

ASSOCIATION OF CHEMISTRY TEACHERS
NATIONAL STANDARD EXAMINATION IN CHEMISTRY 2013-2014

Date of Examination : 24th November 2013

Time 12.30 to 14.30 Hrs

Q. P. Code No. 2 0 7
TWO ZERO SEVEN

INSTRUCTION TO CANDIDATES

1. On the answer sheet, fill up all the entries carefully in the space provided, **ONLY In BLOCK CAPITALS**. Use only **BLUE or BLACK BALL PEN** for making entries and marking answer. Incomplete / incorrect / carelessly filled information may disqualify your candidature.
2. Write the Q.P. Code No. mentioned above on YOUR answer sheet (in the space provided). Otherwise your answer sheet will NOT be examined.
3. The question paper contain 80 multiple-choice question. Each question has 4 options, out of which only one is correct. Choose the correct answer and mark a **cross** in the corresponding box on the answer sheet as **shown below** :

Q.	a	b	c	d
22			<input checked="" type="checkbox"/>	

4. A correct answer carries 3 marks and 1 mark will be deducted for each wrong answer.
5. All rough work may be done on the blank sheet provided at the end of the question paper.
6. **PLEASE DO NOT MAKE ANY MARK OTHER THAN (X) IN THE SPACE PROVIDED ON THE ANSWER SHEET.** Answer sheets are evaluated with the help of a machine. Due to this, **CHANGE OF ENTRY IS NOT ALLOWED.**
7. Scratching or overwriting may result in wrong score. **DO NOT WRITE ANYTHING ON THE BACK OF ANSWER SHEET.**
8. Use of a nonprogrammable calculator is allowed.
9. Periodic table is provided at the end of this question paper.
10. The answers / solutions to this question paper will be available on our website - www.iapt.org.in by 30th November 2013.
11. Attempt the examination honestly. Any dishonestly will disqualify you.

CERTIFICATES & AWARDS

- i) Certificates to top 10% students of each centre.
- ii) Merit certificates to statewide Top 1% students.
- iii) Merit certificate and a prize in term to Nationwide Top 1% students.
12. **Result sheets** and the **“centre top 10%”** certificates of NSEC are dispatched to the Professor in charge of the centre. Thus you will get your marks from the Professor in charge of your centre by January 2014 end.
13. 300 (or so) students are called for the next examination - Indian National Chemistry Olympiads (INChO). Individual letters are sent to these students **ONLY**.
14. Gold medals may be awarded to TOP 35 students in this entire process.
15. No queries will be entertained in this regard.

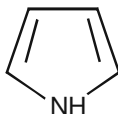
ASSOCIATION OF CHEMISTRY TEACHERS

NATIONAL STANDARD EXAMINATION IN CHEMISTRY 2013-2014

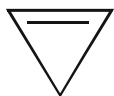
1. The number of optically active stereoisomers of tartaric acid, (HOOC.CHOH.CHOH.COOH) is
 (A) 4 (B*) 2 (C) 1 (D) 3

Sol. (B)
 Tartaric acid has 2 identical chiral carbon and only 2 optically active stereoisomers.

2. Which of the following structure is aromatic ?



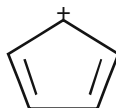
I



II



III



IV

- (A) Structures I and II
 (C) Structures II only

- (B*) Structure I only
 (D) Structure III only

Sol. (B)
 Only I follows Huckel's rule and aromatic.

3. Salicylic acid on treatment with bromine water will give

- (A) 2-bromo-6-hydroxybenzoic acid
 (B*) 2,4,6-tribromophenol
 (C) 2,6-dibromobenzoic acid
 (D) 1,3-dibromo-6-hydroxybenzoic acid

Sol. (B)
 Salicylic acid on treatment with bromine water give 2,4,6-tribromophenol.

4. In which of the following compounds is the oxidation number of the transition metal, zero ?

- (A) $[\text{Fe}(\text{H}_2\text{O})_3](\text{OH})_2$ (B) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_2$
 (C) $[\text{Ni}(\text{CO})_4]$ (D) $[\text{Pt}(\text{C}_2\text{H}_4)\text{Cl}_3]$

Sol. (C)
 $[\text{Ni}(\text{CO})_4]$, oxidation number of Ni is zero.

5. If each of the following salts has solubility product $K_{sp} = 1 \times 10^{-9}$, which of them is least soluble in water ?

- (A) XY (B) X_2Y (C) XY_2 (D) X_3Y

Sol. (A)
 For XY, solubility = $K_{sp} = 10^{-9} = 10^{-4.5}$
 This is the least value.

6. A DNA sample stored at 4°C was removed from the refrigerator and heated in a hot water bath with temperature increasing gradually. Which bond of the DNA molecule will break first ?

- (A) Phosphodiester bond (B) Glycoside linkage
 (C) Hydrogen bond (D) Covalent bond

Sol. (C)
 It is the weakest bond among the given.

7. Which of the following salts produces the most basic solution ?

- (A) $\text{Al}(\text{CN})_3$ (B) $\text{KC}_2\text{H}_3\text{O}_2$ (C) FeCl_3 (D) KCl

Sol. (B)
 Anionic hydrolysis produces most basic solution
 i.e. CH_3COOK

8. Which of the following compounds has zero dipole moment ?

- (A) NH_3 (B) NF_3 (C) BF_3 (D) CHCl_3

Sol. (C)
 BF_3 due to symmetrical structure

9. An isotone of ${}_{32}\text{Ge}^{76}$ is
 (A) ${}_{32}\text{Ge}^{77}$ (B) ${}_{33}\text{As}^{77}$ (C) ${}_{34}\text{Se}^{77}$ (D) ${}_{35}\text{Br}^{80}$

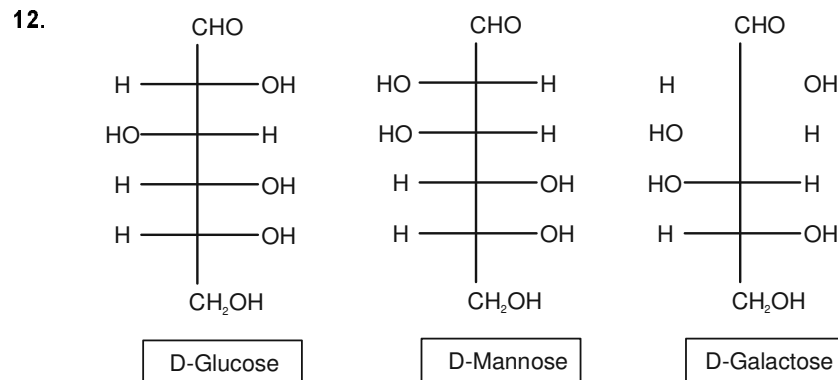
Sol. (B)
 ${}_{32}\text{Ge}^{76}$, no. of neutrons = $A - Z$
 = $76 - 32$
 = 44
 No. of neutrons in ${}_{33}\text{As}^{77}$ is 44.

10. One of the constituents of German silver is
 (A) Ag (B) Mg (C) Cu (D) Al

Sol. (C)
 It is an alloy of copper, zinc & nickel

11. A catalyst is a substance that
 (A) undergoes chemical change to accelerate the rate of the reaction
 (B) decreases the energy of activation of the reaction
 (C) increases the kinetic energy of the reaction
 (D) lowers the potential energy of the products with respect to that of the reactants.

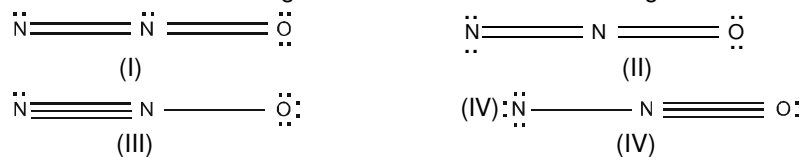
Sol. (B)
 Catalyst lowers the activation energy of reaction.



The above structures are related to each other as
 (A) identical substance (B*) diastereomers
 (C) enantiomers (D) epimers

Sol. (B)
 All the above structures differs in configuration at one or two stereocentre.

13. Which one of the following is not a valid structure for dinitrogen oxide?



- (A) I (B) II (C) III (D) IV

Sol. (A)
 I is not valid i.e. 'N' can't expand its octet

14. A mixture of acidified $\text{K}_2\text{Cr}_2\text{O}_7$ and 10% KI is titrated against $\text{Na}_2\text{S}_2\text{O}_3$ (Sodium thiosulphate) solution using starch indicator. The colour of the reaction mixture at the end point is

- (A) Yellow (B) Blue (C) Green (D) Colourless

Sol. (C)
 Cr^{3+} ion is produced in solution. So green solution.

15. The gas which liberates bromine from a solution of KBr is
 (A) Cl_2 (B) I_2 (C) SO_2 (D) HI

Sol. (A)
 Cl_2 is oxidising agent.

16. The bond order of NO^+ ion is
 (A) 1 (B) 2 (C) 2.5 (D) 3

Sol. (D)
 Bond order of NO^+ is 3

17. What is NOT true for both cellulose and DNA?
 (A) Both are long chain polymers (B*) Both contains similar monomers
 (C) Both have glycosidic Linkages (D) Both can break down by enzymatic hydrolysis

Sol. (B)
 For cellulose β -D-Glucose is the monomer but for DNA the monomer is Deoxyribose sugar, nucleic acids and phosphate.

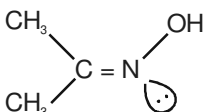
18. An enzyme working at pH 4.5 became inactive when treated with a hydrophobic surfactant. The enzyme may be

(A) Cytosolic (B) Extracellular
 (C*) Peripheral membrane bound (D) Integral Membrane bound

Sol. (C)
 Peripheral membrane bound enzyme working at pH 4.5 became inactive when treated with a hydrophobic surfactant.

19. Which of the following molecules cannot show geometric isomerism?

(A) $\text{CH}_3\text{CH}=\text{NOH}$ (B*) $(\text{CH}_3)_2\text{C}=\text{NOH}$ (C) $\text{HO}-\text{N}=\text{N}-\text{OH}$ (D) $\text{Cl}-\triangle-\text{Cl}$

Sol. (B)
 -does not show Geometrical Isomerism.

20. Which of the following is most stable?
 (A*) 2, 3 Dimethyl-1,2-butene (B) 2-Butene
 (C) 2-Methyl-1,2-butene (D) 1-Butene

Sol. (A)
 It has more α H, hence more stabilized by hyperconjugation.

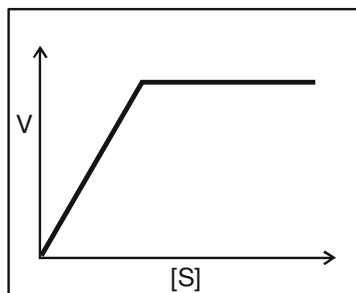
21. RNA forms loop structure because
 (A) It always contain uracyl instead of thymine
 (B*) of presence of nearby complementary bases
 (C) all RNAs have to form loop structure to function
 (D) they are always single stranded

Sol. (B)
 H-bond is formed between complementary bases.

22. Which is the strongest oxidising agent among the species given below?
 (i) In^{3+} $E^0 = -1.34\text{V}$ (ii) Au^{3+} $E^0 = 1.40\text{V}$
 (iii) Hg^{2+} $E^0 = 0.867\text{V}$ (iv) Cr^{3+} $E^0 = -0.786\text{V}$
 (A) Cr^{3+} (B) Au^{3+}
 (C) Hg^{2+} (D) In^{3+}

Sol. (B)
 Au^{3+} is most powerful oxidising agent among given cations.
 Higher is SRP value, greater is oxidising power.

23. The kinetics of an enzyme-catalyzed hydrolysis reaction is represented by the following graph, where [S] is the substrate concentration, and v is the rate of reaction :

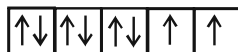


The kinetic course of the reaction can be described as

- (A) First order, zero order (B) Zero order, first order
(C) First order, second order (D) Second order, first order
- Sol. (A)
Initially reaction is 1st order & then zero order.

24. The number of unpaired electrons in Ni²⁺ is
(A) 0 (B) 2 (C) 3 (D) 4

Sol. (B)
Ni²⁺ : 3d⁸



No. of unpaired electron = 2

25. The colourless ion from among the following is
(A) Mn²⁺ (B) Cu⁺ (C) Cr³⁺ (D) Fe²⁺

Sol. (B)
Cu⁺ (No unpaired electron)

26. The metal carbonyl which is paramagnetic is
(A) Ni(CO)₄ (B) V(CO)₆ (C) Cr(CO)₆ (D) Fe(CO)₅

Sol. (B)
[V(CO)₆] has one unpaired electron
V : 3d³ 4s² or 3d⁵ t_{2g}^{2,2,1}, e_g^{0,0}

27. The percentage composition of nitrogen in an organic compound can be determined by
(A*) Dumas method (B*) Kjeldahl method (C) Victor's method (D) Hoffman's method

Sol. (AB)
Both Dumas and Kjeldahl method are used to establish percentage composition of nitrogen in an organic compound.

28. High spin complexes having coordination number ' 6 ' are usually formed through
(A*) sp³d² hybridisation (B) d²sp³ hybridisation (C) sp³ hybridisation (D) sp³d hybridisation

Ans. (A)

29. The blood red color obtained in the detection of nitrogen and sulphur together in an organic compound in Lassaigne's test is due to

(A) [Fe(CNS)]⁺ (B*) [Fe(CNS)₂]⁺ (C) [Fe(CNS)3]⁻ (D) [Fe(CNS)₂]₂²⁺

Sol. (B)
In Lassaigne's test the Fe³⁺ form complex with CNS⁻ ion.

30. A protein attached to carbohydrate moiety is called as
(A) Lipoprotein (B) Nucleoprotein (C) Apoprotein (D*) Glycoprotein

Sol. (D)
It is simple fact.

31. Which of the following aqueous solution has the lowest electrical conductance ?
 (A) 0.01M CaCl_2 (B) 0.01M KNO_2 (C) 0.01M CH_3COOH (D) 0.01M CH_3COCH_3

Sol. (D)
 acetone CH_3COCH_3 is non-electrolyte in aq. medium.

32. The reddish-brown gas formed when nitric oxide is oxidized by air is
 (A) NO_2 (B) N_2O_4 (C) N_2O_5 (D) N_2O_3

Sol. (A)
 $2\text{NO} + \text{O}_2 \longrightarrow 2\text{NO}_{2(\text{g})}$ (reddish brown gas)

33. The electronic level which allows the hydrogen atom to absorb, but not emit a photon is
 (A) 1s (B) 2s (C) 2p (D) 3s

Sol. (A)
 Electron in 1s can absorb light but can't emit.

34. Bell metal is an alloy of copper and
 (A) Tin (B) Aluminium (C) Zinc (D) Nickel

Sol. (A)
 Bell metal : An alloy of tin & copper.

35. Europium (Eu) and Terbium (Tb) attain stable $4f^7$ configuration by exhibiting oxidation states of
 (A) +2 and +4 (B) +3 and +4 (C) +2 and +3 (D) +1 and +3

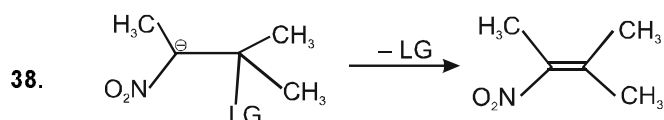
Sol. (A)
 Tb : $[\text{Xe}] 4f^9 6s^2$
 Eu : $[\text{Xe}] 4f^7 6s^2$

36. Which of the following reaction parameters will change due to addition of a catalyst
 (A) Free energy (B) Only equilibrium
 (C) Only rate constant (D) Both equilibrium constant and rate constant

Sol. (C)
 Rate constant is increased by catalyst

37. A plot of $1/[\text{NO}_2]$ verses time for decomposition of NO_2 was found to be linear. This means that the reaction
 (A) Is zero order with respect to $[\text{NO}_2]$
 (B) Is first order with respect to $[\text{NO}_2]$
 (C) Is second order with respect to $[\text{NO}_2]$
 (D) Order cannot be determined from the information given

Sol. (C)
 $\frac{1}{[\text{NO}_2]}$ v/s time, linear so 2nd order reaction



The carbanion expels a leaving group LG to yield an alkene as shown above by
 (A*) $E_{1\text{cb}}$ mechanism
 (B) E_1 mechanism
 (C) E_2 mechanism
 (D) Such a reaction does not take place

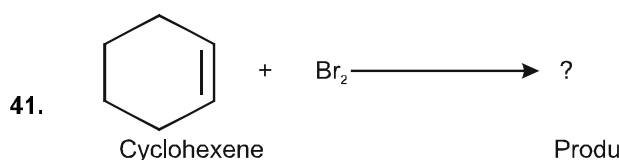
Sol. (A)
 The carbanion intermediate is formed only in $E_{1\text{cb}}$ mechanism.

39. Select the most correct statement among the following :
- (A) SN^1 mechanism takes place in non-polar solvents
 (B) SN^2 mechanism in chiral substrates gives racemic mixtures as products
 (C*) SN^1 mechanism is encouraged by polar solvents
 (D) The solvent never influences the mechanism

Sol. (C)
 SN^1 reaction proceeds through the formation of carbocation intermediate, which is most favored in more polar solvent.

40. Fehling's solution is
- (A) AgNO_3 solution + NaOH solution + NH_4OH
 (B) Alkaline solution of Cupric ion complexed with citrate ion
 (C*) Copper sulphate + sodium potassium tartarate + NaOH
 (D) Copper sulphate solution

Sol. (C)
 Fehling's solution is alkaline solution of CuSO_4 with Rochelle salt i.e. sodium potassium tartarate.



The correct name of the product obtained is

- (A) cis-1,2-dibromocyclohexane
 (B) cis-1,4-dibromocyclohexane
 (C*) trans-1,2-dibromocyclohexane
 (D) trans-1,4-dibromocyclohexane
- Sol. (C)
 Addition of bromine is anti and the product is trans-1,2-dibromocyclohexane.
42. A solution of sodium metal in liquid ammonia is strongly reducing due to the presence of
- (A) sodium atoms
 (B) sodium hydride
 (C) sodium amide
 (D) solvated electrons
- Sol. (D)

43. The number of unpaired electrons in Ni^{2+} ion is 2, therefore its spin multiplicity is
- (A) 2
 (B) 1
 (C) 3
 (D) 4
- Sol. (C)

$$M = 2 \times |S| + 1 \qquad S = 2 \times \pm \frac{1}{2}$$

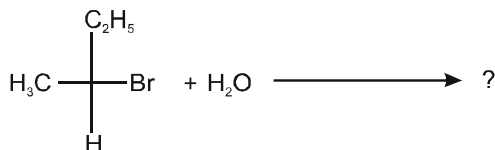
$$= 2 \times 1 + 1 \qquad = 1$$

$$= 3$$

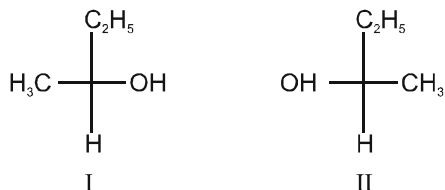
44. A cold aqueous solution of PbCl_2 gives golden yellow precipitate on addition of
- (A) KCl solution
 (B) KI solution
 (C) NaCl solution
 (D) K_2SO_4 solution
- Sol. (B)



45. In the reaction given below :



the product obtained will contain :



- (A) Only Compound I (B) Only Compound II
(C*) Both compound I and II (D) this substitution cannot take place

Sol.

(C)

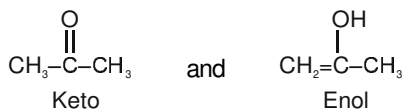
The given reaction is hydrolysis and it follows SN^1 mechanism and both I and II are formed.

46. Acetone and propen-2-ol are

- (A) enantiomers (B*) keto-enol tautomers
(C) diastereoisomers (D) meso compounds

Sol.

(B)



47. How old is a fossil bone whose ^{14}C content is 15.0% of that living bone ?

Half life of ^{14}C isotope is 5.73×10^3 yr.

- (A) 25488 yr (B) 15688 yr (C) 388 yr (D) 6818 yr

Sol.

(B)

$$t = \frac{2.303 \times 5.73 \times 10^3}{0.693} \log \left[\frac{a}{0.15a} \right] = 15688 \text{ year.}$$

48. How much chemical energy is fixed in the form of ATP upon complete oxidation of one mole of glucose ?

(Hydrolysis of ATP yields 7.5 kcal/mole)

- (A) 360 (B) 300 (C) 270 (D) 200

Sol.

(C)

One mole of Glucose upon complete oxidation gives 36 ATP with is equivalent to $36 \times 7.5 \text{ kcal/mole} = 270 \text{ kcal/mole}$

49. The value of the constant in Nernst equation

$$E = E^{\circ} - \frac{\text{constant}}{n} \ln Q \text{ at } 25^{\circ}\text{C is}$$

- (A) 0.592 (B) 0.0592 (C) 0.296 (D) 0.0296

Sol.

(D)

$$E = E^{\circ} - \frac{0.059}{n} \log Q.$$

$$E = E^{\circ} - \frac{RT}{nF} \ln Q$$

$$\text{Constant} = \left(\frac{RT}{F} \right) = 0.0296$$

50. The chemical formula of Plaster of Paris is
 (A) $2\text{CaSO}_4 \cdot \text{H}_2\text{O}$ (B) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (C) $3\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (D) $\text{CaSO}_4 \cdot \text{H}_2\text{O}$

Sol. (A)



51. The K_p/K_c ratio for the reaction :
 $4\text{NH}_3(\text{g}) + 7\text{O}_2(\text{g}) \rightleftharpoons 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$, at 127°C is

(A) 0.0301 (B) 0.0831 (C) 1.0001 (D) 33.26

Sol. (A)

$$K_p = K_c (\text{RT})^{\Delta n} \quad \Delta n = -1$$

$$\frac{K_p}{K_c} = \frac{1}{\text{RT}} = 0.0301.$$

52. Van Arkel method of purification of metals involves converting the metal to a
 (A) Volatile compound (B) Volatile unstable compound
 (C) Non-volatile stable compound (D) Non-volatile unstable compound

Sol. (B)

53. Which of the following reaction mechanisms does not involve carbocation as an intermediate ?

(A) Baeyer-Villiger Oxidation (B) Beckman rearrangement
 (C) Fries Rearrangement (D*) Diels-Alder Reaction

Sol. (D)

Diels Alder reaction is a concerted reaction in which neither cation nor anion is formed.

54. Which of the following statements is correct ?

(A) $-\text{NO}_2$ group activates the benzene ring for attack of electrophile at ortho and para position.
 (B*) $-\text{NH}_2$ group activates the benzene ring for attack of electrophile at ortho and para position.
 (C) Both $-\text{NO}_2$ group as well as $-\text{NH}_2$ group activate the benzene ring for attack of electrophile at ortho and para position.
 (D) Neither $-\text{NO}_2$ group nor $-\text{NH}_2$ group activate the benzene ring for attack of electrophile at ortho and para position.

Sol. (B)

$-\text{NO}_2$ group is strong electron withdrawing due to $-M$ whereas $-\text{NH}_2$ group is strong electron donating group due to $+M$ effect.

55. Which of the following does not have an active methylene group ?

(A) $\text{CH}_3\text{CH}_2\text{NO}_2$ (B) $\text{CH}_3\text{COCH}_2\text{COCH}_3$
 (C) PhCOCH_2CN (D*) $\text{CH}_3\text{CH}_2\text{NH}_2$

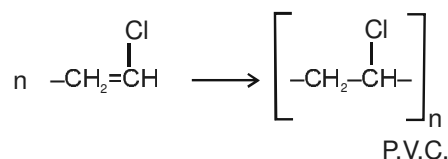
Sol. (D)

Most appropriate answer is D. In $\text{CH}_3\text{CH}_2\text{NH}_2$ the ∞ H is not strong acidic.

56. $\text{CH}_2=\text{CHCl}$ is monomer of

(A) Poly styrene (B) Natural rubber (C*) PVC (D) Nylon-6

Sol. (C)



57. A cell membrane acts as a semi-permeable selective boundary because it contains

(A) Lipids and carbohydrates (B) Proteins and carbohydrates
 (C) Proteins and Nucleic acids (D*) Lipids and proteins

Sol. (D)

It is fact.

58. 4s orbital has lesser energy than 3d orbital because it has
 (A) Greater value of n (B) Lesser value of l
 (C) Lesser value of (n + l) (D) l = 0

Sol. (C)

59. When zinc rod is directly placed in copper sulphate solution
 (A) the blue colour of the solution starts intensifying
 (B) the solution remains electrically neutral
 (C) the temperature of the solution falls
 (D) the weight of zinc rod starts increasing

Sol. (B)

60. The linear molecule among the following is
 (A*) CO₂ (B) NO₂ (C) SO₂ (D) ClO₂

Sol. (A)

61. In the compound Na₂S₂O₃, the oxidation state of sulphur is
 (A) -2 (B) +2 (C) +4 (D) +6

Sol. (B)

62. The pH of 0.1 M NH₄OH, (K_b = 1.8 × 10⁻⁵, K_w = 10⁻¹⁴), is
 (A) 1.0 (B) 5.7 (C) 11.1 (D) 13.0

Sol. (C)

$$\begin{aligned} \text{pOH} &= \frac{1}{2} [\text{pk}_b - \log C] \\ &= \frac{1}{2} [4.76 + 1] \\ &= \frac{5.76}{2} = 2.88 \approx 2.9 \\ \text{pH} &= 14 - 2.9 = 11.1 \end{aligned}$$

63. In animals, the stored carbohydrates is
 (A) Starch (B*) Glycogen (C) Sucrose (D) Fructan

Sol. (B)

64. For a chemical reaction ΔH is negative and ΔS is positive. This reaction is
 (A) spontaneous at all temperatures
 (B) nonspontaneous at all temperature
 (C) spontaneous only at high temperature
 (D) spontaneous only at low temperature

Sol. (A)

$$\begin{aligned} \Delta G &= \Delta H - T\Delta S \\ &= (-) (+) \\ &= (-) \text{ spontaneous at all temperature.} \end{aligned}$$

65. Which of the following salt/s of H₃PO₃ exists ?
 (I) NaH₂PO₃ (II) Na₂HPO₃ (III) Na₃PO₃
 (A) I and II only (B) I, II and III (C) II and III only (D) III only

Sol. (A)

H₃PO₃ is dibasic so
 NaH₂PO₃ & Na₂HPO₃ both exist.

66. Which of the following molecules is most volatile ?
 (A*) Salicylaldehyde (B) p-nitrophenol
 (C) p-hydroxybenzoic acid (D) m-hydroxybenzoic acid

Sol. (A)
 Salicydehyde is *O*-hydroxybenzaldehyde. It is volatile as it has intramolecular hydrogen bonding.

67. The isoelectric point of an amino acid is :
 (A) The pH at which it exists in the acidic form
 (B) The pH at which exists in the basic form
 (C*) The pH at which it exists in the Zwitterion form
 (D) The pH which is equal to its pK_a value

Sol. (C)
 At PI, the total(+) ion concentration is equal to total (-) ion concentration.

68. A gas shows positive Joule-Thomson Effect below its
 (A) Boyle Temperature (B) Critical Temperature
 (C) Inversion Temperature (D) Transition Temperature

Sol. (C)

69. The following data was recorded for the reaction :



Set No.	[A]	[B]	Rate of the reaction
I	0.1 M	0.2 M	0.001
II	0.2 M	0.2 M	0.004
III	0.2 M	0.8 M	0.008

The order of the reaction is

- (A) 1 (B) 2 (C) 2.5 (D) 3

Sol. (C)

$$r = K [A]^X [B]^Y$$

$$\frac{r_2}{r_1} = \left(\frac{0.2}{0.1}\right)^X = \left(\frac{0.004}{0.001}\right)$$

$$= (2)^X = 4 \quad X = 2$$

$$\frac{r_3}{r_2} = \left(\frac{0.8}{0.2}\right)^Y = \left(\frac{0.008}{0.004}\right)$$

$$= (4)^Y = 2$$

$$= (2)^{2Y} = 2^1 \quad \text{So} \quad 2Y = 1$$

$$Y = \frac{1}{2}$$

70. Which solution has the highest pH ?
 (A) 0.01 M CaCl_2 (B) 0.01 M KNO_2
 (C) 0.01 M CH_3COOH (D) 0.01 M CH_3COCH_3

Sol. (B)
 KNO_2 [WASB]

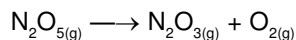
71. The minimum number of H^+ ions that can be released by an amino acid is
 (A*) 1 (B) 2 (C) 3 (D) 4

Sol. (A)

72. Which of the following molecular structures is NOT possible ?
 (A) OF_2 (B) SF_2 (C) OF_4 (D) SF_4

Sol. (C)

73. K_p for the reaction given below is 1.36 at 499 K. Which of the following equations can be used to calculate K_c for this reaction ?



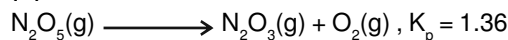
$$(A) K_c = \frac{[(0.0821) \times (499)]}{[1.36]}$$

$$(B) K_c = \frac{[(1.36) \times (0.0821)]}{[499]}$$

$$(C) K_c = \frac{[1.36]}{[(0.0821) \times (499)]}$$

$$(D) K_c = \frac{[(1.36) \times (499)]}{[0.0821]}$$

Sol. (C)



$$K_c = \frac{K_p}{(RT)^{\Delta n}} = \frac{1.36}{0.0821 \times 499}$$

74. A 55-kDa protein was acid hydrolysed to obtain a mixture of amino acids. How many amino acids could be present in the solution ?
 (A) 550 (B*) 500 (C) 1000 (D) 1100

Sol. (B)

37-kDa is equivalent to 333 unit, hence 55-kDa is equivalent to approx 500 units.

75. Which of the following phenols is most soluble in aqueous sodium bicarbonate ?
 (A) 2,4-dihydroxyacetophenone (B) p-cyanophenol
 (C) 3,4-dicyanophenol (D*) 2,4,6-tricyanophenol

Sol. (D)

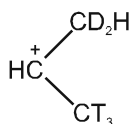
2,4,6-tricyanophenol is most acidic. It readily forms soluble sodium salt and evolves CO_2 gas.

76. 6.24 g of ethanol are vaporized by supplying 5.89 kJ of heat energy. What is the enthalpy of vaporisation of ethanol ?
 (A) 43.42 kJ (B) 47.0 kJ (C) 21.75 kJ (D) 435.0 kJ

Sol. (A)

$$\text{Enthalpy of vapourisation, } \Delta H_{\text{vap}} = \left(\frac{6.24}{46} \right) \text{ kJ/mol} = 43.42 \text{ kJ/mol}$$

77. How many hyperconjugative structures are possible in the following carbocation ?



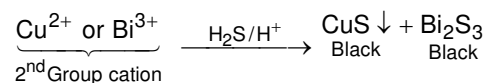
- (A) 1 (B) 3 (C) 5 (D*) 6

Sol. (D)

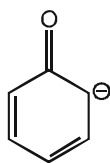
There are only 6 α [H+D+T] atoms.

78. The ions which give black precipitates on passing H_2S gas in acidic medium are
 (A) Al^{3+} and Ni^{2+} (B) Ni^{2+} and Co^{2+} (C) Cu^{2+} and Bi^{3+} (D) Zn^{2+} and Mn^{2+}

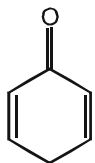
Sol. (C)



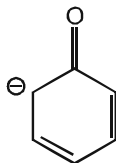
79. Which of the following is not a resonating structure for the phenoxide ion ?



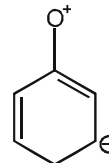
I
(A) I



II
(B) II



III
(C) III



IV
(D*) IV

Sol.

(D)

–ve charge is never delocalized on the meta position.

80. Which of the following statements is true for the reaction given below ?



- (A*) P is a meso compound 2,3-butanediol formed by syn addition.
 (B) P is a meso compound 2,3-butanediol formed by anti addition.
 (C) P is a racemic mixture of d- and l-2,3-butanediol formed by anti addition.
 (D) P is a racemic mixture of d- and l-2,3-butanediol formed by syn addition.

Sol.

(A)

cis-2-Butene undergoes hydroxylation by syn addition forming meso product.

hydrogen 1 H 1.0079	beryllium 4 Be 9.0122	lithium 3 Li 6.941	helium 2 He 4.0026
sodium 11 Na 22.990	magnesium 12 Mg 24.305	aluminum 13 Al 26.982	neon 10 Ne 20.180
potassium 19 K 39.098	calcium 20 Ca 40.078	silicon 14 Si 28.086	argon 18 Ar 39.948
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	phosphorus 15 P 30.974	krypton 36 Kr 83.80
cesium 55 Cs 132.91	barium 56 Ba 137.33	sulfur 16 S 32.065	xenon 54 Xe 131.29
francium 87 Fr [223]	radium 88 Ra [226]	chlorine 17 Cl 35.453	astatine 85 At [210]
		argon 18 Ar 39.948	
		potassium 19 K 39.098	
		calcium 20 Ca 40.078	
		scandium 21 Sc 44.956	
		titanium 22 Ti 47.887	
		vanadium 23 V 50.942	
		chromium 24 Cr 51.996	
		manganese 25 Mn 54.938	
		iron 26 Fe 55.845	
		cobalt 27 Co 58.933	
		nickel 28 Ni 58.693	
		copper 29 Cu 63.546	
		zinc 30 Zn 65.39	
		gallium 31 Ga 69.723	
		germanium 32 Ge 72.61	
		arsenic 33 As 74.922	
		selenium 34 Se 78.96	
		bromine 35 Br 79.904	
		krypton 36 Kr 83.80	
		rubidium 37 Rb 85.468	
		strontium 38 Sr 87.62	
		yttrium 39 Y 88.906	
		zirconium 40 Zr 91.224	
		niobium 41 Nb 92.906	
		molybdenum 42 Mo 95.94	
		technetium 43 Tc [98]	
		ruthenium 44 Ru 101.07	
		rhodium 45 Rh 102.91	
		cadmium 48 Cd 112.41	
		mercury 80 Hg 200.59	
		thallium 81 Tl 204.38	
		lead 82 Pb 207.2	
		bismuth 83 Bi 208.98	
		polonium 84 Po [209]	
		astatine 85 At [210]	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 Cf [251]	
		europium 99 Eu 151.96	
		gadolinium 64 Gd 157.25	
		terbium 65 Tb 158.93	
		erbium 66 Dy 162.50	
		holmium 67 Ho 164.93	
		ytterbium 70 Yb 173.04	
		lutetium 71 Lu 174.967	
		hafnium 72 Hf 178.49	
		tantalum 73 Ta 180.948	
		tungsten 74 W 183.84	
		osmium 76 Os 190.23	
		iridium 77 Ir 192.22	
		platinum 78 Pt 195.08	
		gold 79 Au 196.967	
		mercury 80 Hg 200.59	
		thallium 81 Tl 204.38	
		lead 82 Pb 207.2	
		bismuth 83 Bi 208.98	
		polonium 84 Po [209]	
		astatine 85 At [210]	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 Cf [251]	
		europium 99 Eu 151.96	
		gadolinium 64 Gd 157.25	
		terbium 65 Tb 158.93	
		erbium 66 Dy 162.50	
		holmium 67 Ho 164.93	
		ytterbium 70 Yb 173.04	
		lutetium 71 Lu 174.967	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 Cf [251]	
		europium 99 Eu 151.96	
		gadolinium 64 Gd 157.25	
		terbium 65 Tb 158.93	
		erbium 66 Dy 162.50	
		holmium 67 Ho 164.93	
		ytterbium 70 Yb 173.04	
		lutetium 71 Lu 174.967	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 Cf [251]	
		europium 99 Eu 151.96	
		gadolinium 64 Gd 157.25	
		terbium 65 Tb 158.93	
		erbium 66 Dy 162.50	
		holmium 67 Ho 164.93	
		ytterbium 70 Yb 173.04	
		lutetium 71 Lu 174.967	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 Cf [251]	
		europium 99 Eu 151.96	
		gadolinium 64 Gd 157.25	
		terbium 65 Tb 158.93	
		erbium 66 Dy 162.50	
		holmium 67 Ho 164.93	
		ytterbium 70 Yb 173.04	
		lutetium 71 Lu 174.967	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 Cf [251]	
		europium 99 Eu 151.96	
		gadolinium 64 Gd 157.25	
		terbium 65 Tb 158.93	
		erbium 66 Dy 162.50	
		holmium 67 Ho 164.93	
		ytterbium 70 Yb 173.04	
		lutetium 71 Lu 174.967	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 Cf [251]	
		europium 99 Eu 151.96	
		gadolinium 64 Gd 157.25	
		terbium 65 Tb 158.93	
		erbium 66 Dy 162.50	
		holmium 67 Ho 164.93	
		ytterbium 70 Yb 173.04	
		lutetium 71 Lu 174.967	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 Cf [251]	
		europium 99 Eu 151.96	
		gadolinium 64 Gd 157.25	
		terbium 65 Tb 158.93	
		erbium 66 Dy 162.50	
		holmium 67 Ho 164.93	
		ytterbium 70 Yb 173.04	
		lutetium 71 Lu 174.967	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 Cf [251]	
		europium 99 Eu 151.96	
		gadolinium 64 Gd 157.25	
		terbium 65 Tb 158.93	
		erbium 66 Dy 162.50	
		holmium 67 Ho 164.93	
		ytterbium 70 Yb 173.04	
		lutetium 71 Lu 174.967	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 Cf [251]	
		europium 99 Eu 151.96	
		gadolinium 64 Gd 157.25	
		terbium 65 Tb 158.93	
		erbium 66 Dy 162.50	
		holmium 67 Ho 164.93	
		ytterbium 70 Yb 173.04	
		lutetium 71 Lu 174.967	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 Cf [251]	
		europium 99 Eu 151.96	
		gadolinium 64 Gd 157.25	
		terbium 65 Tb 158.93	
		erbium 66 Dy 162.50	
		holmium 67 Ho 164.93	
		ytterbium 70 Yb 173.04	
		lutetium 71 Lu 174.967	
		thorium 90 Th 232.04	
		protactinium 91 Pa 231.04	
		uranium 92 U 238.03	
		neptunium 93 Np [237]	
		plutonium 94 Pu [244]	
		americium 95 Am [243]	
		curium 96 Cm [247]	
		berkelium 97 Bk [247]	
		californium 98 C	