+}/Cu}$ = 0.34 V and $E^\circ_{Cu^{2+}/Cu^+}$ = 0.15 V)
(a) + 0.49 V (b) + 0.38 V
(c) – 0.19 V (d) – 0.38 V

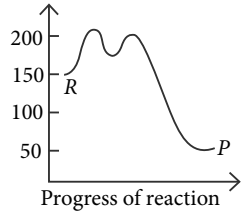
7. According to collision theory of reaction rates, rise in temperature of a reaction will increase the rate of the reaction because of
(a) increase in the velocity of the reacting molecules
(b) increase in the number of collisions
(c) increase in the number of molecules having the activation energy (threshold energy)
(d) none of these.

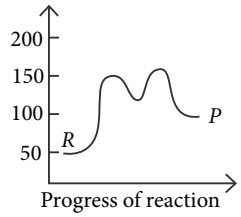
8. An exothermic chemical reaction occurs in two stages :
Reactants $\xrightarrow{\text{stage-1}}$ Intermediate $\xrightarrow{\text{stage-2}}$ Products

The activation energy of stage-1 is 50 kJ mol^{-1}. The overall enthalpy change for the reaction is –100 kJ mol^{-1}. Which diagram could represent the energy level diagram for the reaction?

(a) 

(b) 

(c) 

(d) 

9. The half-life period of radioactive element is 140 days. After 560 days, 1 g of element will reduce to

(a) $\frac{1}{2}$ g (b) $\frac{1}{4}$ g

(c) $\frac{1}{8}$ g (d) $\frac{1}{16}$ g

10. A current of 12 amperes is passed through an electrolytic cell containing aqueous $NiSO_4$ solution. Both Ni and H_2 gas are formed at the cathode. The current efficiency is 60%. The mass of nickel deposited on the cathode per hour is

(a) 7.883 g (b) 3.941 g

(c) 5.91 g (d) 2.645 g

11. For a first order gas phase reaction,

$$A_{(g)} \longrightarrow 2B_{(g)} + C_{(g)}$$

P_0 be initial pressure of A and P_t be the total pressure at time 't'.

Integrated rate equation is

(a) $\frac{2.303}{t}\log\left(\frac{P_0}{P_0 - P_t}\right)$

(b) $\frac{2.303}{t}\log\left(\frac{2P_0}{3P_0 - P_t}\right)$

(c) $\frac{2.303}{t}\log\left(\frac{P_0}{2P_0 - P_t}\right)$

(d) $\frac{2.303}{t}\log\left(\frac{2P_0}{2P_0 - P_t}\right)$

12. Molar conductivities of Li^+, Na^+, K^+ and Rb^+ ions in aqueous solutions are in the following order :

(a) $Li^+ > Na^+ = K^+ < Rb^+$

(b) $Li^+ > Na^+ > K^+ = Rb^+$

(c) $Rb^+ > K^+ > Na^+ > Li^+$

(d) $Li^+ > Rb^+ > K^+ > Na^+$

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of assertion.

(c) If assertion is true but reason is false.

(d) If both assertion and reason are false.

13. **Assertion :** On dilution, the equivalent as well as molar conductivity of solution increases.

Reason : With dilution, the number of current carrying particles per cm^3 increases.

14. **Assertion :** A catalyst lowers the activation energy and makes the reaction faster.

Reason : A catalyst does not affect the order of reaction.

15. **Assertion :** In electrolysis, the quantity of electricity needed for deposition of 1 mole of silver is different from that required for 1 mole of copper.

Reason : The molecular weight of silver and copper is different.

JEE MAIN / JEE ADVANCED

Only One Option Correct Type

16. Consider the following half-cell reactions :

I. $A + e^- \longrightarrow A^-$; $E^\circ = 0.96$ V

II. $B^- + e^- \longrightarrow B^{2-}$; $E^\circ = -0.12$ V

III. $C^+ + e^- \longrightarrow C$; $E^\circ = +0.18$ V

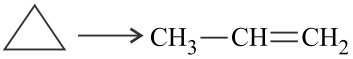
IV. $D^{2+} + 2e^- \longrightarrow D$; $E^\circ = -1.12$ V

What combination of two half-cells will result in the largest potential?

(a) I and II (b) I and III

(c) I and IV (d) II and IV

17. Cyclopropane rearranges to form propene,



if reaction follows first order kinetics, then the rate constant is 2.714×10^{-3} sec^{-1}. The initial concentration of cyclopropane is 0.29 M. What will be the concentration of cyclopropane after 100 seconds?

(a) 0.035 M (b) 0.22 M

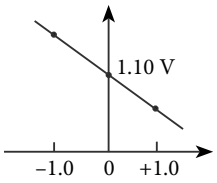
(c) 0.145 M (d) 0.0018 M

18. Which graph correctly correlates E_{cell} as a function of concentration for the cell (for different values of M and M') :

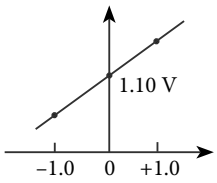
$Zn_{(s)} + Cu^{2+}_{(M)} \longrightarrow Zn^{2+}_{(M')} + Cu_{(s)}$; $E^\circ_{cell} = 1.10$ V

X-axis : $\log_{10}\frac{[Zn^{2+}]}{[Cu^{2+}]}$, Y-axis : E_{cell}

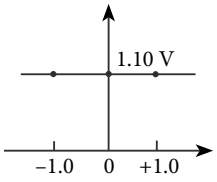
(a)



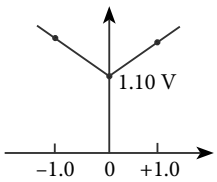
(b)



(c)



(d)



19. Half-lives of first order and zeroth order reactions are same. Ratio of rates at the start of reaction is

(a) 0.693 (b) $\frac{1}{0.693}$

(c) 2×0.693 (d) $\frac{2}{0.693}$

More than One Options Correct Type

20. The function of a catalyst in chemical reaction is to

(a) increase the average kinetic energy of the reacting molecules

(b) decrease the activation energy

(c) alter the reaction mechanism

(d) increase the frequency of collision of the reacting species.

21. Which of the following reactions are related to rusting?

(a) $CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$

(b) $Fe \xrightarrow{H^+} Fe^{3+} + 3e^-$

(c) $4H^+ + O_2 + 4e^- \longrightarrow 2H_2O$

(d) $4Fe^{2+} + O_2 + 4H_2O \longrightarrow 2Fe_2O_3 + 8H^+$

22. For a first order reaction, which of the following statements are correct?

(a) The degree of dissociation is equal to $(1 - e^{-kt})$.

(b) A plot of reciprocal of concentration of the reactant versus time gives a straight line.

(c) The time taken for the completion of 75% of the reaction is thrice the $t_{1/2}$ of the reaction.

(d) The pre-exponential factor in the Arrhenius equation has the dimension of $time^{-1}$.

23. There is blue colour formation if

(a) Cu electrode is placed inside $AgNO_3$ solution

(b) Cu electrode is placed inside $ZnSO_4$ solution

(c) Cu electrode is placed inside dil. HNO_3

(d) Cu electrode is placed inside dil. H_2SO_4.

Integer Answer Type

24. $t_{½}$ for a first order reaction is 14.26 min. The percentage of reactant decomposed after 50 sec is x. The value of x is

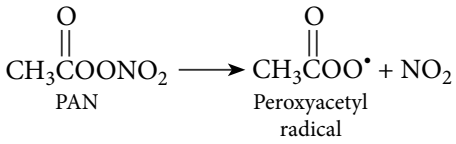
25. After electrolysis of an aqueous sodium chloride solution with inert electrodes for a certain period of time 600 mL of solution was left which was found to be 1 N in sodium hydroxide. During the same time 31.8 g of Cu was deposited in a copper voltameter in series. The percentage of theoretical yield of sodium hydroxide obtained is $x \times 10$ where x is

26. The rate constant at 25°C for the reaction of NH_4^+ and OH^- to form NH_4OH (aq. NH_3) is

4.0×10^{10} M^{-1} s^{-1}. The rate constant for proton transfer to NH_3 is 7.2×10^{x} s^{-1}. Ionisation constant of aq. NH_3 is 1.8×10^{-5}. The value of x is

Comprehension Type

Peroxyacetyl nitrate (PAN) is an air pollutant produced in photochemical smog by the reaction of hydrocarbons, oxides of nitrogen and sunlight. It dissociates as :



A sample of polluted air is analysed for its PAN content which is reported as PAN molecules per litre in air at 25°C.

Time (min)	Molecules $\times 10^{-14}$/L
0.0	5.0
10.0	4.0
20.0	3.2
30.0	2.6
40.0	2.1
50.0	1.7
60.0	1.3

27. What is the order of the PAN decomposition reaction?

(a) 0 (b) 1
(c) 2 (d) 3

28. Rate constant for of the reaction will be

(a) 0.0231 min^{-1}
(b) 0.009 min^{-1}
(c) 0.0231 L mol^{-1} min^{-1}
(d) 0.009 L mol^{-1} min^{-1}

Matrix Match Type

29. Match the Column I with Column II and mark the appropriate option.

Column I	Column II
(A) Oxidation potential of hydrogen electrode set up in a solution with pH = 2	(P) 0.018 V
(B) Oxidation potential of hydrogen electrode set up in 0.5 M HCl solution	(Q) 0.059 V
(C) EMF of concentration cell with hydrogen electrodes set up in 0.1 M and 0.01 M HCl solutions	(R) 0.035 V
(D) EMF of concentration cell with hydrogen electrodes set up in 0.1 M and 0.4 M HCl solutions	(S) 0.118 V

	A	B	C	D
(a)	P	S	Q	R
(b)	R	P	Q	S
(c)	Q	P	S	R
(d)	S	P	Q	R

30. Match the Column I with Column II and mark the appropriate option.

Column I	Column II
(A) Zero order reaction	(P) Rate constant has the units L mol^{-1} min^{-1}
(B) First order reaction	(Q) Arrhenius parameter '*A*' has the same units as rate constant
(C) Second order reaction	(R) Solvent in excess in one of the reactants
(D) Pseudounimolecular reaction	(S) Plot of $t_{1/2}$ vs conc. is linear passing through the origin

	A	B	C	D
(a)	Q, S	P	P, Q	Q, R
(b)	S	Q	P, R	P, Q, R
(c)	Q, S	Q	P, Q	P, Q, R
(d)	P	Q, S	P, Q	P, R

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SELF CHECK

No. of questions attempted .....
No. of questions correct .....
Marks scored in percentage .....

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

JEE Advanced

PRACTICE PROBLEMS

SECTION 1 (Maximum Marks : 18)

This section contains 6 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which only one is correct. For each question you will be awarded 3 marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (–1) mark will be awarded.

1. A 10.0 g mixture of *n*-butane and 2-butene was treated with bromine in CCl_4 and consumed 8.0 g of bromine (atomic weight = 80). Another 10.0 g of the same mixture was hydrogenated to get *n*-butane only. The weight of 2-butene in the original mixture and the gain in the weight of the mixture after hydrogenation, respectively are

(a) 2.8 g and 0.1 g (b) 5.6 g and 4.0 g
(c) 7.2 g and 0.8 g (d) 8.0 g and 10.0 g

2. The values of IE_1, IE_2, IE_3, IE_4 and IE_5 of an element are 7.1, 14.3, 34.5, 46.8 and 162.2 eV respectively. The element is likely to be

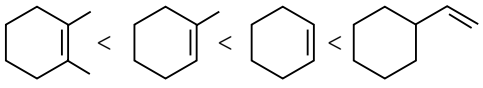
(a) Na (b) Si
(c) F (d) Ca

3. Which of the following is the incorrect order

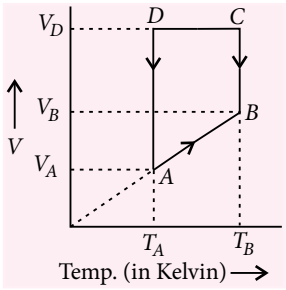
(a) $CH_3\bar{S} > CH_3\bar{O} > H\bar{O} > H_2O$
(nucleophilicity in protic solvent)

(b) $\bar{Cl} > \bar{O}-\underset{\underset{O}{\|}}{C}-CH_3 > \bar{O}CH_3 > \bar{N}H_2$
(leaving group ability)

(c) $CH_3—CH_2—F > CH_3—CH_2—Cl > CH_3—CH_2—Br > CH_3—CH_2—I$ (boiling point)

(d)  (rate of catalytic hydrogenation)

4. A monoatomic ideal gas of two moles is taken through a cyclic process starting from *A* as shown in figure. The volume ratios are $\frac{V_B}{V_A} = 2$ and $\frac{V_D}{V_A} = 4$. If the temperature T_A at *A* is 27°C. Calculate the total heat absorbed (in Calorie) in the cyclic process.

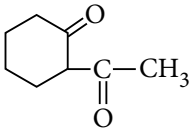


(a) 1080 (b) 900
(c) 600 (d) 1200

5. IUPAC name of,

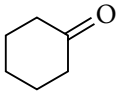
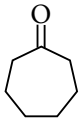
$$H_3C-\underset{\underset{C_2H_5}{|}}{CH}-CH_2-\underset{\underset{CHO}{|}}{CH}-CH_2Cl$$ is

(a) 2-chloromethyl-4-methyl-hexanal
(b) 1-chloro-4-ethyl-2-pentanal
(c) 1-chloro-4-methyl-2-hexanal
(d) 1-chloro-2-aldo-4-methyl hexane.

6.  $\xrightarrow{NaOI}$ $\underset{\text{(yellow ppt.)}}{A}$ + $B \xrightarrow{H^+}$

$C_7H_{10}O_3 \xrightarrow[-CO_2]{\Delta} C \xrightarrow[(ii)\ NaNO_2 + HCl]{(i)\ HCN,\ (ii)\ LiAlH_4} D$

Product *D* is

(a)  (b) 

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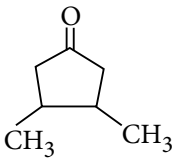
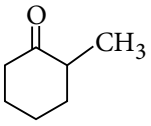
(c) 

(d) 

SECTION 2 (Maximum Marks : 24)

This section contains 6 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which one or more than one answer is correct. For each question you will be awarded 4 marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. No negative marking in this section.

7. Sodium peroxide which is yellow solid becomes white on exposure to air due to the formation of

(a) Na_2O (b) Na_2SO_4

(c) NaOH (d) Na_2CO_3

8. $BN + HCl \longrightarrow P + NH_3\uparrow$

$P + H_2O \longrightarrow Q + HCl$

Find the true statements about *P* and *Q*?

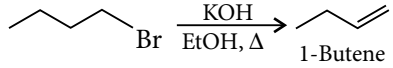
(a) *P* is Lewis base.

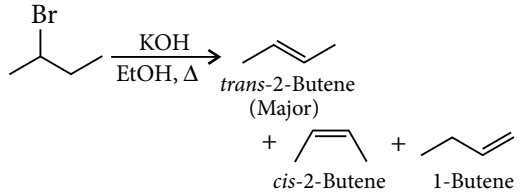
(b) *P* has zero dipole moment.

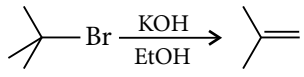
(c) *Q* on reaction with NaOH acts as strong acid in presence of *cis*-diol.

(d) *Q* is planar trigonal in shape and sp^2 hybridised compound.

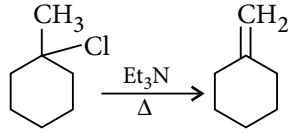
9. Choose the correct reaction/s :

(a) 

(b) 

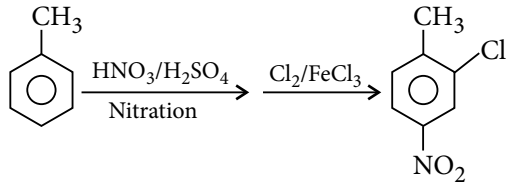
(c) 

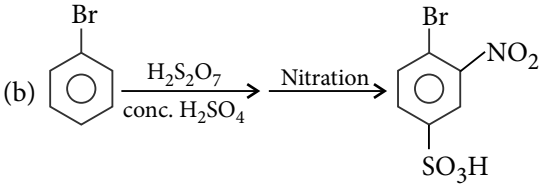
2-Methyl propene

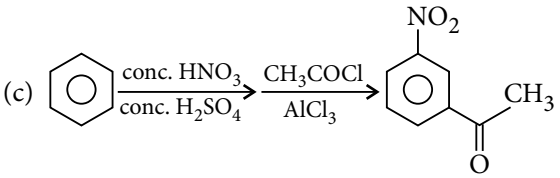
(d) 

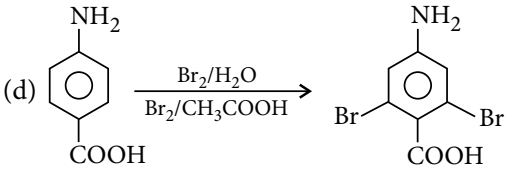
(Major)

10. Which of the following is/are correctly matched?

(a) 

(b) 

(c) 

(d) 

11. Which of the following will emit positron?

(a) $^{30}_{15}P$ (b) $^{13}_{7}N$

(c) $^{3}_{1}H$ (d) $^{14}_{6}C$

12. Fe^{3+} is reduced to Fe^{2+} by using

(a) H_2O_2 in presence of NaOH

(b) Na_2O_2 in water

(c) H_2O_2 in presence of H_2SO_4

(d) Na_2O_2 in presence of H_2SO_4

SECTION 3 (Maximum Marks : 27)

This section contains 3 paragraphs. Based upon each paragraph, 3 multiple choice questions have to be answered. For each question you will be awarded 3 marks if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (–1) mark will be awarded.

PARAGRAPH 1

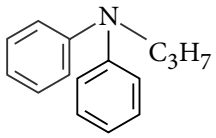
A compound (*W*) $C_{15}H_{17}N$ is treated with benzene sulphonyl chloride and aqueous KOH no apparent change occurs. Acidification of the mixture gives a clear solution. When *W* is reacted with CH_3I, an optically active compound (*Y*) is formed. *Y* gives yellow precipitate with $AgNO_3$ solution. When *Y* is heated with Ag_2O then an amine of molecular formula $C_{14}H_{15}N$ and ethylene are formed.

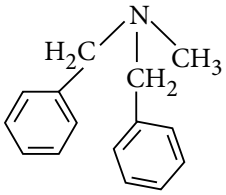
13. The degree of unsaturation in $C_{15}H_{17}N$ is _____ and the number of phenyl groups should be _____.

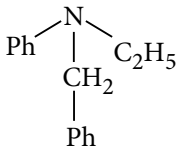
(a) 8, 8 (b) 2, 8

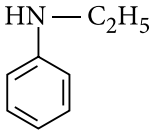
(c) 2, 2 (d) 8, 2

14. The compound *W* is therefore

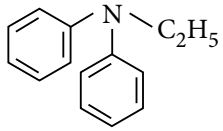
(a) 

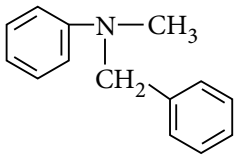
(b) 

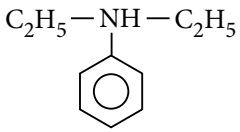
(c) 

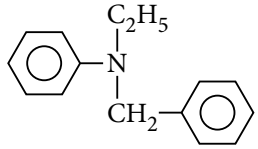
(d) 

15. The structure of amine formed will be

(a) 

(b) 

(c) 

(d) 

PARAGRAPH 2

Two ores of same metal (*M*) are A_1 and A_2.

(a) $A_1 \xrightarrow{\text{roasting}} B + C(\text{gas})$

$B \xrightarrow{HCl}$ $C(\text{gas}) \xrightarrow{\text{Acidified } K_2Cr_2O_7}$ Green solution

Green solution $\xrightarrow{NH_4CNS}$ Deep red colouration

(b) $A_2 \xrightarrow{\text{roasting}} D + E + C(\text{gas})$

$D \xrightarrow{\text{Partial oxidation}} D'$; $E \xrightarrow{\text{Partial oxidation}} E'$

$D + D' \xrightarrow{\text{Auto reduction}} \text{metal} + \text{gas}(C)$

$D' \xrightarrow{\text{Conc. } H_2SO_4} \xrightarrow{K_4Fe(CN)_6}$ reddish brown ppt.

16. Ore A_1 is

(a) FeO (b) CuO

(c) FeS_2 (d) Fe_3O_4

17. Ore A_2 is

(a) FeS_2 (b) $CuCO_3$

(c) $FeCO_3$ (d) $CuFeS_2$

18. Compound *B* is

(a) $FeCl_2$ (b) FeO

(c) Fe_2O_3 (d) CuO

PARAGRAPH 3

If a cell has cell potential '*E*' and standard cell potential E° then free energy change of cell process may be calculated as :

$$\Delta G = -W = -nFE$$

$$\Delta G^\circ = -W_{max} = -nFE^\circ$$

Where '*n*' is the number of electrons involved in overall cell process. According to Gibbs – Helmholtz equation,

$$\Delta G = \Delta H - T\Delta S = \Delta H + T\left(\frac{\delta \Delta G}{dT}\right)_p$$

Temperature coefficient of the cell, $\mu = \left(\frac{dE}{dT}\right)_p$

19. ΔG° for the Daniell cell $Zn_{(s)} \,|\, ZnSO_4 \,||\, CuSO_4 \,|\, Cu_{(s)}$

$E^\circ_{Zn^{2+}/Zn} = -0.76$ V, $E^\circ_{Cu^{2+}/Cu} = +0.34$ V will be

(a) –312.3 kJ (b) –212.3 kJ

(c) –132.2 kJ (d) –323.1 kJ

20. The temperature coefficient of a cell potential $\left(\frac{dE}{dT}\right)_p$ is

(a) $\frac{\Delta S}{nF}$ (b) $\frac{nF}{\Delta S}$ (c) $\frac{\Delta S}{nFT}$ (d) $-nFE$

21. $Pb_{(s)} + HgCl_{2(aq)} \longrightarrow PbCl_{2(aq)} + Hg_{(l)}$;

$\left(\frac{dE}{dT}\right)_p = 1.5 \times 10^{-4}$ V K^{-1} at 298 K

The change in entropy in J K^{-1} mol^{-1} for the cell reaction is

(a) 14.475 (b) 28.95 (c) 57.9 (d) 86.82

ANSWER KEY

1.	(a)	**2.**	(b)	**3.**	(c)	**4.**	(d)	**5.**	(a)
6.	(b)	**7.**	(c, d)	**8.**	(b, c, d)	**9.**	(a, b, c, d)		
10.	(a, b)	**11.**	(a, b)	**12.**	(a, b)	**13.**	(d)	**14.**	(c)
15.	(b)	**16.**	(c)	**17.**	(d)	**18.**	(c)	**19.**	(b)
20.	(a)	**21.**	(b)						

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CHEMISTRY MUSING

SOLUTION SET 46

1. (b) : For the precipitation of Ag^+ and Hg_2^{2+} ions, the conc. of $[I^-]$ required can be derived as :

For AgI : $[Ag^+][I^-] = K_{sp}$ of AgI

$$(0.1)[I^-] = 8.5 \times 10^{-17}$$

$$\Rightarrow \quad [I^-] = 8.5 \times 10^{-16}\ M \qquad ...(i)$$

For Hg_2I_2 : $[Hg_2^{2+}]\ [I^-]^2 = K_{sp}$ of Hg_2I_2

$$(0.1)\ [I^-]^2 = 2.5 \times 10^{-26}$$

$$\Rightarrow \quad [I^-] = 5 \times 10^{-13}\ M \qquad ...(ii)$$

Thus, AgI will be precipitated before Hg_2I_2 because $[I^-]$ required to precipitate AgI is less. Also, it will continue, upto addition of $[I^-] = 5 \times 10^{-13}$ when Hg_2I_2 begins to precipitate and thus, maximum $[I^-]$ for AgI precipitation $= 5 \times 10^{-13}$ M

Now at this concentration of I^-, $[Ag^+]$ left in solution is $[Ag^+]_{left}\ [I^-] = K_{sp}$ of AgI

$$[Ag^+]_{left} = \frac{8.5 \times 10^{-17}}{5.0 \times 10^{-13}} = 1.7 \times 10^{-4}\ M$$

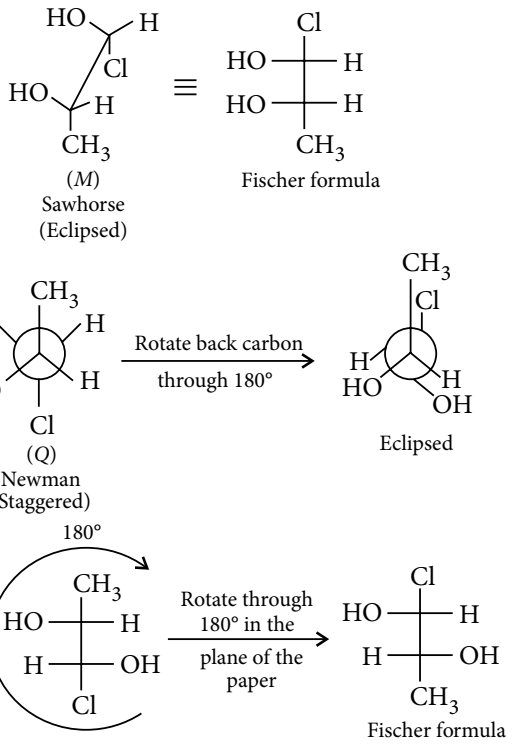
$\because$ 0.1 M Ag^+ will leave $= 1.7 \times 10^{-4}$ M Ag^+ in solution

$\therefore$ 100 M Ag^+ will leave = 0.17 M Ag^+ in solution

$\therefore$ % of Ag precipitated = 100 – 0.17 = 99.83%

2. (b)

3. (d) :



After examining all the Fischer formulae, we observe that :

(a) *M* and *N* are non-mirror image stereoisomers. Actually they are diastereomers. Therefore, option (a) is correct.

(b) *M* and *O* are identical, therefore, option (b) is correct.

(c) *M* and *P* are enantiomers, *i.e.*, these are non-superimposable mirror images. Therefore, option (c) is correct.

(d) *M* and *Q* are not mirror images of each other, *i.e.*, they are diastereomers. Therefore, option (d) is wrong.

4. (b) : $Ag^+ + 2NH_3 \overset{K_f}{\rightleftharpoons} [Ag(NH_3)_2]^+$

$$\text{Stability constant, } K_f = \frac{[Ag(NH_3)_2]^+}{[Ag]^+\,[NH_3]^2} = 1.7 \times 10^7$$

$$\frac{[Ag(NH_3)_2]^+}{[Ag]^+} = 1.7 \times 10^7 \times [NH_3]^2$$

$$= 1.7 \times 10^7 \times (0.1)^2 = 1.7 \times 10^5$$

$$\therefore \quad \frac{[Ag]^+}{[Ag(NH_3)_2]^+} = \frac{1}{1.7 \times 10^5} = 5.88 \times 10^{-6}$$

5. (b) : $NH_{3(g)} + HCl_{(g)} \longrightarrow NH_4Cl_{(s)}$; $\Delta H = -43.0$ kJ

Initial mole	$\frac{2 \times 1}{0.08 \times 200}$	$\frac{8 \times 0.8}{0.08 \times 200}$	
	0.125	0.4	0
Final mole	0	0.275	0.125

$\therefore$ Heat produced $= 0.125 \times 43 = 5.375$ kJ

The heat produced is used to increase the temperature of HCl left in flask since heat capacity of flask and $NH_4Cl = 0$

$\therefore \quad Q = n \times C_v \times \Delta T$

$5.375 \times 10^3 = 0.275 \times 20 \times \Delta T \ \Rightarrow \ \Delta T = 977.27$ K

$\therefore$ Final temperature $= 200 + 977.27 = 1177.27$ K

6. (c) : 1 g H contains $= 6.023 \times 10^{23}$ atoms

$\therefore$ 1.8 g H contains $= 6.023 \times 10^{23} \times 1.8$

$$= 10.84 \times 10^{23} \text{ atoms}$$

$$\text{No. of atoms in } 3^{rd} \text{ shell} = \frac{10.84 \times 10^{23} \times 27}{100}$$

$$= 292.68 \times 10^{21} \text{ atoms}$$

$$\text{No. of atoms in } 2^{nd} \text{ shell} = \frac{10.84 \times 10^{23} \times 15}{100}$$

$$= 162.6 \times 10^{21} \text{ atoms}$$

When all the atoms return to Ist shell, then

(i) $E'_{(3\to1)} = (E_3 - E_1) \times 292.68 \times 10^{21}$

$$= \left(-\frac{13.6}{9} + 13.6\right) \times 1.602 \times 10^{-19} \times 292.68 \times 10^{21}$$

$$= 5.668 \times 10^5 \text{ J}$$

(i) $E''_{(2\to1)} = (E_2 - E_1) \times 162.6 \times 10^{21}$

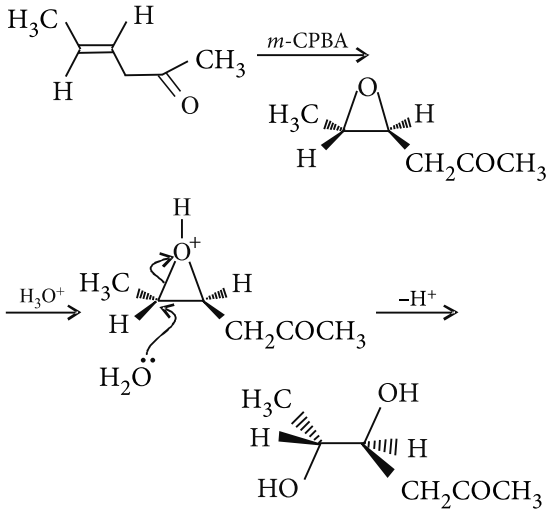
$$= \left(-\frac{13.6}{4} + 13.6\right) \times 1.602 \times 10^{-19} \times 162.6 \times 10^{21}$$

$$= 2.657 \times 10^5 \text{ J}$$

$\therefore$ $E = E' + E'' = 5.668 \times 10^5 + 2.657 \times 10^5$ J

$= 832.50$ kJ

7. (a) : Alkenes, in general, are more reactive than ketones towards peracids. And during such epoxidation reaction, the stereochemistry is retained.



8. (c) : All these reactions are similar in the sense that they begin with the nucleophilic attack on carbonyl carbon. Greater the positive charge density on carbonyl carbon, more reactive is the compound. In statement II, the presence of nitro group would make the compound more reactive.

$O{=}C(OC_2H_5)_2$ is actually more electrophilic than ordinary esters. Combined inductive effect of two $-OC_2H_5$ groups is more than the resonance effect. In fact, there is a small difference between two large effects, and also $-OC_2H_5$ is a better leaving group.

9. (9) : Emission of an α-particle shows a decrease in mass number by 4 units and decrease in atomic number by 2 units.

Emission of a β-particle shows a gain in atomic number by one unit and mass number remains the same.

Thus, for the given nuclear change,

$$_{88}Ra^{226} \xrightarrow{-{}_2He^4} {}_{86}Rn^{222} \xrightarrow{-{}_2He^4} {}_{84}Po^{218} \xrightarrow{-{}_{-1}e^0} {}_{85}At^{218} \xrightarrow{-{}_2He^4} {}_{83}Bi^{214}$$

Hence, final product *R* is Bi which belongs to group-15 and 6th period.

$x = 15$, $y = 6$, $x - y = 15 - 6 = 9$

10. (2) : For a compound in gaseous state,

$$PV = \frac{w}{m}RT$$

$$\frac{768}{760} \times \frac{37.24}{1000} = \frac{0.120}{m} \times 0.0821 \times 378$$

$\therefore$ $m = 99$

Combustion of compound, $C_aH_bCl_z$;

$$C_a H_b Cl_z + (a + b/4)O_2 \longrightarrow aCO_2 + \frac{b}{2}H_2O + \frac{z}{2}Cl_2$$

As 99 g of the compound gives $44a$ g of CO_2

$\therefore$ 0.22 g compound will give $= \frac{44a \times 0.22}{99}$ g CO_2

Thus, $\frac{44a \times 0.22}{99} = 0.195$

$\therefore$ $a = 1.99 \approx 2$

Similarly,

$\because$ 99 g of the compound gives $18 \times \frac{b}{2}$ g of H_2O

$\therefore$ 0.22 g of the compound will give

$$= \frac{18 \times b \times 0.22}{2 \times 99} \text{ g } H_2O$$

Thus, $\frac{18 \times b \times 0.22}{2 \times 99} = 0.0804$

$\therefore$ $b = 4$

Now, for $C_aH_bCl_z$ $\quad 12a + b + 35.5z = 99$

$12 \times 2 + 4 + 35.5z = 99$

$\therefore$ $z = 2$

$\therefore$ The compound is $C_2H_4Cl_2$.

MPP-2 CLASS XI ANSWER KEY

1.	(b)	**2.**	(b)	**3.**	(c)	**4.**	(d)	**5.**	(c)
6.	(a)	**7.**	(d)	**8.**	(c)	**9.**	(c)	**10.**	(b)
11.	(a)	**12.**	(b)	**13.**	(c)	**14.**	(c)	**15.**	(c)
16.	(b)	**17.**	(c)	**18.**	(c)	**19.**	(a)	**20.**	(a,c,d)
21.	(a,b)	**22.**	(a,c,d)	**23.**	(a,b,d)	**24.**	(4)	**25.**	(4)
26.	(6)	**27.**	(b)	**28.**	(b)	**29.**	(c)	**30.**	(a)

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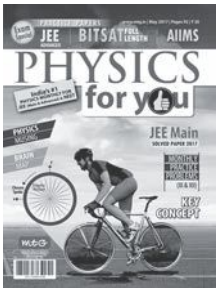

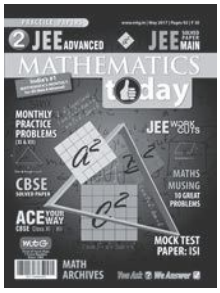

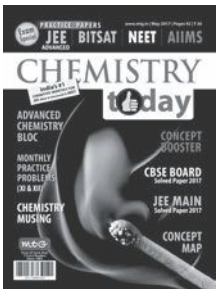

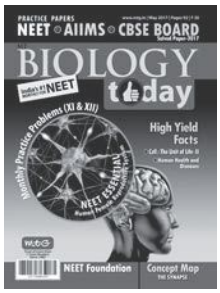

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