INDIAN ASSOCIATION OF PHYSICS TEACHERS

NATIONAL STANDARD EXAMINATION IN CHEMISTRY - 2022

Date of Examination: November 27, 2022
Time: 11:30 AM to 1:30 PM

Question Paper Code: 31

Student's Roll No:										

Write the question paper code (mentioned above) on YOUR OMR Answer Sheet (in the space provided), otherwise your Answer Sheet will NOT be evaluated. Note that the same Question Paper Code appears on each page of the question paper.

Instructions to Candidates:

1. Use of mobile phone, smart watch, and ipad during examination is STRICTLY PROHIBITED.
2. In addition to this question paper, you are given OMR Answer Sheet along with Candidate's copy.
3. On the OMR 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 OMR Answer Sheet, use only **BLUE** or **BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. Your **Ten-digit roll number and date of birth** entered on the OMR Answer Sheet shall remain your login credentials means login id and password respectively for accessing your performance / result in NSEC - 2022.
6. Question paper has two parts. In part A1 (Q. No.1 to 48) 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. 12 (a) (●) (c) (d)

   In part A2 (Q. No. 49 to 60) each question has four alternatives out of which any number of alternative (s) (1, 2, 3, or 4) may be correct. You have to choose all correct alternative(s) and fill the appropriate bubble(s), as shown

   Q.No. 52 (a) (●) (c) (●)
7. For **Part A1**, each correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer. In **Part A2**, you get 6 marks if all the correct alternatives are marked. No negative marks in this part.
8. Rough work may be done in the space provided. There are 16 printed pages in this paper
9. Use of **non - programmable scientific** calculator is allowed.
10. No candidate should leave the examination hall before the completion of the examination.
11. After submitting answer paper, take away the question paper & Candidate's copy OMR sheet for your reference.

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

OMR 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 OMR ANSWER SHEET.

Instructions to Candidates (Continued) :

You may read the following instructions after submitting the answer sheet.

12. Comments/Inquiries/Grievances regarding this question paper, if any, can be shared on the Inquiry/Grievance column on www.iapt.org.in **on the specified format till December 3, 2022**

13. The answers/solutions to this question paper will be available on the website:

www.iapt.org.in **by December 2, 2022.**

14. CERTIFICATES and AWARDS:

Following certificates shall be awarded by IAPT/ACT to the students, successful in the NATIONAL STANDARD EXAMINATION IN CHEMISTRY – 2022

(i) CENTRE TOP 10 % To be downloaded from iapt.org.in after 15.01.23

(ii) STATE TOP 1 % Will be dispatched to the examinee

(iii) NATIONAL TOP 1 % Will be dispatched to the examinee

(iv) GOLD MEDAL & MERIT CERTIFICATE to all students who attend OCSC – 2023 at HBCSE Mumbai

Certificate for centre toppers shall be uploaded on iapt.org.in

15. List of students (with centre number and roll number only) having score above MAS will be displayed on the website: www.iapt.org.in by **December 25, 2022. See the Minimum Admissible Score** clause on the Student's brochure on the web.

16. List of students eligible to appear for Indian National Chemistry Olympiad (INChO – 2023) shall be displayed on www.iapt.org.in by December 30, 2022.

Constants you may need….

Charge of electron,	$e = 1.602 \times 10^{-19} C$	Speed of light,	$c = 3.0 \times 10^{8}\ ms^{-1}$
Mass of electron,	$m_e = 9.1 \times 10^{-31} kg$	Avogadro constant,	$N_A = 6.022 \times 10^{23}\ mol^{-1}$
Planck's constant,	$h = 6.63\ 10^{-34}\ Js$	Faraday	$F = 96500\ C\ mol^{-1}$
		Molar gas constant,	$R = 0.082\ L\ atm\ mol^{-1}\ K^{-1}$ $= 8.314\ J\ mol^{-1}\ K^{-1}$

INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN CHEMISTRY
(NSEC - 2022)

Time: 120 minute **Max. Marks: 216**

Attempt All Sixty Questions

A - 1

ONLY ONE OUT OF FOUR OPTIONS IS CORRECT. BUBBLE THE CORRECT OPTION.

1. The results obtained by four students, each performing a set of four titrations with the same solution under identical conditions, are given below. If the expected titre value is 20.0 mL, the set of data (mL) with good accuracy and poor precision is
   (a) 19.9, 20.0, 20.1, 19.9 (b) 18.1, 18.2, 18.0, 18.1
   (c) 17.9, 18.1, 21.5, 21.0 (d) 20.0, 19.8, 19.4, 20.2

2. The statement that is NOT correct about atomic spectra is
   (a) Electric discharges through gases produce line spectra
   (b) Each element in the gaseous state has a unique line spectrum
   (c) The number of lines in the spectrum is same as the number of electrons in the atom
   (d) Atoms can emit photons with wavelengths lower than that of visible light

3. A closed 2.0 L container initially holds 3.0 mol of O_2 (g) and 2.0 mol of N_2(g) at room temperature, T. If the pressure remains constant when 1.0 mol of O_2 (g) is added, the final temperature of the system is- (Assume ideal gas behaviour throughout)
   (a) (3/5) T (b) (5/6) T (c) 2T (d) (6/5) T

4. The equilibrium constant (K_c) for trimerization of phenyl acetylene to triphenyl benzene is 3.0 at 310 K. If at equilibrium, 0.9 mol dm^{-3} of triphenyl benzene is present, concentration of phenyl acetylene at equilibrium is:
   (a) 1/3 mol dm^{-3} (b) 3.0 mol dm^{-3} (c) 1.732 mol dm^{-3} (d) 0.67 mol dm^{-3}

5. At 298 K, the standard free energies of formation of *cis*- and *trans*-1,2-dichloroethene are 41.549 kJ and 33.235 kJ respectively. The most appropriate mol ratio of *trans*- and *cis*- isomers at equilibrium at 298 K is
   (a) 10:3 (b) 3:10 (c) 28:1 (d) 1:28

6. The pH of the solution produced by complete consumption of 10 mL of 0.4 M NaOH to 'x' mL of 0.5M CH_3COOH was found to be 4.57. The value of 'x' (mL) is (Given-K_a of $CH_3COOH = 1.8 \times 10^{-5}$).
   (a) 12.0 (b) 10.4 (c) 19.8 (d) 6.5

7. The correct order of concentrations of the ions/molecules present in 1.0 L of 1.0 M H_2SO_4 (aq) solution is
   (a) $OH^- < SO_4^{2-} < HSO_4^- < H_3O^+ < H_2O$ (b) $OH^- < HSO_4^- < SO_4^{2-} < H_3O^+ < H_2O$
   (c) $H_2O < HSO_4^- < OH^- < SO_4^{2-} < H_3O^+$ (d) $H_2O < OH^- < SO_4^{2-} < HSO_4^- < H_3O^+$

8. The pOH of the solution obtained by mixing 30 mL of a strong monobasic acid of pH 3.0 and 70 mL of a strong monoacidic base of pH 12.0 at 298 K is
(a) 3.17 (b) 2.17 (c) 5.17 (d) 0.17

9. If refractive index, density, pressure, volume, heat capacity and surface tension are represented respectively as η, ρ, P, V, Q and γ, the set that contains only intensive properties is
(a) η, ρ, γ, Q (b) ρ, P, Q, γ (c) V, Q, η, ρ (d) η, ρ, P, γ

10. Heat of reaction and heat of formation will be the same in
I. $1/2\,N_2(g) + O_2(g) \rightarrow NO_2(g)$
II. $Xe(g) + 2F_2(g) \rightarrow XeF_4(g)$
III. $N_2(g) + O_3(g) \rightarrow N_2O_3(g)$
IV. $C(\text{diamond}) + O_2(g) \rightarrow CO_2(g)$
(a) Only I (b) Only I and II (c) Only I, II and III (d) Only II, III and IV

11. From the following data
$2CH_6N_2(\ell) + 5O_2(g) \rightarrow 2N_2(g) + 2CO_2(g) + 6H_2O(g)\ (\Delta H_r^0 = -2606\ kJ)$ and
$H_2O(\ell) \rightarrow H_2O(g)\ (\Delta H_v^0 = 44\ kJ\ mol^{-1})$
Heat of combustion of CH_6N_2 at 298K can be calculated as
(a) $-1567\ kJ\ mol^{-1}$ (b) $-1435\ kJ\ mol^{-1}$ (c) $-1171\ kJ\ mol^{-1}$ (d) $-2342\ kJ\ mol^{-1}$

12. When 100 g each of the salts NaCl, $MgSO_4$, $Ca(NO_3)_2$, K_2CO_3, were dissolved separately in 1.0 kg of water, the solution with the highest boiling point will be of
(a) $Ca(NO_3)_2$ (b) $MgSO_4$ (c) NaCl (d) K_2CO_3

13. When the pH of the system is increased by 2.0 units, maximum decrease in half cell potential for the reaction will be observed in
(a) $V^{2+}(aq) \rightarrow V^{3+}(aq) + e^-$ (b) $VO_3^- + 2H^+ \rightarrow VO_2^+ + H_2O$
(c) $VO^{2+} + 2H^+ + e^- \rightarrow V^{3+} + H_2O$ (d) $VO^{2+} + H_2O \rightarrow VO_2^+ + 2H^+ + e^-$

14. The reaction that takes place during charging of the lead storage cell is given below
$2\,PbSO_4(s) + 2\,H_2O(\ell) \rightarrow Pb(s) + PbO(s) + 2\,H_2SO_4(aq)$
If a current of 10.0 A is passed for 1.50 h for charging, the amount of $PbSO_4$ reacted is
(a) 25.0 g (b) 56.0 g (c) 120.5 g (d) 170.0 g

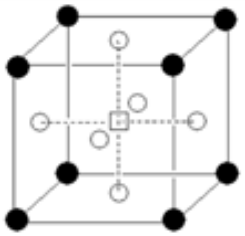
15. A sample of water from a water tank has a resistance of 100 Ω at 298 K, when placed in a conductivity cell of cell constant 0.2 m^{-1}. On dissolving 58.5 g of NaCl in the water tank, a sample of this solution gave a resistance of 40 Ω . The molar conductivity of NaCl at this concentration is 10 $\Omega^{-1} m^2 mol^{-1}$. The volume of water in the water tank is
(a) 3.33×10^6 L (b) 3333.3 L (c) 363.5 L (d) 4.2×10^5 L

16. Initial concentrations of the reactants and the corresponding half-lives for the reaction $P + Q \rightarrow R$ are given below. The rate law for the reaction is

Entry	$[P_0]$ (mol dm^{-3} x 10^{-6})	$[Q_0]$ (mol dm^{-3} x 10^{-6})	$t_{1/2}$ (s)
1	500	10	30
2	500	20	60
3	10	500	60
4	20	500	60

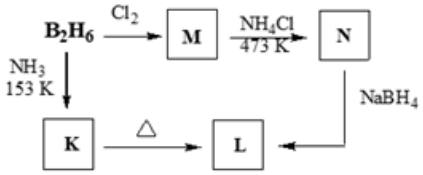
(a) $dR/dt = k[P]$ (b) $dR/dt = k[P]/[Q]$ (c) $dR/dt = k[Q]$ (d) $-d[P]/dt = k[P]/[Q]$

17. The unit cell structure of a mineral perovskite crystallizes in cubic unit cell wherein calcium (filled circles) and oxide (hollow circles) constitute a cubic close packing (ccp) arrangement and titanium ion (hollow square) occupies an interstitial hole as shown below. (Charges are omitted for simplicity). The empirical formula of this compound is



(a) Ca_2TiO_3 (b) Ca_4TiO_6
(c) $CaTiO_3$ (d) Ca_8TiO_6

18. Study the sequence of reactions of diborane (B_2H_6) given below and identify the products K, L, M and N. (The shown reagents are taken in excess).



(a) **K** = BNH_6; **L** = (BN)x; **M** = B_2H_5Cl; **N** = $B_3N_3H_3Cl_3$
(b) **K** = $[B_2H_6.2NH_3]$; **L** = $B_3N_3H_6$; **M** = B_2H_5Cl; **N** = $B_3N_3Cl_6$
(c) **K** = BNH_6; **L** = (BN)x; **M** = BCl_3; **N** = $B_3N_3Cl_6$
(d) **K** = $[B_2H_6.2NH_3]$; **L** = $B_3N_3H_6$; **M** = BCl_3; **N** = $B_3N_3H_3Cl_3$

19. During extraction of gold, the gold ore is treated with aqueous KCN solution as shown by the equations (not balanced) below to get compound X which is further reduced by Zn to obtain compound Y and metallic gold. Identify X and Y.

Gold ore + $CN^- + H_2O + O_2 \rightarrow [X] + OH^-$ ..... (i)

$[X] + Zn \rightarrow [Y] + Au$ ..... (ii)

(a) X = $[Au(CN)_2]^-$, Y = $[Zn(CN)_2]^{2-}$ (b) X = $[Au(CN)_2]^-$, Y = $[Zn(CN)_4]^{2-}$
(c) X = $[Au(CN)_4]^{3-}$, Y = $[Zn(CN)_4]^{2-}$ (d) X = $[Au(CN)_2]^-$, Y = $[Zn(CN)_4]^{4-}$

20. The correct IUPAC name for the complex $[Au(en)_2(H_2O)_2]$ $[Au(ox)_3]$ is (en=ethylenediamine and ox=oxalate)
(a) Bisaquobisethylenediaminegold (III) trioxalatoaurate (III)
(b) Diaquobisethylenediamineaurate (III) trisoxalatogold (III)
(c) Bisaquodiethylenediamineaurate (III) trisoxalatogold (III)
(d) Diaquobisethylenediaminegold (III) trioxalatoaurate (III)

21. Addition of dil. HCl to an aqueous solution of a mixture of two inorganic salts yielded white precipitate **E** and filtrate **F**. Precipitate **E** dissolved in hot water. **F** in alkaline alizarin gives a positive red lake test. The cations present in the precipitate **E** and solution **F** respectively are
(a) $Ag^{+}; Fe^{3+}$ (b) $Hg^{2+}; Ba^{2+}$ (c) $Pb^{2+}; Al^{3+}$ (d) $Pb^{2+}; Zn^{2+}$

22. Br_2 disproportionates to Br^{-} and BrO_3^{-} in a hot alkaline solution as
$3Br_2 + 6\,OH^{-} \rightarrow 5Br^{-} + BrO_3^{-} + 3H_2O$
The equivalent weight of Br_2 is: (M = molar mass of Br_2)
(a) M/5 (b) M/6 (c) 3M/5 (d) 5M/3

23. The number of all the possible geometrical isomers for trigonal bipyramidal $OsO_2F_3^{+}$ cation is:
(a) 2 (b) 3 (c) 1 (d) 4

24. The correct order for the wavelength of absorption in the following complex ions is
(a) $[Ni(NO_2)_6]^{4-} < [Ni(NH_3)_6]^{2+} < [Ni(H_2O)_6]^{2+}$
(b) $[Ni(NO_2)_6]^{4-} < [Ni(H_2O)_6]^{2+} < [Ni(NH_3)_6]^{2+}$
(c) $[Ni(H_2O_6]^{2+} < [Ni(NH_3)_6]^{2+} < [Ni(NO_2)_6]^{4-}$
(d) $[Ni(NH_3)_6]^{2+} < [Ni(H_2O)_6]^{2+} < [Ni(NO_2)_6]^{4-}$

25. Mixing of an aqueous salt solution containing nitrate ion with ferrous ion followed by gentle addition of conc. sulphuric acid from the sides of the test tube, results in brown coloration at the interface is due to
(a) interaction of ferrous ion with nitric oxide
(b) interaction between the resulting nascent oxygen, ferrous ion and nitrate ion
(c) formation of ferrous ion and nitrogen dioxide
(d) complex formation between ferrous ion and nitrate ion

26. Aqueous solutions of hydrogen sulphide and sulphur dioxide when mixed together gives
(a) bisulphite ion and water (b) hydrogen and sulphurous acid
(c) sulphur and water (d) hydrogen peroxide and sulphur

27. The ion with least coagulation value for arsenous sulphide sol is
(a) SO_4^{2-} (b) PO_4^{3-} (c) Al^{3+} (d) Ba^{2+}

28. The correct order of catenation property among the following is
(a) Pb > Si > Ge > Sn (b) Pb > Sn > Ge > Si
(c) Si > Sn > Ge > Pb (d) Si > Ge > Sn > Pb

29. An agriculturist wants to use different concentrations of phosphorus as a fertilizer using P_4O_{10}. The correct expression to calculate P from P_4O_{10} is
(a) $P_4O_{10} \times 2.29$ (b) $P \times 0.44$ (c) $P \times 2.29$ (d) $P_4O_{10} \times 0.44$

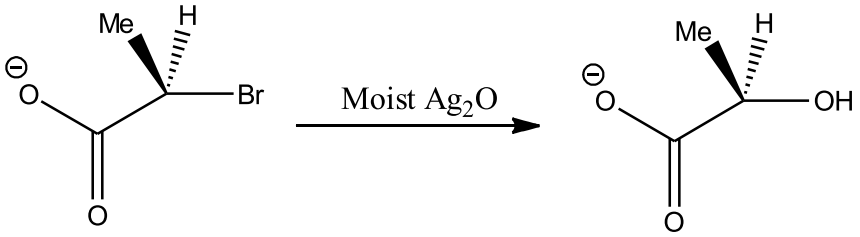
30. Given below are some names of the compounds.
(p) Acetals; (q) silicones; (r) ferrocene; (s) glyoxal, (t) ethyl acetate, (u) gammaxene
The set which is **NOT** having a double bond between an element and O(E=O where E is any element in the periodic table) as a functional group is
(a) p, s, u, t (b) p, q, r, s (c) q, r, s, t (d) p, q, r, u

31. Hybridization of S in CH_3SH molecule is
(a) dsp^3 (b) sp^2 (c) sp^3 (d) sp^3d

32. Using different reaction conditions nickel reacts with (p) Cl^-, (q) CN^-, (r) CO and (s) small amount of Al. Choose **incorrect** statement.
(a) (p), (q), and (r) respectively can result in tetrahedral, octahedral and square planar geometries around nickel
(b) Ligand (p) and (q) leads to homoleptic complex formation wherein final electronic configuration shows maximum multiplicity in case of (p)
(c) Ligand (r) reacts only in reducing medium to form organometallic compound
(d) In case of (s) formation of spongy product with large surface drive reduction reaction of C=C compounds

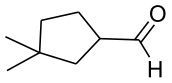
33. Optically pure 2-butanol has a specific rotation of +13.52 degrees. A synthesized and purified sample of 2-butanol has the observed specific rotation of +6.76 degrees. The correct statement based on this observation is
(a) the sample is completely racemized (b) 25% of the sample is racemic
(c) 50% of the sample is racemic (d) 6.76% of the sample is racemic

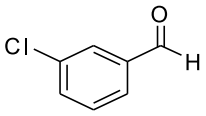
34. Certain organic reactions proceed through formation of intermediates which are highly strained and reactive. Given the following reaction, the correct statement about the mechanism of the reaction is

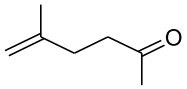


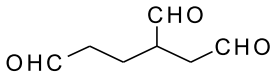
(a) Intramolecular S_N2 attack by $-COO^-$ to form an intermediate followed by the attack by HO^- via S_N2 pathway on the intermediate
(b) Intramolecular S_N2 attack by $-COO^-$ to form an intermediate followed by the attack by HO^- via S_N1 pathway on the intermediate
(c) HO^- attacks via S_N1 pathway on the reactant
(d) HO^- attacks via S_N2 pathway on the reactant

35. Which of the following compound is **NOT** named correctly according to the IUPAC nomenclature?

(a)  3,3 - Dimenthyl cyclopentanecar baldehyde

(b)  3 - Chlorobenzaldehyde

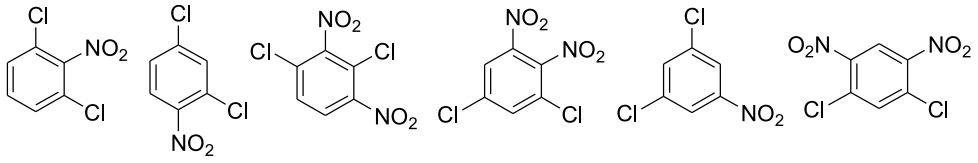
(c)  2 - Methy1-1-penten-4-one

(d)  Butane - 1,2,4-tricarbaldehyde

36. Which of the following compounds contains the maximum number of sp^2 hybridized carbon atoms?

(a) 1, 4-Cyclohexadiene
(b) 2, 5-dimethyl -2, 3, 4-hexatriene
(c) Benzaldehyde
(d) 1, 1-diallyl -3, 3-divinylcyclopentane

37. The number of products from the following, which cannot be formed on nitration of 1, 3-dichlorobenzene with a mixture of concentrated nitric acid and sulfuric acid is

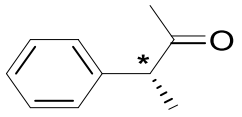


(i) (ii) (iii) (iv) (v) (vi)

(a) Four (b) Three (c) Two (d) One

38. Optically pure 3-Phenyl-2-butanone (X) with the following structure is treated with methyl magnesium iodide in anhydrous ether. The product formed after acidic hydrolysis is

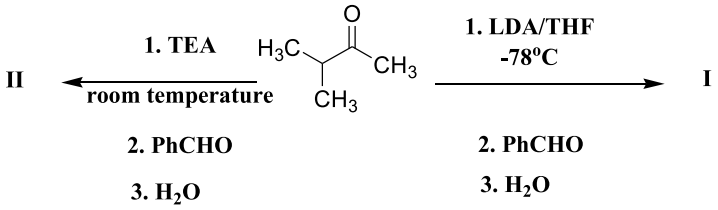
(a) diastereomeric mixture of alcohols
(b) optically pure alcohol
(c) racemic mixture of alcohols
(d) optically inactive alcohol



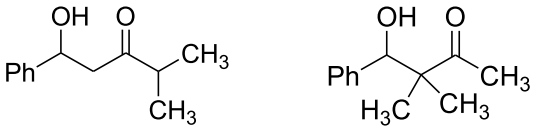
[X]

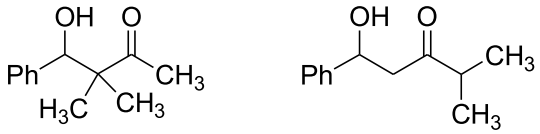
3-phenyl-2-butanone

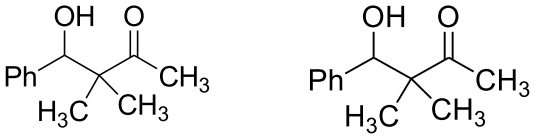
39. Aldehydes react with carbonyl compounds in the presence of bases by a mechanism similar to aldol condensation. Given below is the reaction of benzaldehyde with 3-methyl-2-butanone in the presence of lithium diisopropylamide (LDA), a strong bulky base and triethyl amine (TEA), a weak base. The correct structures of the major products, **I** and **II** formed in the following reactions are respectively

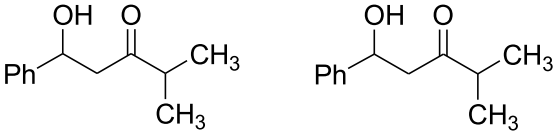


I **II**

(a) 

(b) 

(c) 

(d) 

40. The correct order of the given reagents to convert benzene to m-Chlorobromobenzene is

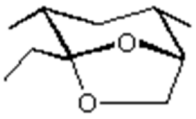
(1) sulfuric acid (conc.) and heat	(2) Cl_2 + $FeCl_3$ and heat	(3) $NaNO_2$ + H_3O^+ 0 °C	(4) H_2 Pt catalyst	(5) Mg in ether
(6) PBr_3	(7) H_3PO_2 (aqueous)	(8) HNO_3 (conc.) + H_2SO_4 (conc.) and heat	(9) Cu_2Br_2 + HBr	(10) $(CH_3CO)_2O$ + pyridine

(a) 1, 2, 5, 7 and 6 (b) 2, 8, 4, 3 and 9 (c) 8, 4, 10, 2, 3 and 9 (d) 8, 2, 4, 3 and 9

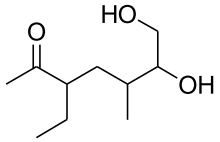
41. A chiral hydrocarbon (Molecular Formula C_6H_{12}) undergoes catalytic hydrogenation to yield an achiral product (Molecular Formula C_6H_{14}). The chiral hydrocarbon is

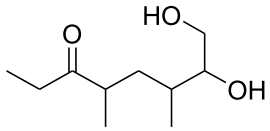
(a) *cis*-2-hexene
(b) 3-methyl-2-pentene
(c) 4-methyl-2-pentene
(d) 3-methyl-1-pentene

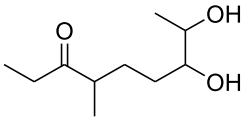
42. The structure of multistriatin, a pheromone of the elm bark beetle, is shown beside. The open chain ketodiol that on dehydrative cyclization gives multistriatin, bicyclic ketal (ignore stereo chemical aspects) is

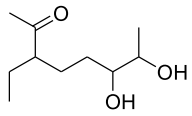


multistriatin

(a) 

(b) 

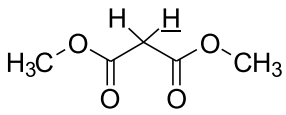
(c) 

(d) 

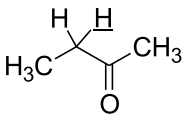
43. A monobasic acid (0.100 g) on complete combustion gave 0.252 g of CO_2 and 0.044 g of H_2O. For complete neutralization of 0.122 g of the acid, 10.0 mLof 0.1M NaOH solution was required. Molecular formula of the acid is

(a) $C_7H_6O_2$ (b) $C_6H_7O_2$ (c) $C_7H_7O_2$ (d) $C_6H_6O_2$

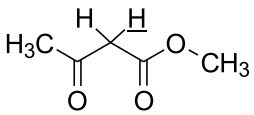
44. Acidity of acidic compounds depend on the stability of their conjugate bases. The correct order of acidity of the underlined H in the following compounds is
(Note: Assume that all the compounds exist in the keto form)



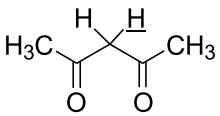
(i)



(ii)



(iii)

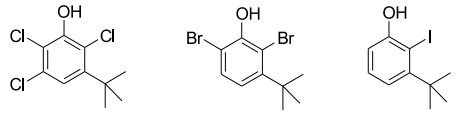


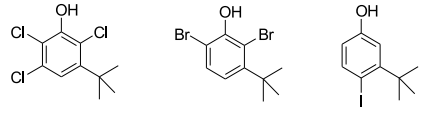
(iv)

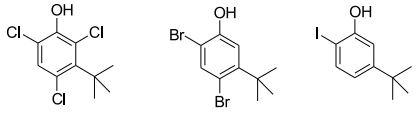
(a) (ii) > (iii) > (iv) > (i)
(b) (iv) > (iii) > (i) > (ii)
(c) (iii) > (ii) > (iv) > (i)
(d) (i) > (iii) > (iv) > (ii)

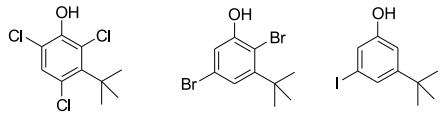
45. Reaction of *para*-Chloroaniline with acetic anhydride in pyridine gave a crude mixture of 94% of *para*-chloroacetanilide and 6% unreacted amine.
From the following, the best treatment suitable for purification of *para*-chloroacetanilide is
(a) treating the reaction mixture with methyl iodide
(b) washing an ether solution of the crude product with concentrated brine (aq. NaCl)
(c) washing an ether solution of the crude product with 5% cold aqueous sulfuric acid
(d) washing an ether solution of the crude product with 5% aqueous sodium carbonate

46. 3-tert-butylphenol when reacted separately with excess chlorine, bromine and iodine gave trichloro, di-bromo and mono-iodo derivatives of 3-tert-butylphenol respectively. The correct structures of the respective halogen derivatives are

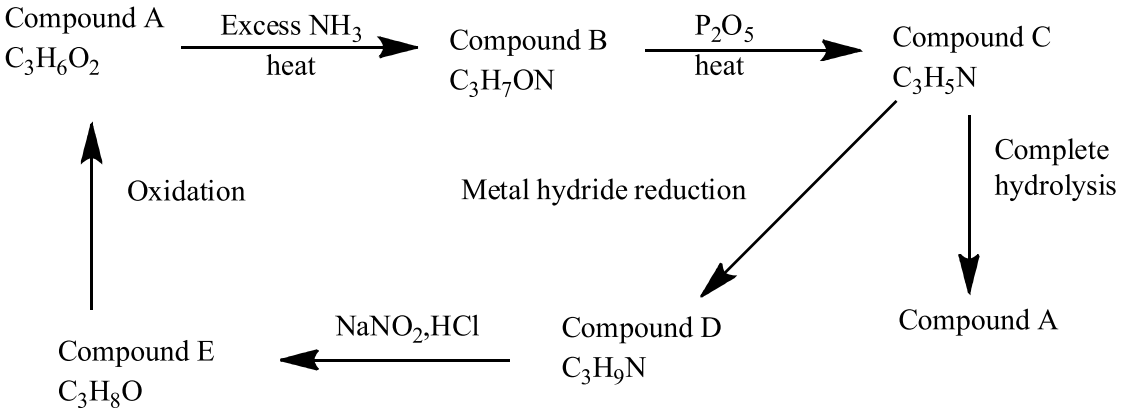
(a) 

(b) 

(c) 

(d) 

47. Consider the following sequence of reactions:
The functional groups undergoing change in the conversion of A to E respectively are



(a) -COOH, -NC, -$CONH_2$, -NH_2, -CH_2OH
(b) -COOH, -CN, -$CONH_2$, -NH_2, -CH_2OH
(c) -COOH, -$CONH_2$, -CN, -CH_2NH_2, -CH_2OH
(d) -$CONH_2$, -COOR, -NC, -NHR, >CHOH

48. The correct sequence of reagents which would convert p-Nitrotoluene to p-Iodobenzoic acid is

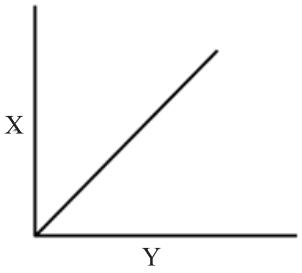
(a) (i) Br_2 + $FeBr_2$, (ii) Mg in ether, then CO_2, (iii) 3 H_2 and Pt or Ni catalyst, (iv) HNO_2, 0ºC, (v) KI solution
(b) (i) Br_2 in CCl_4 and heat, (ii) NaI in acetone, (iii) 3 H_2 and Pt or Ni catalyst, (iv) HNO_2, 0 ºC, (v) H_3PO_2
(c) (i) 3 H_2 and Pt or Ni catalyst, (ii) HNO_2, 0 ºC, (iii) Cu_2Br_2 + HBr, (iv) $KMnO_4$ and heat, (v) KI solution
(d) (i) $KMnO_4$ and heat, (ii) 3 H_2 and Pt or Ni catalyst, (iii) HNO_2, 0 ºC, (iv) KI solution

A – 2

ANY NUMBER OF OPTIONS 4, 3, 2 or 1 MAY BE CORRECT

MARKS WILL BE AWARDED ONLY IF ALL THE CORRECT OPTIONS ARE BUBBLED.

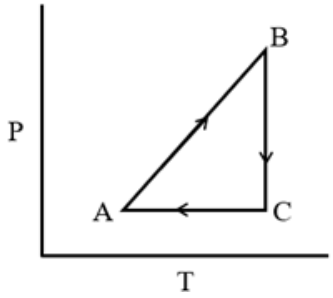
49. Following is a qualitative plot that can represent kinetic data obtained with a reactant R where $[R]_0$ and [R] represent the concentrations of R, at t = 0 and t = t respectively. 'Y' and 'X' are suitable parameters on the x- and y- axes.



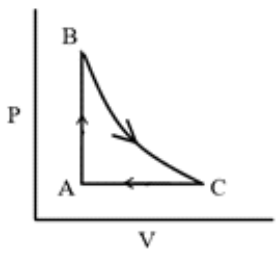
The correct representation of the curve is

	X	Y	order	X	Y	order
(a)	$[R]_0$ - [R]	time	Zero	Rate	time	First
(b)	$[R]_0$ - [R]	time	Zero	Initial rate	$[R]_0$	First
(c)	Rate	[R]	Zero	$t_{1/2}$	[R]	First
(d)	$t_{1/2}$	[R]0	Zero	ln $\{[R]_0/[R]\}$	t	First

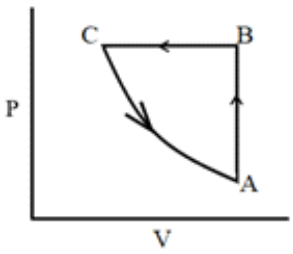
50. A given amount of an ideal gas undergoes the cyclic process ABCA as given below.



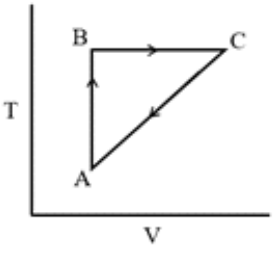
The equivalent representation/s of the same process is/are



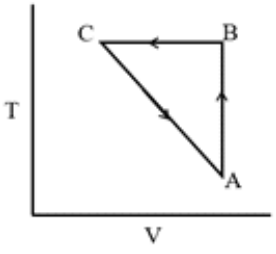
(a)



(b)



(c)



(d)

51. The correct statements among the following is /are

(a) When equal volumes of a solution containing Sr^{2+} (0.01M) and another containing F^- (0.001M) are mixed at 25ºC, SrF_2 will be precipitated (K_{sp} of $SrF_2 = 8.0 \times 10^{-10}$ at 25ºC)

(b) When equal volumes of a solution containing Ba^{2+} (1.0×10^{-4} M) and another containing F^- (1.0×10^{-2}M) are mixed at 25ºC, BaF_2 will be precipitated (K_{sp} of $BaF_2 = 1.0 \times 10^{-6}$ at 25ºC)

(c) The solubility product (K_{sp}) and the molar solubility (s) of $La(IO_3)_3$ are related as $K_{sp} = 27s^4$

(d) The solubility product and the molar solubility of $Ca_3(PO_4)_2$ are related as $27s^4$

52. For the phenomenon of adsorption, the correct statement/s among the following is /are

(a) According to Freundlich model, mass of N_2 gas adsorbed per g of silica surface will increase with temperature of adsorption

(b) If S is the surface area of an adsorbent, and 'A', 'm' and 'M' are the cross-sectional area, mass adsorbed and molar mass of the adsorbate respectively, then $S = \left(\frac{m}{M}\right) A N_A$ (N_A-Avogadro's number)

(c) The number of gas molecules physisorbed on unit mass of an adsorbent will be the same for two different gases at the same temperature.

(d) Adsorption of H_2 on Ni surface with $E_a = 96$ kJ mol^{-1} can be termed as chemisorption

53. When excess $KMnO_4$ is added to concentrated H_2SO_4, an oily green colored covalent compound **Y** is formed. Which of the following statements is/ are true for the above reaction.

(a) Compound **Y** is formed by a dehydration reaction

(b) In compound **Y** Mn is octahedrally surrounded by oxygen atoms

(c) **Y** is the highest oxide of Manganese

(d) Compound **Y** has Mn-O-Mn bridge

54. Read carefully all the three statements on defects in solids:

(i) In Frenkel defect, interstitial Ag^+ site is surrounded tetrahedrally by four Cl^- ions and four Ag^+ ions, where interstitial Ag^+ and Cl^- interaction is covalent

(ii) Addition of small amount of $SrCl_2$ in NaCl yields solid solution with a formula of $Na_{1-2x}Sr_xV_{Nax}Cl$, where V = valency

(iii) In general, Schottky defect increases the density of the substance

Choose the correct alternative(s).

(a) Statement (i) is correct

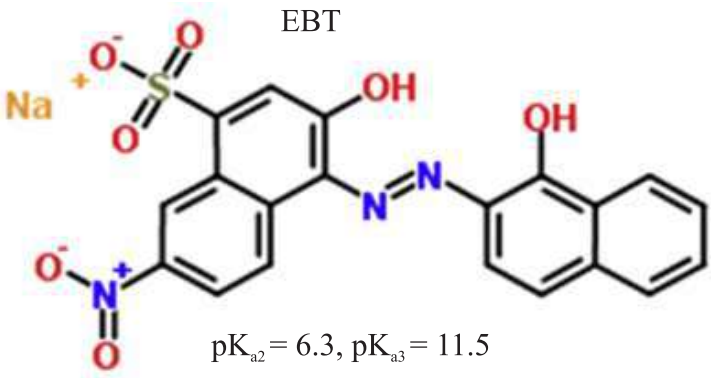
(b) Statements (ii) and (iii) are correct

(c) Statements (i) and (ii) are correct

(d) Statements (i) and (iii) are correct

55. Eriochrome black T (EBT) is an indicator in titrimetric estimation of calcium at pH 10.0 giving pink colour to the solution. It has structure as shown below. Considering that the pH of solution is 10.0, which statement(s) describe(s) the complexation of EBT with Ca(II) correctly

EBT



$pK_{a2} = 6.3$, $pK_{a3} = 11.5$

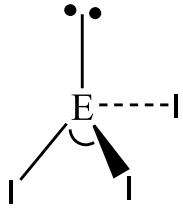
(a) On dissociation of EBT, Ca(II) binds at SO_3^- to form 1:2 complex

(b) Both sulphonate and nitro groups are involved in 1:1 complexation with Ca(II)

(c) EBT acts as a bidentate ligand to form a dianionic species, with deprotonation of one – OH, where Ca(II) binds to azide nitrogen and phenolic oxygen *trans* to $-NO_2$ group in 1:2 ratio

(d) There is a mixture of complexes of Ca(II) with EBT acting as a bidentate and tridentate ligand

56. The correct statement(s) regarding three EI_3 molecules (where E=P, As or Sb) is/are:



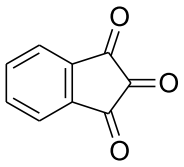
(a) These compounds are formed by mutual sharing of electrons and hence considered as covalent compounds

(b) PI_3 is most susceptible towards hydrolysis in water to give phosphorous acid

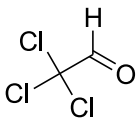
(c) SbI_3 has highest boiling point amongst all

(d) In AsI_3, there is least repulsion between bond pair and lone pair and thus has the largest I-E-I angle

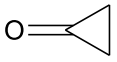
57. Aldehydes and ketones can react with water in the presence of an acid or base to yield an equilibrium mixture of the aldehyde/ketone and the corresponding hydrates (geminal diol). Among the following, the aldehyde/ketones which will have a greater percentage of the hydrate at equilibrium are



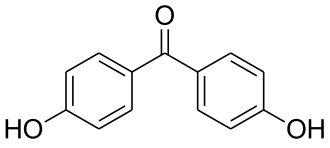
(a)



(b)

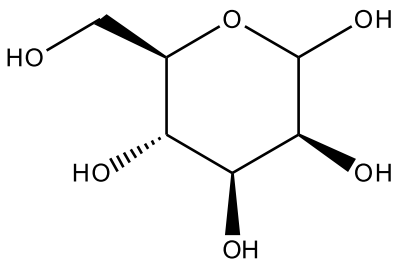


(c)



(d)

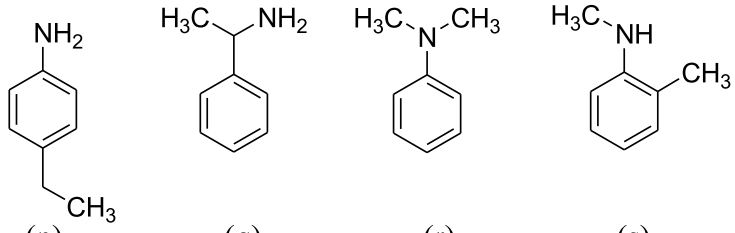
58. The correct statement/s about the pyranose form of a sugar (X) given below is/are:



(X)

(a) It exists in two anomeric pyranose forms
(b) It reacts with Tollens' reagent to give a silver mirror
(c) The penta-O-methyl derrvative of (X) is non reducing.
(d) It resists reduction with aqueous sodium borohydride

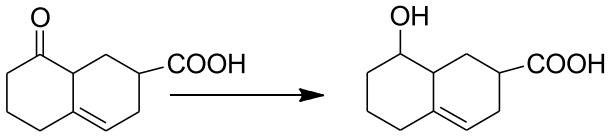
59. Given below are isomeric amines. The **incorrect** statement/s about them from the following is/are



(p) (q) (r) (s)

(a) (p) and (q) both will give unstable products respectively with $NaNO_2$ in HCl at 268 K
(b) Reaction of all amines with HCl is exothermic
(c) Reaction of benzene sulphonyl chloride with (s) gives a solid product that is soluble in NaOH
(d) (q) has the highest basicity among these

60. Which one/s of the reduction techniques mentioned below is/are **NOT** suitable for the following chemical transformation



(a) $NaBH_4$ based reduction
(b) $LiAlH_4$ based reduction
(c) DIBAL-H based reduction
(d) B_2H_6 based reduction

IUPAC Periodic Table of the Elements

1																	18
1 H hydrogen 1.008 [1.0078, 1.0082]	2		Key: atomic number **Symbol** name conventional atomic weight standard atomic weight									13	14	15	16	17	2 He helium 4.0026
3 Li lithium 6.94 [6.938, 6.997]	4 Be beryllium 9.0122											5 B boron 10.81 [10.806, 10.821]	6 C carbon 12.011 [12.009, 12.012]	7 N nitrogen 14.007 [14.006, 14.008]	8 O oxygen 15.999 [15.999, 16.000]	9 F fluorine 18.998	10 Ne neon 20.180
11 Na sodium 22.990	12 Mg magnesium 24.305 [24.304, 24.307]	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 26.982	14 Si silicon 28.085 [28.084, 28.086]	15 P phosphorus 30.974	16 S sulfur 32.06 [32.059, 32.076]	17 Cl chlorine 35.45 [35.446, 35.457]	18 Ar argon 39.95 [39.792, 39.963]
19 K potassium 39.098	20 Ca calcium 40.078(4)	21 Sc scandium 44.956	22 Ti titanium 47.867	23 V vanadium 50.942	24 Cr chromium 51.996	25 Mn manganese 54.938	26 Fe iron 55.845(2)	27 Co cobalt 58.933	28 Ni nickel 58.693	29 Cu copper 63.546(3)	30 Zn zinc 65.38(2)	31 Ga gallium 69.723	32 Ge germanium 72.630(8)	33 As arsenic 74.922	34 Se selenium 78.971(8)	35 Br bromine 79.904 [79.901, 79.907]	36 Kr krypton 83.798(2)
37 Rb rubidium 85.468	38 Sr strontium 87.62	39 Y yttrium 88.906	40 Zr zirconium 91.224(2)	41 Nb niobium 92.906	42 Mo molybdenum 95.95	43 Tc technetium	44 Ru ruthenium 101.07(2)	45 Rh rhodium 102.91	46 Pd palladium 106.42	47 Ag silver 107.87	48 Cd cadmium 112.41	49 In indium 114.82	50 Sn tin 118.71	51 Sb antimony 121.76	52 Te tellurium 127.60(3)	53 I iodine 126.90	54 Xe xenon 131.29
55 Cs caesium 132.91	56 Ba barium 137.33	57-71 lanthanoids	72 Hf hafnium 178.49(2)	73 Ta tantalum 180.95	74 W tungsten 183.84	75 Re rhenium 186.21	76 Os osmium 190.23(3)	77 Ir iridium 192.22	78 Pt platinum 195.08	79 Au gold 196.97	80 Hg mercury 200.59	81 Tl thallium 204.38 [204.38, 204.39]	82 Pb lead 207.2	83 Bi bismuth 208.98	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	89-103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium	113 Nh nihonium	114 Fl flerovium	115 Mc moscovium	116 Lv livermorium	117 Ts tennessine	118 Og oganesson

57 La lanthanum 138.91	58 Ce cerium 140.12	59 Pr praseodymium 140.91	60 Nd neodymium 144.24	61 Pm promethium	62 Sm samarium 150.36(2)	63 Eu europium 151.96	64 Gd gadolinium 157.25(3)	65 Tb terbium 158.93	66 Dy dysprosium 162.50	67 Ho holmium 164.93	68 Er erbium 167.26	69 Tm thulium 168.93	70 Yb ytterbium 173.05	71 Lu lutetium 174.97
89 Ac actinium	90 Th thorium 232.04	91 Pa protactinium 231.04	92 U uranium 238.03	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

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Rough Work