

**INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN CHEMISTRY 2016 -17**

Date of Examination: 27th November, 2016

Write the question paper code mentioned above on YOUR answer sheet (in the space provided), otherwise your answer sheet will NOT be assessed. Note that the same Q.P. Code appears on each page of the question paper.

Instructions to Candidates –

1. Use of mobile phones, smartphones, ipads during examination is STRICTLY PROHIBITED.
2. In addition to this question paper, you are given answer sheet along with Candidate's copy.
3. On the answer sheet, make all the entries carefully in the space provided **ONLY** in **BLOCK CAPITALS** as well as by properly darkening the appropriate bubbles. **Incomplete/ incorrect/carelessly filled information may disqualify your candidature.**
4. On the answer sheet, use only BLUE or BLACK BALL POINT PEN for making entries and filling the bubbles.
5. The email ID and date birth entered in the answer sheet will be your login credentials for accessing performance report. Please take care while entering.
6. Question paper has 80 multiple choice questions. Each question has four alternatives, out of which only one is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q. No. 22 a b c d

7. A correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer.
8. Any rough work should be done only in the space provided.
9. Use of **non-programmable** calculator is allowed.
10. No candidate should leave the examination hall before the completion of the examination.
11. After submitting your answer paper, take away the Candidate's copy for your reference.

Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the answer sheet.

Answer sheets are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED.

Scratching or overwriting may result in a wrong score.

DO NOT WRITE ON THE BACK SIDE OF THE ANSWER SHEET.

Instructions to Candidates (continued) –

Read the following instructions after submitting the answer sheet.

12. Comments regarding this question paper, if any, may be sent by email only to iapt.nse@gmail.com till 29th November, 2016.
13. The answers/solutions to this question paper will be available on our website – www.iapt.org.in by 2nd December, 2016.
14. **CERTIFICATES and AWARDS –**
Following certificates are awarded by the IAPT to students successful in NSEs
 - (i) Certificates to “Centre Top 10%” students
 - (ii) Merit Certificates to “Statewise Top 1%” students
 - (iii) Merit Certificates and a book prize to “National Top 1%” students
15. Result sheets can be downloaded from our website in the month of February. The “Centre Top 10%” certificates will be dispatched to the Prof-in-charge of the centre by February, 2017.
16. List of students (with centre number and roll number only) having score above MAS will be displayed on our website (www.iapt.org.in) by 22nd December, 2016. See the **Eligibility Clause** in the Student’s brochure on our website.
17. Students eligible for the INO Examination on the basis of selection criteria mentioned in Student’s brochure will be informed accordingly.

Useful Constants:

Charge of electron, $e = 1.602 \times 10^{-19} \text{ C}$

Mass of electron, $m_e = 9.1 \times 10^{-31} \text{ kg}$

Planck’s constant, $h = 6.626 \times 10^{-34} \text{ J s}$

Speed of light, $c = 3.0 \times 10^8 \text{ m s}^{-1}$

Avogadro constant, $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Molar gas constant, $R = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$

$= 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$

CHEMISTRY

1. The kinetic energy of an electron that has a wavelength of 10 nm is
 (a) 2.4×10^{-21} J (b) 4.8×10^{-21} J (c) 2.4×10^{-29} J (d) 4.8×10^{-29} J

1. (a)

$$KE = \frac{h^2}{2m\lambda^2} = \frac{2.41 \times 10^{-37}}{\lambda^2} = \frac{2.4 \times 10^{-37}}{(10^{-8})^2} = 2.4 \times 10^{-21} \text{ J}$$

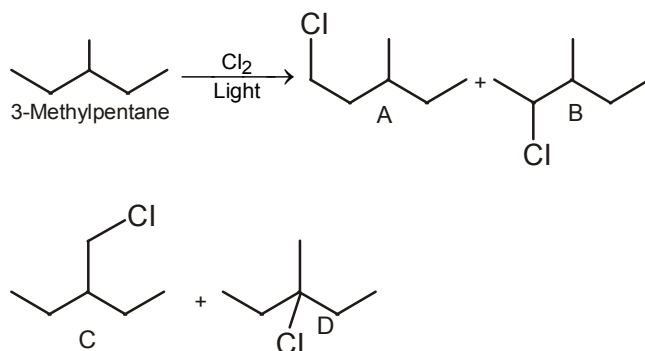
2. Which of the following compounds contain 3-centered 2-electron bonding?

i: $[\text{BeF}_2]_n$ ii: $[\text{Be}(\text{CH}_3)_3]_n$ iii: $[\text{BeCl}_2]_n$ iv: $[\text{BeH}_2]_n$
 (a) i and ii (b) ii and iii (c) ii and iv (d) iii and iv

2. (c)

$[\text{Be}(\text{CH}_3)_3]_n$ & $(\text{BeH}_2)_n$ contain (3c-2e) bond while $[\text{BeF}_2]_n$ and $[\text{BeCl}_2]_n$ contain (3c-4e) bond.

3. 3-Methylpentane on monochlorination gives four possible products. The reaction follows free radical mechanism. The relative reactivities for replacement of H are $3^\circ : 2^\circ : 1^\circ = 6 : 4 : 1$



Relative amounts of A, B, C and D formed are

- (a) 6/31, 16/31, 6/31, 3/31 (b) 16/31, 6/31, 6/31, 3/31
 (c) 6/31, 16/31, 3/31, 6/31 (d) 6/31, 3/31, 6/31, 16/31

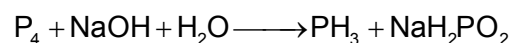
3. (c)

$$\frac{6}{6} : \frac{4}{16} : \frac{3}{3} : \frac{1}{1} = \frac{6}{31} : \frac{16}{31} : \frac{3}{31} : \frac{6}{31}$$

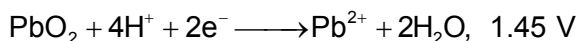
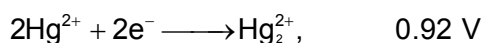
4. White phosphorous on reaction with NaOH gives PH_3 and

(a) Na_2HPO_3 (b) NaH_2PO_2 (c) NaH_2PO_3 (d) Na_3PO_4

4. (b)



5. Given the E_0 values for the half reactions:



Which of the following statements is true ?

- (a) Sn^{2+} is a stronger oxidizing agent than Pb^{4+}
- (b) Sn^{2+} is a stronger reducing agent than Hg_2^{2+}
- (c) Hg_2^{2+} is a stronger oxidizing agent than Pb^{4+}
- (d) Pb^{2+} is a stronger reducing agent than Sn^{2+}

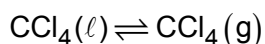
5. (b)

$$E^0(\text{Sn}^{4+} | \text{Sn}^{2+}) < E^0(\text{Hg}_2^{2+} | \text{Hg}^{2+})$$

6. For the conversion $\text{CCl}_4(\text{l}) \rightarrow \text{CCl}_4(\text{g})$ at 1 bar and 350 K, the correct set of thermodynamic parameters is (Boiling point of CCl_4 is 77°C)

- (a) $\Delta G = 0, \Delta S = +ve$
- (b) $\Delta G = 0, \Delta S = -ve$
- (c) $\Delta G = -ve, \Delta S = 0$
- (d) $\Delta G = -ve, \Delta S = +ve$

6. (a)



$$\Delta G = 0$$

$$\Delta S = +ve$$

7. How many isomers are possible for complex $[\text{Co}(\text{ox})_2\text{Cl}_2]^+$?

- (a) 1
- (b) 3
- (c) 2
- (d) 4

7. (b)

$\text{C}_2\text{O}_4^{2-} \rightarrow$ didentate symmetrical ligand.

Type of complex is $[\text{M}(\text{AA})_2\text{b}_2]^{\pm n}$.

\therefore Total isomers = 3

8. The compound that will not react with silver perchlorate under normal conditions is

- (a) 3-Bromocyclopropene
- (b) Tetraethyl ammonium chloride
- (c) Tetramethylammonium hydroxide
- (d) Polyvinyl chloride

8. (d)

PVC is organic polymer

9. The conductivity of 0.10 M KCl solution at 298 K is $1.29 \times 10^{-2} \text{ S cm}^{-1}$. The resistance of this solution is found to be 28.44Ω . Using the same cell, the resistance of 0.10 M NH_4Cl solution is found to be 28.50Ω . The molar conductivity of NH_4Cl solution in $\text{S cm}^2 \text{ mol}^{-1}$ is
- (a) 0.130 (b) 13 (c) 130 (d) 1300

9. (c)

$$K = C \times \text{Cell constant}$$

$$\frac{K_{\text{KCl}}}{K_{\text{NH}_4\text{Cl}}} = \frac{R_{\text{NH}_4\text{Cl}}}{R_{\text{KCl}}}$$

$$K_{\text{NH}_4\text{Cl}} = \frac{1.29 \times 10^{-2} \times 28.44}{28.5} = 1.28 \times 10^{-2}$$

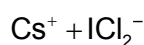
$$\lambda_{\text{NH}_4\text{Cl}} = \frac{1.28 \times 10^{-2} \times 1000}{1} = 128 \approx 130$$

10. Consider a compound CsXY_2 where X and Y are halogens. Which of the following statements is / are correct ?

- i : X and Y have different oxidation states.
 ii : For Y with lower atomic number than X, X can assume oxidation state higher than normal.
 iii : Such compounds exist because Cs^+ has a high charge to size ratio.

- (a) Only i (b) i and ii (c) Only ii (d) i and iii

10. (b)



Where, $\text{I} \rightarrow x$, $\text{Cl} \rightarrow y$

11. Match the compounds given in List - I with their characteristic reactions in List - II

List-I (Compound)	List-II (Reaction)
1. Tertbutyl amine	a. Liberation of ammonia on heating with aq NaOH
2. 2-Methyl-2-pentanol	b. Effervescence with NaHCO_3
3. 2, 4, 6-Trinitrophenol	c. Foul smell with chloroform in alkaline condition
4. Cyclohexane carboxamide	d. Formation of an water insoluble compound on treatment with conc. HCl and ZnCl_2

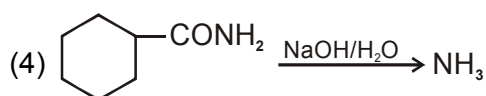
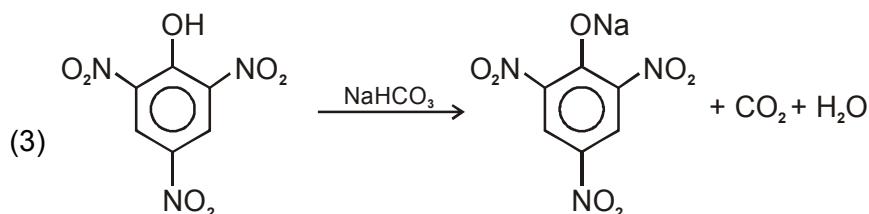
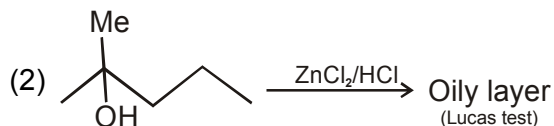
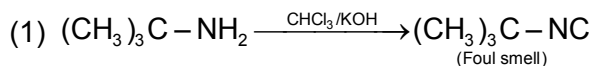
- (a) 1-a, 2-c, 3-d, 4-b

- (b) 1-c, 2-d, 3-b, 4-a

- (c) 1-a, 2-b, 3-c, 4-d

- (d) 1-d, 2-a, 3-b, 4-c

11. (b)



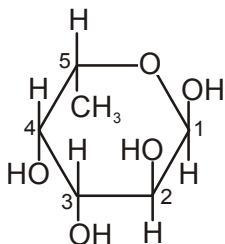
12. Which of the following statements is not correct regarding the galvanic cells ?

- (a) Oxidation occurs at the anode
- (b) Ions carry current inside the cell
- (c) Electrons flow in the external circuit from cathode to anode
- (d) When the cell potential positive, the cell reactions is spontaneous.

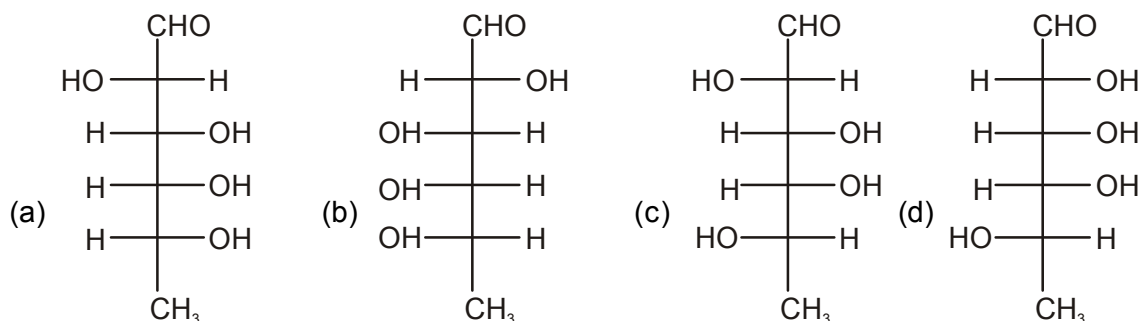
12. (c)

In external circuit electrons flow from Anode to cathode.

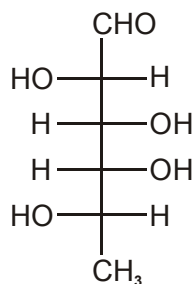
13. L-Fucose with the following planar representation is a sugar component of the determinants of the A, B, O blood group typing.



The open chain structure of L-Fucose can be represented as



13. (c)



14. In ammonia the bond angle is $107^\circ 48'$ while in SbH_3 the bond angle is about $91^\circ 18'$. The correct explanation among the following is / are

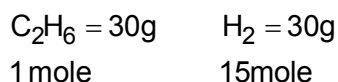
- (a) The orbitals of Sb used for the formation of Sb-H bond are almost pure p-orbitals
 (b) Sb has larger size compared to N.
 (c) Sb has more metallic character than N
 (d) All the statements are correct.

14. (c)

15. Equal masses of ethane and hydrogen gas are present in a container at 25°C . The fraction of the total pressure exerted by ethane gas is

- (a) $1/2$ (b) $1/16$ (c) $15/16$ (d) $1/8$

15. (b)



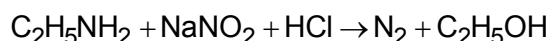
$$P_{\text{C}_2\text{H}_6} = \frac{1}{1+15} P_{\text{total}}$$

$$\frac{P_{\text{C}_2\text{H}_6}}{P_T} = \frac{1}{16}$$

16. The volume of nitrogen evolved on complete reaction of 9g of ethylamine with a mixture of NaNO_2 and HCl at 273°C and 1 atm pressure is

- (a) 11.2 dm^3 (b) 5.6 dm^3 (c) 4.48 dm^3 (d) 22.4 dm^3

16. (c)



$$\frac{9}{45} = \frac{1}{5} = 0.2 \text{ mole}$$

$$V = \frac{0.2 \times 0.082 \times 273}{1} = 4.48 \text{ L}$$

We have assumed given temperature in Kelvin instead of °C.

17. The electrons identified by quantum numbers n and l ,

- (i) $n = 4, l = 1$, (ii) $n = 4, l = 0$, (iii) $n = 3, l = 2$ (iv) $n = 3, l = 1$

can be placed in order of increasing energy from lowest to highest as

- (a) $iv < ii < iii < i$ (b) $ii < iv < i < iii$ (c) $i < iii < ii < iv$ (d) $iii < i < iv < ii$

17. (a)

(i) $n = 4, l = 1$ 4p

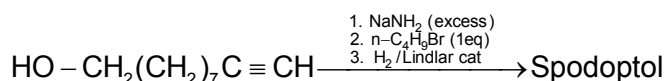
(ii) $n = 4, l = 0$ 4s

(iii) $n = 3, l = 2$ 3d

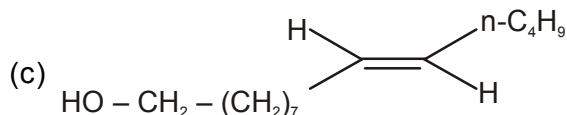
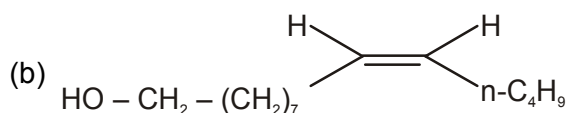
(iv) $n = 3, l = 1$ 3p

(iv) $< ii < iii < i$

18. Spodoptol, a sex attractant, produced by a female fall armyworm moth, can be prepared as following. The structure of Spodoptol is (pKa: terminal alkynes ~25, alcohols ~ 17)

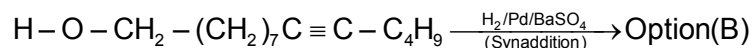
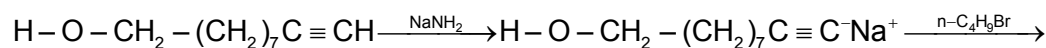


(a) $\text{n-C}_4\text{H}_9 - \text{O} - \text{CH}_2 - (\text{CH}_2)_7 - \text{HC} = \text{CH}_2$



(d) $\text{HO} - \text{CH}_2 - (\text{CH}_2)_{12} - \text{CH}_3$

18. (b)

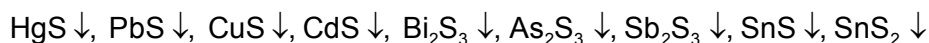


19. Passing H_2S gas into a mixture of Mn^{2+} , Ni^{2+} , Cu^{2+} and Hg^{2+} in an acidified aqueous solution precipitates

- (a) CuS and HgS (b) MnS and CuS (c) MnS and NiS (d) NiS and HgS

19. (a)

Group(II) basic radical precipitates as their sulphide in acidic solution.



20. Battery acid (H_2SO_4) has density 1.285 g cm^{-3} . 10.0 cm^3 of this acid is diluted to 1L. 25.0 cm^3 of this diluted solution requires 25.0 cm^3 of 0.1 N sodium hydroxide solution for neutralization. The percentage of sulphuric acid by mass in the battery acid is

(a) 98

(b) 38

(c) 19

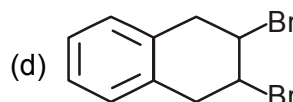
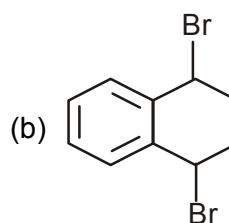
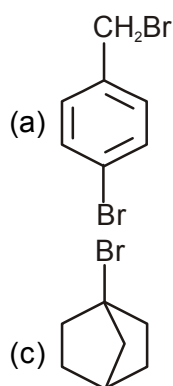
(d) 49

20. (b)

$$\text{H}_2\text{SO}_4 = \frac{25 \times .1 \times 40 \times 98}{1000 \times 2} = 4.9 \text{ gm}$$

$$\% = \frac{4.9}{12.85} \times 100 = 38.13\%$$

21. The compound that reacts fastest with methylamine is



21. (a)

According to SN^2 reaction mechanism.

22. HgO is prepared by two different methods: one shows yellow colour while the other shows red colour. The difference in colour is due to difference in

(a) Electronic d-d transitions

(b) Particle size

(c) Frenkel defect

(d) Schottky defect

22. (b)

Due to difference in particle size.

23. The pH of a $1.0 \times 10^{-3} \text{ mol L}^{-1}$ solution of a weak acid HA is 3.60. The dissociation constant of the acid is

- (a) 8.4×10^{-8} (b) 8.4×10^{-6} (c) 8.4×10^{-2} (d) 8.4×10^{-2}

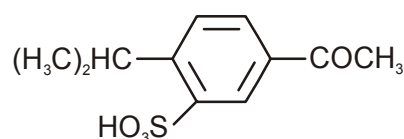
23. (c)

$$\text{pH} = 3.60$$

$$\text{H}^+ = 2.5 \times 10^{-4}$$

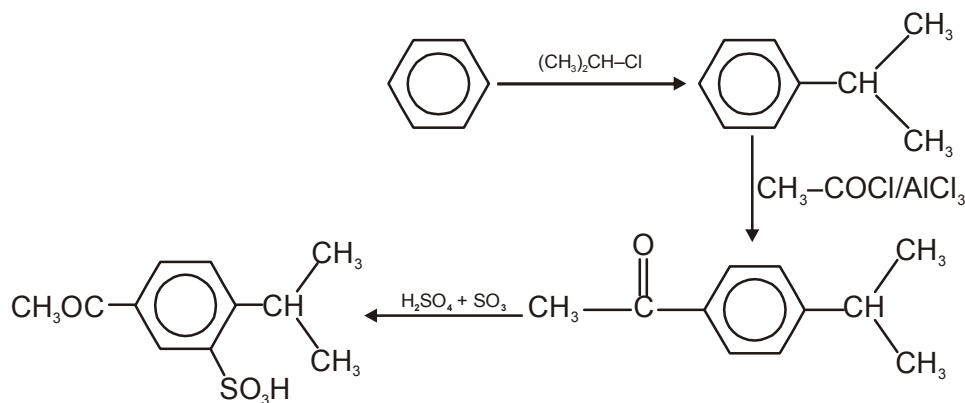
$$K_a = \frac{2.5 \times 10^{-4} \times 2.5 \times 10^{-4}}{7.5 \times 10^{-4}} = 8.33 \times 10^{-5}$$

24. The best sequence of reactions for preparation of the following compound from benzen is



- (a) (i) $\text{CH}_3\text{COCl}/\text{AlCl}_3$ (ii) Oleum (iii) $(\text{CH}_3)_2\text{CH}-\text{Cl}$ (1 mole)/ AlCl_3
 (b) (i) $(\text{CH}_3)_2\text{CH}-\text{Cl}$ (1 mole)/ AlCl_3 (ii) $\text{CH}_3\text{COCl}/\text{AlCl}_3$ (iii) Oleum
 (c) (i) Oleum (ii) $\text{CH}_3\text{COCl}/\text{AlCl}_3$ (iii) $(\text{CH}_3)_2\text{CH}-\text{Cl}$ (1 mole)/ AlCl_3
 (d) (i) $(\text{CH}_3)_2\text{CH}-\text{Cl}$ (1 mole) / AlCl_3 (ii) Oleum (iii) $\text{CH}_3\text{COCl}/\text{AlCl}_3$

24. (b)



25. Which reaction is spontaneous at all temperatures at standard pressure and concentration ?

- (a) Exothermic reaction with a decrease in entropy
 (b) Exothermic reaction with an increase in entropy
 (c) Endothermic reaction with a decrease in entropy
 (d) Endothermic reaction with an increase in entropy

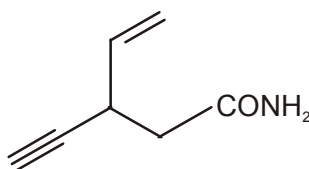
25. (b)

$$\Delta G^0 = \Delta H^0 - T\Delta S^0$$

$$\Delta H = -ve \text{ \& \ } \Delta S^0 = +ve$$

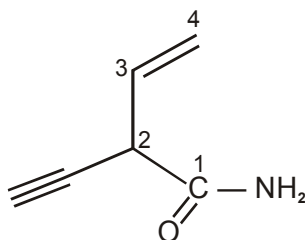
Spontaneous at all temperature

26. The IUPAC name of the following compound is



- (a) 3-Aminocarbonylpent-1-en-4-yne
 (b) 2-Ethenylbut-3-yn-1-amide
 (c) 2-Ethynylbut-3-en-1-amine
 (d) 3-Aminocarbonylpent-4-en-1-yne

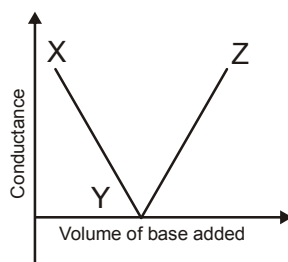
26. (c)



2-Ethynylbut-3-en-1-amine

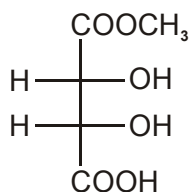
27. NaOH solution is added dropwise to HCl solution and the conductance of the mixture is measured after addition of each drop. The variation of conductance with volume of NaOH added is as shown below.

The statement that is not true for the above is



- (a) Decrease in conductance from X \rightarrow Y is due to decrease in $[H^+]$
 (b) Point Y represents the equivalence point of titration]
 (c) Na^+ has the higher equivalence than H_3O^+
 (d) Segment YZ represents the conductance due to ions from NaCl and NaOH in solution.

30. (c)



Diastereomer of x.

31. Given $\Delta_r H^\circ = -54.08 \text{ kJ mol}^{-1}$ and $\Delta_r S^\circ = 10.0 \text{ J mol}^{-1}$ at 25°C , the value of $\log_{10} K$ for the reaction $A \rightleftharpoons B$ is

- (a) 3.4 (b) 10 (c) 0.53 (d) 113

31. (b)

$$\Delta G^0 = -54080 - 298 \times 10$$

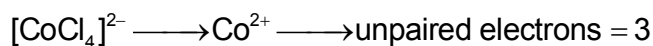
$$-298 \times 2.303 \times 8.314 \times \log k = -57060$$

$$-5706 \log k = -57060, \quad \log k = 10$$

32. Which of the complexes has the magnetic moment of 3.87 B. M. ?

- (a) $[\text{Co}(\text{NH}_3)_6]^{3+}$ (b) $[\text{CoF}_6]^{3-}$
 (c) $[\text{CoCl}_4]^{2-}$
 (d) $[\text{Co}(\text{dmg})_2]$ square planar complex (dmg = dimethyl glyoxime).

32. (c)



$$\therefore \text{MM} = \sqrt{3(3+2)} \text{ B.M} = \sqrt{15} \text{ B.M}$$

33. For a gaseous reaction, $A + B \rightarrow \text{Products}$, the energy of activation was found to be 2.27 kJ mol^{-1} at 273 K . The ratio of the rate constant (k) to the frequency factor (A) at 273 K is

- (a) 0.368 (b) 3.68 (c) 4.34 (d) 0.434

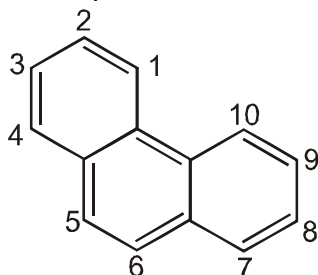
33. (a)

$$\frac{k}{A} = e^{-\frac{E_a}{RT}}$$

$$\frac{k}{A} = e^{-\frac{2.27 \times 10^3}{8.31 \times 273}}$$

$$\frac{k}{A} = \frac{1}{e} = 0.37$$

34. In the case of dibromo derivatives of the following compound, the derivative having highest energy has the bromo substituents in positions



- (a) 1, 2 (b) 2, 3 (c) 4, 5 (d) 1, 10
34. (d)
Maximum repulsion at 1 and 10.
35. The ionization energy of a certain element is 412 kJ mol^{-1} . When the atoms of this element are in the first excited state, however, the ionization energy is only 126 kJ mol^{-1} . The region of the electromagnetic spectrum in which the wavelength of light emitted in a transition from the first excited state to the ground state is
- (a) Visible (b) UV (c) IR (d) X-ray
35. (a)
- $$\frac{(412 - 126) \times 10^3}{6.023 \times 10^{23} \times 1.6 \times 10^{-19}} = 2.96 \text{ eV visible}$$
36. The reaction of an olefin with HBr can proceed by ionic as well as radical mechanism. The reaction in the presence of light takes place by radical mechanism, as
- (a) the free energy of the reaction in radical mechanism is higher than in ionic mechanism
(b) ionic mechanism requires a catalyst while radical mechanism does not.
(c) in the presence of light the activation energy of the reaction is lower than that for ionic mechanism.
(d) a radical reaction has very low activation energy as compared to that for the corresponding ionic reaction.
36. (c)
In the presence of light lower activation energy is involved.
37. The correct statement/s is /are
- I. Soap is excellent for cleaning, 100% broken down by bacteria in rivers and hence has no further environmental damaging repercussions.
II. Soap forms an insoluble precipitate/scum when hard water containing calcium and magnesium ion is used.
III. Soaps can be used for cleansing under acidic solutions.
- (a) Only I (b) Only II (c) Only III (d) I and III
37. (b)

38. The kinetic data recorded at 278 K for the reaction
 $\text{NH}_4^+ (\text{aq}) + \text{NO}_2^- (\text{aq}) \rightarrow \text{N}_2(\text{g}) + 2\text{H}_2\text{O} (\text{l})$ is

Set No.	$[\text{NH}_4^+]/\text{M}$	$[\text{NO}_2^-]/\text{M}$	Rate of reaction/ M s^{-1}
1	0.24	0.10	7.2×10^{-6}
2	0.12	0.10	3.6×10^{-6}
3	0.12	0.15	5.4×10^{-6}

The kinetic rate expression and the unit of rate constant (k) of the above reaction are respectively

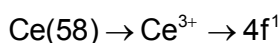
- (a) $k [\text{NH}_4^+] [\text{NO}_2^-]$ and M s^{-1} (b) $k [\text{NH}_4^+]$ and s^{-1}
 (c) $k [\text{NH}_4^+] [\text{NO}_2^-]$ and $\text{M}^{-1} \text{s}^{-1}$ (d) $k [\text{NO}_2^-]$ and s^{-1}
38. (c)

$$R = K [\text{NH}_4^+]^x [\text{NO}_2^-]^y, x = 1, y = 1$$

39. Which of the following statements is not true for Ce^{3+} and Yb^{3+} ?

- (a) Both absorb in UV region (b) Both show f-f transition
 (c) Both show 4f to 5d transition (d) Both ions are colorless

39. (d)



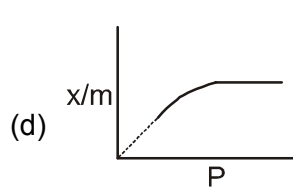
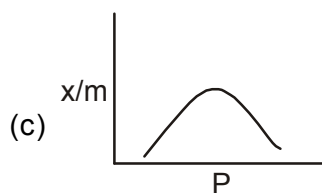
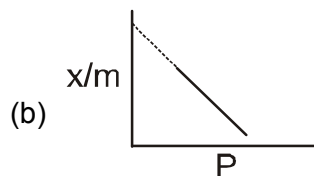
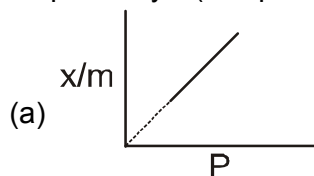
Both are coloured due to f-f transition. Both absorb wavelength near UV region.

40. Complete catalytic hydrogenation of naphthalene gives decalin ($\text{C}_{10}\text{H}_{18}$). The number of isomers decaline formed and the total number of isomers of decalin possible are respectively
 (a) 1, 2 (b) 2, 2 (c) 2, 4 (d) 3, 4

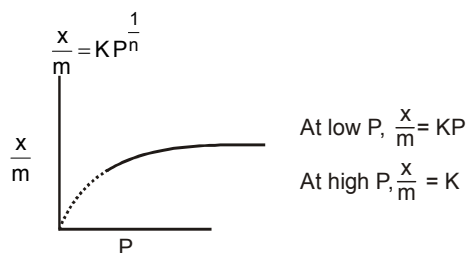
40. (b)



41. The mass of argon adsorbed per unit mass of carbon surface is plotted against pressure. Which of the following plots is correct if x and m represent the masses of argon and carbon respectively ? (---represents extrapolated data)



41. (d)



42. In a process n-propyl chloride is reacted with sodium butanoate in an aqueous medium. After the reaction diethyl ether is added and the solution is shaken. The two layers are separated. The incorrect statement with respect to this procedure is
- The reaction gives a solid product which precipitates in the aqueous solution.
 - The reaction takes place in the aqueous medium.
 - The product is extracted in diethyl ether and the organic layer is the upper layer.
 - The salt formed in the reaction remains in aqueous medium.

42. (a)

Both compounds are soluble in water.

43. Which of the following statements about ammonium cerium (IV) nitrate, $(\text{NH}_4)_2 [\text{Ce}(\text{NO}_3)_6]$ is false ?

- NO_3^- acts as a monodentate ligand
- The Ce atom has a coordination number of 12
- The shape of the complex ion is icosahedron.
- The solution is used as oxidizing agent.

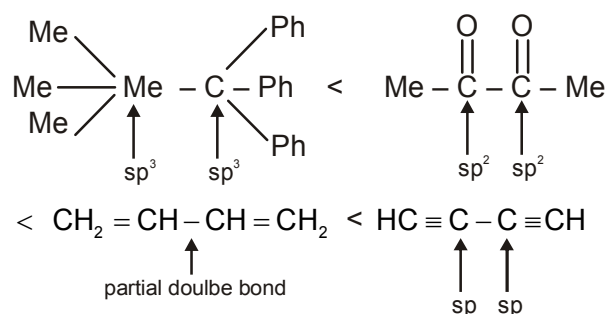
43. (b)

Co-ordination number of $\text{Ce}^{4+} = 6$.

44. The correct order of the magnitude of bond energy (kJ/mol) of the central C-C bond in the following compounds is

- | | |
|---|---|
| (i) $\text{CH}_2 = \text{CH}-\text{CH} = \text{CH}_2$ | (j) $\text{Me}_3\text{C}-\text{CPh}_3$ |
| (k) $\text{MeCO}-\text{CO}-\text{Me}$ | (l) $\text{CH} \equiv \text{C}-\text{C} \equiv \text{CH}$ |
| (a) $k > i > l > j$ | (b) $j > k > l > i$ |
| (c) $i > j > k > l$ | (d) $l > i > k > j$ |

44. (d)



45. Which one of the following information about the compounds is correct ?

Compounds	Oxidation state of P	No. of P—OH bonds	No. of P—H bonds	No. of P=O bonds
[I] H ₃ PO ₂ Hypophosphorous acid	1+	2	1	0
[II] H ₄ P ₂ O ₅ pyrophosphorus acid	3+	2	2	2
[III] H ₄ P ₂ O ₆ Hypophosphoric acid	4+	2	2	2
[IV] H ₄ P ₂ O ₇ pyrophosphoric acid	5+	3	1	4

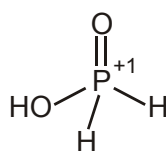
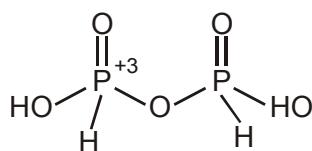
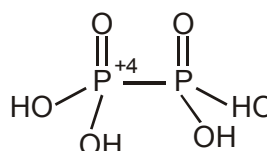
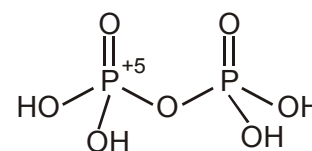
(a) I

(b) III

(c) IV

(d) II

45. (d)

(H₃PO₂)(H₄P₂O₅)(H₄P₂O₆)(H₄P₂O₇)

46. The best method of preparation of 2-benzyloxynaphthalene is a base catalysed reaction of

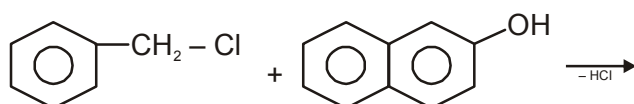
(a) benzyl chloride and 1-naphthol

(b) 1-chloromethylnaphthalene and phenol

(c) 1-chloronaphthalene and benzyl alcohol

(d) benzyl alcohol and 1-naphthol

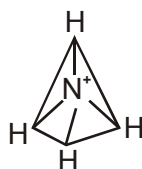
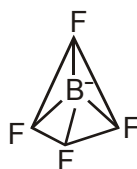
46. (No option is correct)



47. The pair that is isostructural (i.e. having the same shape and hybridization) is

(a) NF₃ and BF₃(b) BF₄⁻ and NH₄⁺(c) BCl₃ and BrCl₃(d) NH₃ and NO₃⁻

47. (b)



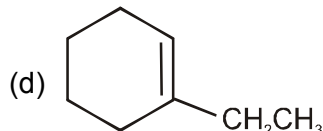
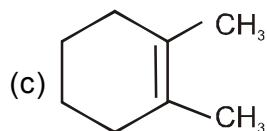
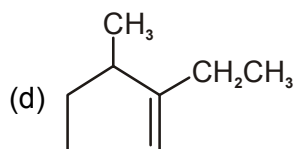
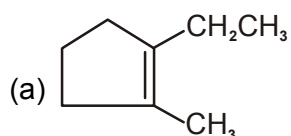
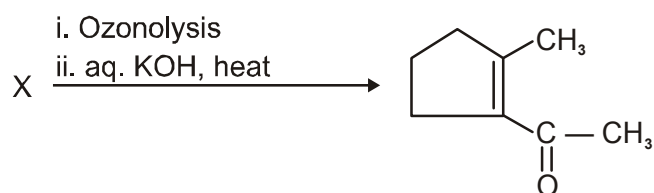
hybridization = sp³
Geometry → tetrahedral

48. A group which departs from the substrate in a nucleophilic substitution reaction is called a leaving group. The ease of departure is determined by the acidity of the conjugate acid of the leaving group; higher the acidity better is the leaving group. The correct order of the reactivity of the following compounds in a given nucleophilic reaction is -

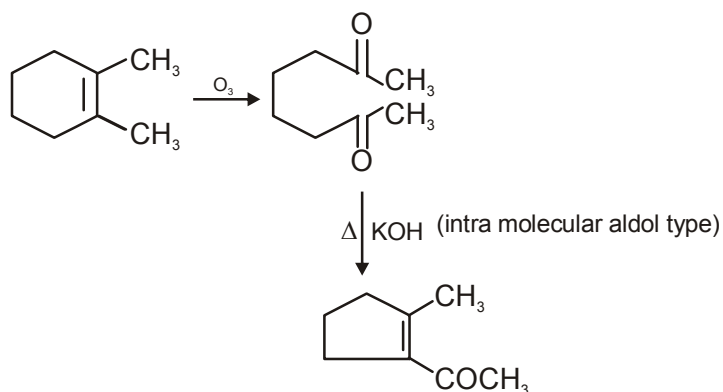
- (a) $R-Cl > R-OCOCH_3 > R-OSO_2CH_3 > RI$
 (b) $R-OSO_2CH_3 > R-Cl > R-OCOCH_3 > ROH$
 (c) $R-I > RNH_2 > R-OCOCH_3 > R-OSO_2CH_3$
 (d) $R-Br > R-OSO_2CH_3 > R-OCOCH_3 > ROCH_3$

48. (d)

49. Compound 'X' in the following reaction is



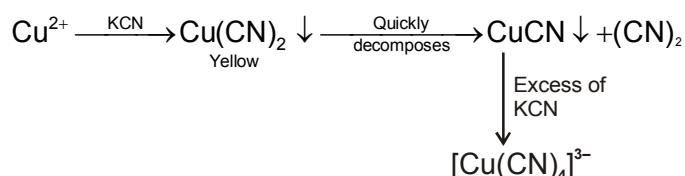
49. (c)



54. Cyanide ion is a very good complexing agent and also functions as a reducing agent. Hence many cyanide complexes of metals are known. Addition of an aqueous solution of KCN to a solution of copper sulphate yields a white precipitate which is soluble in excess of aqueous KCN to form the complex :

- (a) $[\text{Cu}(\text{CN})_4]^{1-}$ (b) $[\text{Cu}(\text{CN})_4]^{2-}$ (c) $[\text{Cu}(\text{CN})_4]^{3-}$ (d) $[\text{Cu}(\text{CN})_4]^{4-}$

54. (c)



55. When a certain metal was irradiated with light of frequency 3.2×10^{16} Hz, the photoelectrons emitted had twice the kinetic energy as did the photoelectrons emitted when the same metal was irradiated with light of frequency 2.0×10^{16} Hz. The ν_0 of the metal is

- (a) 2.4×10^{16} Hz (b) 8.0×10^{16} Hz (c) 8.0×10^{15} Hz (d) 7.2×10^{16} Hz

55. (c)

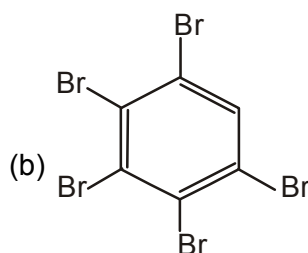
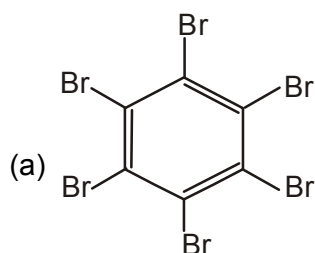
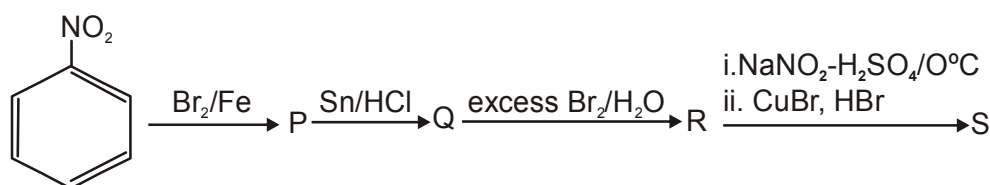
$$2\text{KE} = h(3.2 \times 10^{16}) - h\nu_0$$

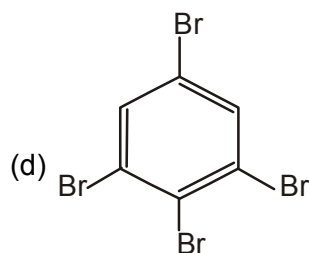
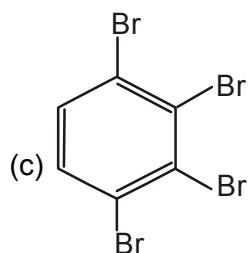
$$\text{KE} = h \times 2 \times 10^{16} - h\nu_0$$

$$\Rightarrow 4 \times 10^{16} = 3.2 \times 10^{16} + \nu_0$$

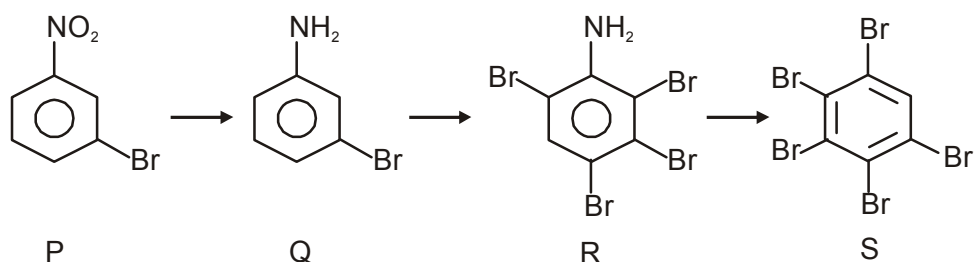
$$\nu_0 = 0.8 \times 10^{16} = 8 \times 10^{15}$$

56. The major product 'S' of the following reaction sequence is :





56. (b)



57. 1.250g of metal carbonate (MCO_3) was treated with 500 mL of 0.1 M HCl solution. The unreacted HCl required 50.0 mL of 0.500 M NaOH solution for neutralization. Identify the metal M :

- (a) Mg (b) Ca (c) Sr (d) Ba

57. (b)

m.e. of MCO_3 = left m.e. of HCl

$$1000 \times \frac{W}{\frac{m}{2}} = 25$$

$$M_{MCO_3} = 100 \text{ g}$$

$$M_M = 40 \text{ g (Ca)}$$

58. An electron beam can undergo diffraction by crystals which proves the wave nature of electrons. The potential required for a beam of electrons to be accelerated so that its wavelength becomes equal to 0.154 nm is:

- (a) 63.5 V (b) 31.75 V (c) 635 V (d) 127 V

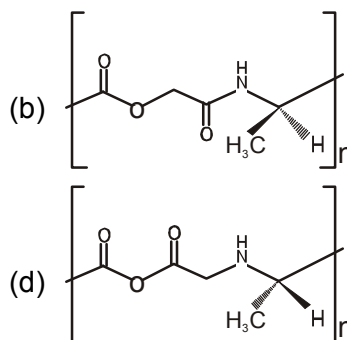
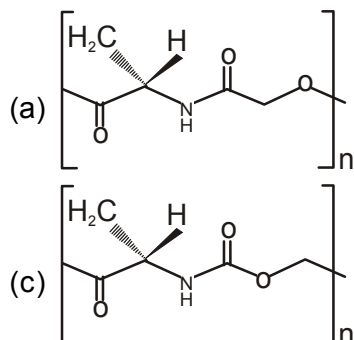
58. (a)

$$\lambda(A) = \left(\frac{150}{V} \right)^{\frac{1}{2}}$$

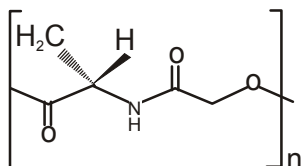
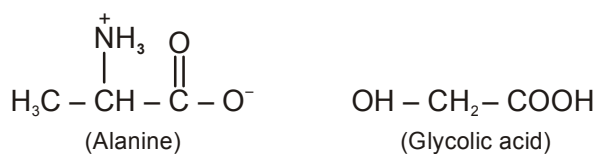
$$1.54 = \left(\frac{150}{V} \right)^{\frac{1}{2}}$$

$$V = 63.5 \text{ volt}$$

59. A biodegradable alternating copolymer of L-alanine and glycolic acid ($\text{HO}-\text{CH}_2-\text{COOH}$) is :



59. (a)



60. In which of the following complexes the metal ion has the lowest ionic radius?



60. (d)

V^{+2} ion has exceptionally very low ionic radius among Ti^{+2} , V^{+2} , Cr^{+2} , Mn^{+2} .

61. In cold climate, the water in a radiator of a car gets frozen causing damage to the radiator. Ethylene glycol is used as an antifreezing agent. The amount of ethylene glycol that should be added to of water to prevent it from freezing at -7°C is :

(Given: K_f for water = $1.86 \text{ K mole}^{-1} \text{ kg}$; Molar mass of ethylene glycol = 62 g mol^{-1})



61. (a)

$$\Delta T_f = k_f \times m$$

$$7 = 1.86 \times \frac{w \times 1000}{62 \times 5000}$$

$$w = 1165 \text{ g}$$

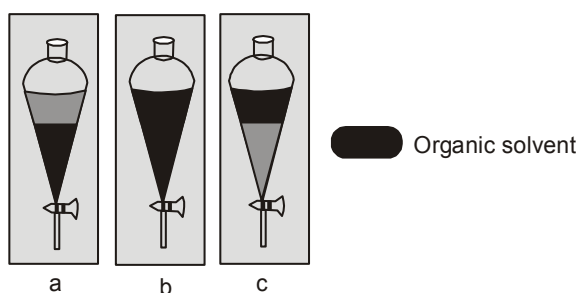
62. The ratio of the energy of the electron in ground state of hydrogen atom to that of the electron in the first excited state of Be^{3+} is :

- (a) 1:4 (b) 1 : 8 (c) 1 : 16 (d) 4 : 1

62. (a)

$$\frac{E_{\text{H},1}}{E_{\text{Be}^{3+},2}} = \frac{-13.6}{-13.6 \times \frac{16}{4}} = \frac{1}{4}$$

63. Water insoluble, but organic solvent soluble, dye is dissolved in three organic solvents and taken three separating funnels, a, b and c. To each solution, water is added, shaken and kept undisturbed. The solvents in separating funnels a, b and c from the following figures are respectively:



- (a) a : EtOH ; b : CCl_4 ; c : EtOAc (b) a : CCl_4 ; b : EtOH ; c : EtOAc
(c) a : EtOAc; b : CCl_4 ; c : EtOH (d) a : CCl_4 ; b : EtOAc; EtOH

63. (b)

H_2O is completely soluble in EtOH

64. P, Q, R and S are four metals whose typical reactions are given below :

- (I) Only Q and R react with dilute HCl to give H_2 gas
(II) When Q is added to a solution containing the ions of the other metals, metallic P, R and S are formed
(III) P reacts with concentrated HNO_3 but S does not

The correct order of their reducing character is :

- (a) $\text{S} < \text{P} < \text{R} < \text{Q}$ (b) $\text{S} < \text{R} < \text{P} < \text{Q}$ (c) $\text{R} < \text{Q} < \text{P} < \text{S}$ (d) $\text{Q} < \text{P} < \text{S} < \text{R}$

64. (a)

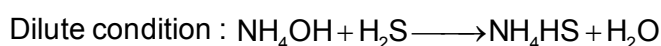
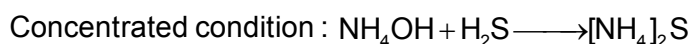
Q is strongest reducing agent.

S is weakest reducing agent.

65. If a dilute solution of aqueous NH_3 is saturated with H_2S then the product formed is :

- (a) $(\text{NH}_4)_2\text{S}$ (b) NH_4HS (c) $(\text{NH}_4)_2\text{S}_x$ (d) $\text{NH}_4\text{OH} + \text{S}$

65. (b)



66. Three Faradays of electricity are passed through aqueous solutions of AgNO_3 , NiSO_4 and CrCl_3 kept in three vessels using inert electrodes. The ratio (in moles) in which the metals Ag, Ni and Cr are deposited is :

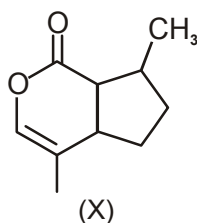
- (a) 1 : 2 : 3 (b) 3 : 2 : 1 (c) 6 : 3 : 2 (d) 2 : 3 : 6

66. (c)

equivalent of substance deposited are equal due to same quantity of electricity of is passed through three solution :

$$n_1 : n_2 : n_3 = 1 : \frac{1}{2} : \frac{1}{3} = 6 : 3 : 2$$

67. Nepetalactone (X) is isolated as an oil from Catnip.



The number of chiral carbon atoms and the amount of KOH consumed by 83 mg of Nepetalactone are respectively

- (a) 3,50 mg (b) 2,56 mg (c) 3,56 mg (d) 3, 28 mg

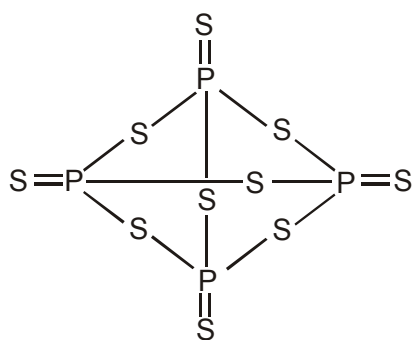
67. (d)

56 mg of KOH reacts with 156 mg of nepetalactone 83 mg of nepetalactone reacts with 30.18.

68. Number of P–S single bonds and P=S double bonds ($\text{P}=\text{S}$) in P_4S_{10} are respectively :

- (a) 10, 6 (b) 16, 0 (c) 14, 2 (d) 12, 4

68. (d)

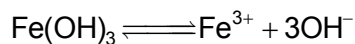


Total (P – S) bonds = 12
Total (P = S) bonds = 4

69. If the solubility product of iron (III) hydroxide is 1.8×10^{-37} , the pH of a saturated solution of iron (III) hydroxide in distilled water is close to :

- (a) 4 (b) 5 (c) 7 (d) 9

69. (c)



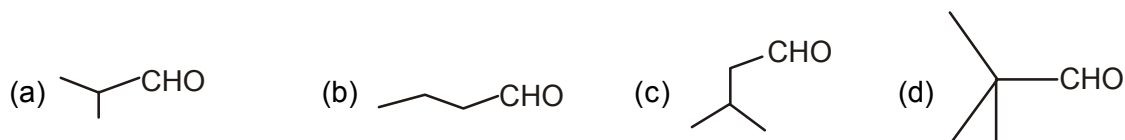
$$K_{sp} = [\text{Fe}^{3+}] [\text{OH}^-]^3$$

$$K_{sp} = 27S^4 ; S = 0.285 \times 10^{-9}$$

$$[\text{OH}^-] = 3 \times S = 0.285 \times 10^{-9} \times 3$$

$[\text{OH}^-] \ll 10^{-7}$, so we consider $[\text{H}^+]$ concentration from water, so pH = 7

70. An alkyl halide (X) on reaction with ethanolic sodium hydroxide forms an alkene (Y) which on further reaction with HBr gives the same alkyl halide. The alkene (Y) on reaction with HBr/peroxide followed by reaction with Mg metal followed by reaction with HCN produces an aldehyde (Z), Z is :



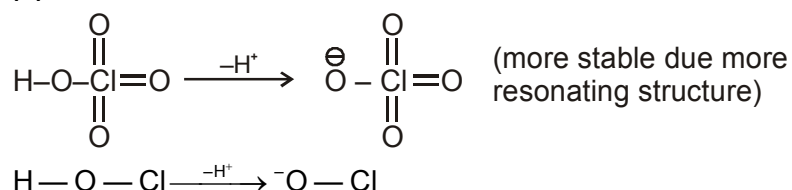
70. (b or c)

As molecular formula of X is not given.

71. HClO_4 is stronger acid than HClO . The correct statement is :

- (a) ClO_4^- ion is more stabilized than ClO^-
 (b) ClO_4^- ion has higher hydration energy than ClO^-
 (c) HClO_4 is better solvated in water than HClO
 (d) In HClO_4 , H is attached to Cl, while in HClO it is attached to O.

71. (a)



72. For an elementary rearrangement reaction $A \rightleftharpoons P$, the following data were recorded at 303 K, when $[P]_0 = 0$:

Set No.	$[A]_0/\text{mol L}^{-1}$	Rate of conversion of A/mol L ⁻¹ min ⁻¹
1	0.340	0.1000
2	0.170	0.050
3	0.085	0.025

If the equilibrium constant of the reaction is 1.12 at 303 K, the rate constant for the reaction P→A is :

- (a) 0.263 min⁻¹ (b) 0.294 min⁻¹ (c) 0.526 min⁻¹ (d) 0.588 min⁻¹

72. (a)

from data reaction is 1st order

$$0.1 = K_f \times 0.34 \quad K_f = 0.10$$

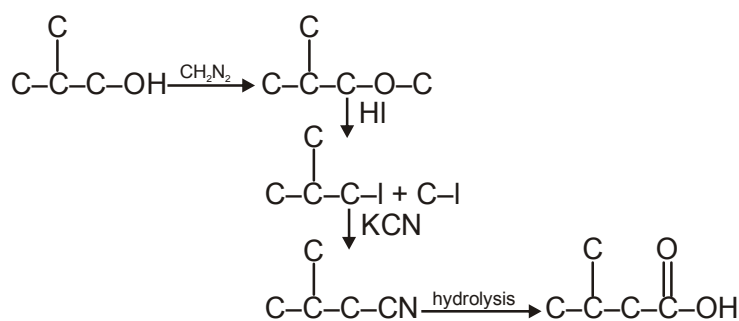
$$K_{\text{eq}} = 1.12 = \frac{K_f}{K_b}$$

$$K_b = \frac{K_f}{1.12} = \frac{0.10}{0.34 \times 1.12} = 0.263 \text{ min}^{-1}$$

73. Compound P on treatment with CH_2N_2 (diazomethane) produces compound Q. Compound Q on reaction with HI produces two alkyl iodides R and S. Alkyl iodide S with higher number of carbon atoms on reaction with KCN followed by hydrolysis gives 3-methylbutanoic acid. The compound P is:

- (a) 2-butanol (b) 1-butanol
(c) 2-methyl-2-propanol (d) 2-methyl-1-propanol

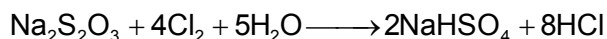
73. (d)



74. I_2 reacts with aqueous $\text{Na}_2\text{S}_2\text{O}_3$ to give $\text{Na}_2\text{S}_4\text{O}_6$ and NaI . The products of reaction of Cl_2 with aqueous $\text{Na}_2\text{S}_2\text{O}_3$ are :

- (a) $\text{Na}_2\text{S}_4\text{O}_6 + \text{NaCl}$ (b) $\text{NaHSO}_4 + \text{HCl}$ (c) $\text{NaHSO}_3 + \text{HCl}$ (d) $\text{NaHSO}_3 + \text{NaCl}$

74. (b)

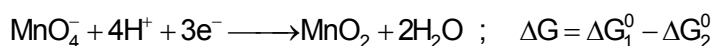
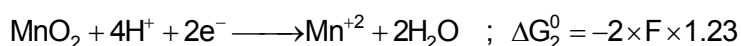
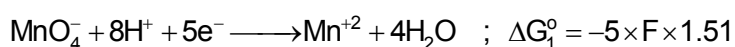


Since Cl_2 is a stronger oxidising agent than I_2 hydrogen sulphates ion are formed rather than tetrathionate.

75. The standard potentials (E°) of $\text{MnO}_4^-/\text{Mn}^{2+}$ and $\text{MnO}_2/\text{Mn}^{2+}$ half cell in acidic medium are 1.51V and 1.23 V respectively at 298 K. The standard potential of $\text{MnO}_4^-/\text{MnO}_2$ half-cell in acidic medium at the same temperature is :

- (a) 5.09 V (b) 1.70 V (c) 0.28 V (d) 3.34 V

75. (b)

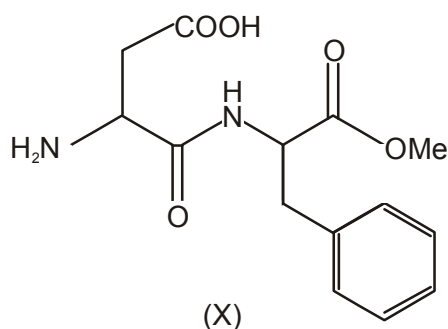


$$-3 \times F \times E_{\text{MnO}_4^-/\text{MnO}_2}^0 = -5 \times F \times 1.51 + 2 \times F \times 1.23$$

$$E_{\text{MnO}_4^-/\text{MnO}_2}^0 = \frac{-5 \times 1.51 + 2 \times 1.23}{-3}$$

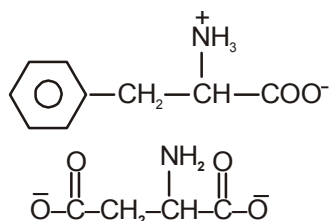
$$= \frac{7.55 - 2.46}{3} = 1.70$$

76. Aspartame (X) is an artificial sweetening agent and is 200 times sweeter than sugar. It is an ester of the dipeptide of :

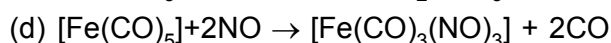
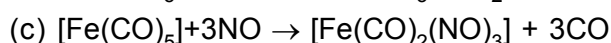
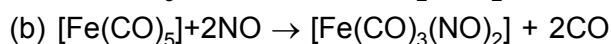
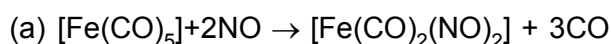


- (a) alanine and phenylalanine (b) aspartic acid and alanine
(c) phenylalanine and glycine (d) aspartic acid and phenylalanine

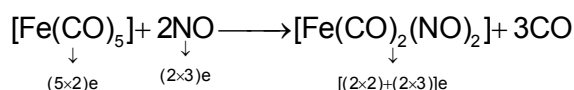
76. (d)



77. Which one of the following reactions is correct?



77. (a)

78. Standard molar enthalpy of formation of CO_2 (g) is equal to :

(a) Zero

(b) The standard molar enthalpy of combustion of carbon (graphite)

(c) The standard molar enthalpy of combustion of C(g)

(d) The standard molar enthalpy of combustion of CO(g)

78. (b)

79. The reaction of 1-phenylpropane with limited amount of chlorine in the presence of light gives mainly:

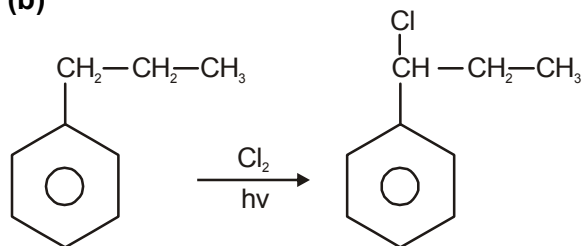
(a) 4-chloropropylbenzene

(b) 1-chloro-1-phenylpropane

(c) 3-chloro-1-phenylpropane

(d) 2-chloro-1-phenylpropane

79. (b)

80. An ionic solid LaI_2 shows electrical conduction due to presence of :(a) La^{2+} and 2I^- (b) La^{3+} , 2I^- and e^- (c) La^{2+} , I_2 and $2e^-$ (d) La^{3+} , I_2 and $3e^-$

80. (b)