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**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
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0
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7
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TWO
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ZERO
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SEVEN
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### **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			X	

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](http://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

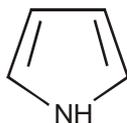
## NATIONAL STANDARD EXAMINATION IN CHEMISTRY 2013-2014

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

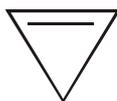
Sol. (B)

Tartaric acid has 2 identical chiral carbon and only 2 optically active stereoisomers.

2. Which of the following structure is aromatic ?



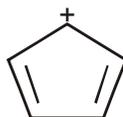
I



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)

$$\text{For XY, solubility} = \sqrt{K_{sp}} = \sqrt{10^{-9}} = 10^{-4.5}$$

This is the least value.

6. A DNA sample stored at  $4^\circ\text{C}$  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)  $\text{FeCl}_3$

(D) KCl

Sol. (B)

Anionic hydrolysis produces most basic solution  
 i.e.  $\text{CH}_3\text{COOK}$

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

(A)  $\text{NH}_3$

(B)  $\text{NF}_3$

(C)  $\text{BF}_3$

(D)  $\text{CHCl}_3$

Sol. (C)

$\text{BF}_3$  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

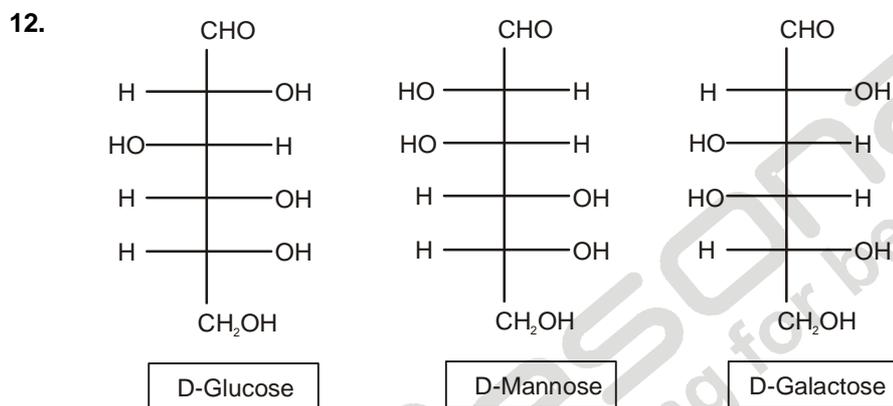
No. of neutrons in  ${}_{33}\text{As}^{77}$  is 44.

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.

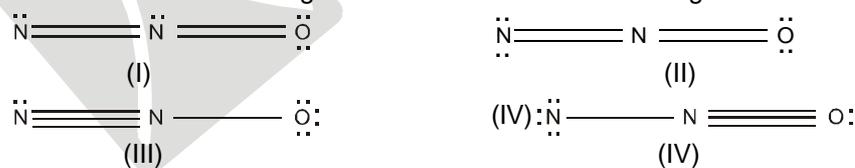


The above structures are related to each other as

- (A) identical substance (B\*) diastereomers  
 (C) enantiomers (D) epimers

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

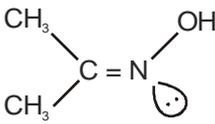
13. Which one of the following is not a valid structure for dinitrogen oxide?



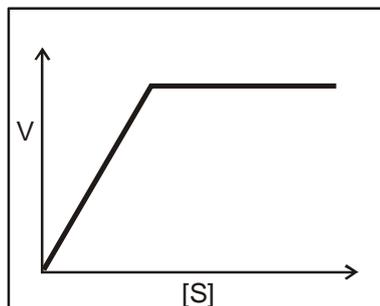
(A) I (B) II (C) III (D) IV  
**Sol. (A)**  
 I is not valid i.e. 'N' can't expand its octet

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)**  
 $\text{Cr}^{3+}$  ion is produced in solution. So green solution.

15. The gas which liberates bromine from a solution of KBr is  
 (A)  $\text{Cl}_2$  (B)  $\text{I}_2$  (C)  $\text{SO}_2$  (D) HI  
**Sol. (A)**  
 $\text{Cl}_2$  is oxidising agent.
16. The bond order of  $\text{NO}^+$  ion is  
 (A) 1 (B) 2 (C) 2.5 (D) 3  
**Sol. (D)**  
 Bond order of  $\text{NO}^+$  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  $\beta$ -D.Glucose is the monomer but for DNA the monomer is Deoxyribose sugar, nuclei acids and phosphate.
18. An enzyme working at  $\text{P}^{\text{H}}$  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  $\text{P}^{\text{H}}$  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 alpha 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 is between complementary bases.
22. Which is the strongest oxidising agent among the species given below?  
 (i)  $\text{In}^{3+}$   $E^0 = -1.34\text{V}$  (ii)  $\text{Au}^{3+}$   $E^0 = 1.40\text{V}$   
 (iii)  $\text{Hg}^{2+}$   $E^0 = 0.867\text{V}$  (iv)  $\text{Cr}^{3+}$   $E^0 = -0.786\text{V}$   
 (A)  $\text{Cr}^{3+}$  (B)  $\text{Au}^{3+}$   
 (C)  $\text{Hg}^{2+}$  (D)  $\text{In}^{3+}$   
**Sol. (B)**  
 $\text{Au}^{3+}$  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 1<sup>st</sup> order & then zero order.

24. The number of unpaired electrons in Ni<sup>2+</sup> is

- (A) 0 (B) 2 (C) 3 (D) 4

Sol. (B)

Ni<sup>2+</sup> : 3d<sup>8</sup>



No. of unpaired electron = 2

25. The colourless ion from among the following is

- (A) Mn<sup>2+</sup> (B) Cu<sup>+</sup> (C) Cr<sup>3+</sup> (D) Fe<sup>2+</sup>

Sol. (B)

Cu<sup>+</sup> (No unpaired electron)

26. The metal carbonyl which is paramagnetic is

- (A) Ni(CO)<sub>4</sub> (B) V(CO)<sub>6</sub> (C) Cr(CO)<sub>6</sub> (D) Fe(CO)<sub>5</sub>

Sol. (B)

[V(CO)<sub>6</sub>] has one unpaired electron

V : 3d<sup>3</sup> 4s<sup>2</sup> or 3d<sup>5</sup> t<sub>2g</sub><sup>2,2,1</sup>, e<sub>g</sub><sup>0,0</sup>

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\*) sp<sup>3</sup>d<sup>2</sup> hybridisation (B) d<sup>2</sup>sp<sup>3</sup> hybridisation (C) sp<sup>3</sup> hybridisation (D) sp<sup>3</sup>d 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)]<sup>+</sup> (B\*) [Fe(CNS)<sub>2</sub>]<sup>+</sup> (C) [Fe(CNS)3]<sup>-</sup> (D) [Fe(CNS)<sub>2</sub>]<sub>2</sub><sup>+</sup>

Sol. (B)

In Lassaigne's test the Fe<sup>3+</sup> form complex with CNS<sup>-</sup> 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<sub>2</sub> (B) 0.01M KNO<sub>2</sub> (C) 0.01M CH<sub>3</sub>COOH (D) 0.01M CH<sub>3</sub>COCH<sub>3</sub>

Sol. (D)  
 acetone CH<sub>3</sub>COCH<sub>3</sub> is non-electrolyte in aq. medium.

32. The reddish-brown gas formed when nitric oxide is oxidized by air is  
 (A) NO<sub>2</sub> (B) N<sub>2</sub>O<sub>4</sub> (C) N<sub>2</sub>O<sub>5</sub> (D) N<sub>2</sub>O<sub>3</sub>

Sol. (A)  
 $2\text{NO} + \text{O}_2 \longrightarrow 2\text{NO}_{2(g)}$  (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<sup>7</sup> 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 : [Xe] 4f<sup>9</sup> 6s<sup>2</sup>  
 Eu : [Xe] 4f<sup>7</sup> 6s<sup>2</sup>

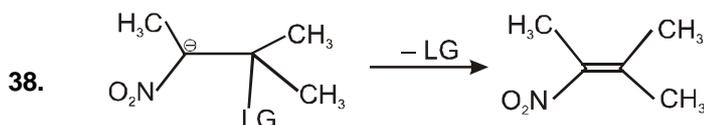
36. Which of the following reaction parameters will change due to addition of a catalyst  
 (A) Free energy (B) Only equilibrium  
 (C) Only rate constant (D) Both equilibrium constant and rate constant

Sol. (C)  
 Rate constant is increased by catalyst

37. A plot of 1/[NO<sub>2</sub>] verses time for decomposition of NO<sub>2</sub> was found to be linear. This means that the reaction

- (A) Is zero order with respect to [NO<sub>2</sub>]  
 (B) Is first order with respect to [NO<sub>2</sub>]  
 (C) Is second order with respect to [NO<sub>2</sub>]  
 (D) Order cannot be determined from the information given

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



The carbanion expels a leaving group LG to yield an alkene as shown above by

- (A\*) E<sub>1</sub>cb mechanism  
 (B) E<sub>1</sub> mechanism  
 (C) E<sub>2</sub> mechanism  
 (D) Such a reaction does not take place

Sol. (A)  
 The carbanion intermediate is formed only in E<sub>1</sub>cb mechanism.

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

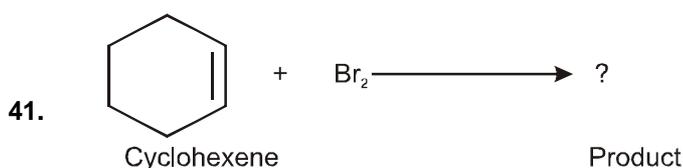
Sol. (C)

SN<sup>1</sup> reaction proceed through the formation of carbocation intermediate, which is most favored in more polar solvent.

40. Fehlings solution is
- (A) AgNO<sub>3</sub> solution + NaOH solution + NH<sub>4</sub>OH  
 (B) Alkaline solution of Cupric ion complexed with citrate ion  
 (C\*) Copper sulphate + sodium potassium tartarate + NaOH  
 (D) Copper sulphate solution

Sol. (C)

Fehlings solution is alkaline solution of CuSO<sub>4</sub> with rochell 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<sup>2+</sup> ion is 2, therefore its spin multiplicity is
- (A) 2  
 (B) 1  
 (C) 3  
 (D) 4

Sol. (C)

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

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

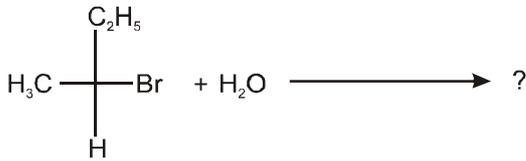
$$= 3$$

44. A cold aqueous solution of PbCl<sub>2</sub> gives golden yellow precipitate on addition of
- (A) KCl solution  
 (B) KI solution  
 (C) NaCl solution  
 (D) K<sub>2</sub>SO<sub>4</sub> solution

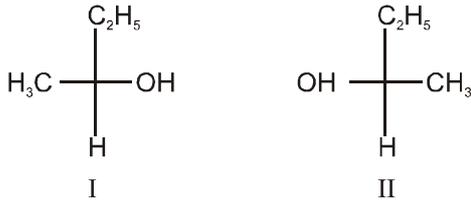
Sol. (B)



45. In the reaction given below :



the product obtained will contain :



(A) Only Compound I  
(C\*) Both compound I and II

(B) Only Compound II  
(D) this substitution cannot take place

Sol.

(C)

The given reaction is hydrolysis and it follows  $\text{S}_\text{N}1$  mechanism and both I and II are formed.

46. Acetone and propen-2-ol are

(A) enantiomers  
(C) diastereoisomers

(B\*) keto-enol tautomers  
(D) meso compounds

Sol.

(B)



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

Half life of  $^{14}\text{C}$  isotope is  $5.73 \times 10^3$  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

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

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

Sol.

(D)

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

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

$$\begin{aligned} \text{Constant} &= \left( \frac{RT}{F} \right) = \\ &= 0.0296 \end{aligned}$$

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  $127^\circ\text{C}$  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)  $\text{PhCOCH}_2\text{CN}$  (D\*)  $\text{CH}_3\text{CH}_2\text{NH}_2$

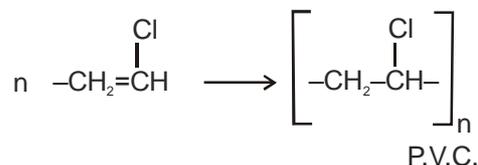
Sol. (D)

Most appropriate answer is D. In  $\text{CH}_3\text{CH}_2-\text{NH}_2$  the  $\alpha$  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\*) CO<sub>2</sub> (B) NO<sub>2</sub> (C) SO<sub>2</sub> (D) ClO<sub>2</sub>

Sol. (A)

61. In the compound Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, the oxidation state of sulphur is  
 (A) -2 (B) +2 (C) +4 (D) +6

Sol. (B)

62. The pH of 0.1 M NH<sub>4</sub>OH, (K<sub>b</sub> = 1.8 × 10<sup>-5</sup>, K<sub>w</sub> = 10<sup>-14</sup>), is  
 (A) 1.0 (B) 5.7 (C) 11.1 (D) 13.0

Sol. (C)

$$\begin{aligned}
 p^{OH} &= \frac{1}{2} [pk_b - \log C] \\
 &= \frac{1}{2} [4.76 + 1] \\
 &= \frac{5.76}{2} = 2.88 \approx 2.9 \\
 pH &= 14 - 2.9 = 11.1
 \end{aligned}$$

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 H<sub>3</sub>PO<sub>3</sub> exists ?  
 (I) NaH<sub>2</sub>PO<sub>3</sub> (II) Na<sub>2</sub>HPO<sub>3</sub> (III) Na<sub>3</sub>PO<sub>3</sub>  
 (A) I and II only (B) I, II and III (C) II and III only (D) III only

Sol. (A)

H<sub>3</sub>PO<sub>3</sub> is dibasic so  
 NaH<sub>2</sub>PO<sub>3</sub> & Na<sub>2</sub>HPO<sub>3</sub> 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)  
 Salicylaldehyde 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 it 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  $\text{CaCl}_2$  (B) 0.01 M  $\text{KNO}_2$   
 (C) 0.01 M  $\text{CH}_3\text{COOH}$  (D) 0.01 M  $\text{CH}_3\text{COCH}_3$

Sol. (B)  
 $\text{KNO}_2$  [WASB]

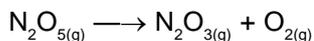
71. The minimum number of  $\text{H}^+$  ions that can be released by an amino acid is  
 (A\*) 1 (B) 2 (C) 3 (D) 4

Sol. (A)

72. Which of the following molecular structures is NOT possible ?  
 (A)  $\text{OF}_2$  (B)  $\text{SF}_2$  (C)  $\text{OF}_4$  (D)  $\text{SF}_4$

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  $\text{CO}_2$  gas.

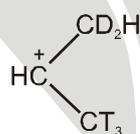
76. 6.24 g of ethanol are vaporized by supplying 5.89 kJ of heat energy. What is the enthalpy of vapourisation of ethanol ?

(A) 43.42 kJ (B) 47.0 kJ (C) 21.75 kJ (D) 435.0 kJ

Sol. (A)

$$\text{Enthalpy of vapourisation, } \Delta H_{\text{vap}} = \left( \frac{5.89}{\frac{6.24}{46}} \right) \text{ kJ/mol} = 43.42 \text{ kJ/mol}$$

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



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

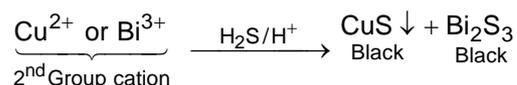
Sol. (D)

There are only 6  $\alpha$  [H+D+T] atoms.

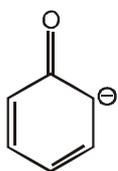
78. The ions which give black precipitates on passing  $\text{H}_2\text{S}$  gas in acidic medium are

(A)  $\text{Al}^{3+}$  and  $\text{Ni}^{2+}$  (B)  $\text{Ni}^{2+}$  and  $\text{Co}^{2+}$  (C)  $\text{Cu}^{2+}$  and  $\text{Bi}^{3+}$  (D)  $\text{Zn}^{2+}$  and  $\text{Mn}^{2+}$

Sol. (C)

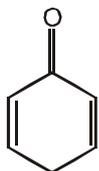


79. Which of the following is not a resonating structure for the phenoxide ion ?



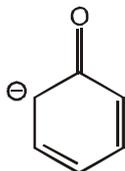
I

(A) I



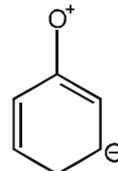
II

(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	beryllium 4 Be	lithium 3 Li	boron 5 B	carbon 6 C	nitrogen 7 N	oxygen 8 O	fluorine 9 F	helium 2 He
22.990 Na	24.305 Mg	6.941 Li	10.811 Al	12.011 Si	14.007 P	15.999 S	18.998 Cl	39.948 Ar
39.098 K	40.078 Ca	39.098 Rb	39.098 Yttrium	39.098 Zr	39.098 Nb	39.098 Mo	39.098 Tc	39.098 Ru
85.468 Cs	87.62 Ba	85.468 Fr	85.468 Lu	85.468 Hf	85.468 Ta	85.468 W	85.468 Re	85.468 Os
132.91 Fr	137.33 Ra	132.91 Ac	132.91 La	132.91 Ce	132.91 Pr	132.91 Nd	132.91 Pm	132.91 Sm
174.97 Lu	174.97 Lr	174.97 Ac	174.97 La	174.97 Ce	174.97 Pr	174.97 Nd	174.97 Pm	174.97 Sm
178.49 Lu	178.49 Lr	178.49 Ac	178.49 La	178.49 Ce	178.49 Pr	178.49 Nd	178.49 Pm	178.49 Sm
180.55 Lu	180.55 Lr	180.55 Ac	180.55 La	180.55 Ce	180.55 Pr	180.55 Nd	180.55 Pm	180.55 Sm
183.84 Lu	183.84 Lr	183.84 Ac	183.84 La	183.84 Ce	183.84 Pr	183.84 Nd	183.84 Pm	183.84 Sm
186.21 Lu	186.21 Lr	186.21 Ac	186.21 La	186.21 Ce	186.21 Pr	186.21 Nd	186.21 Pm	186.21 Sm
187.75 Lu	187.75 Lr	187.75 Ac	187.75 La	187.75 Ce	187.75 Pr	187.75 Nd	187.75 Pm	187.75 Sm
188.906 Lu	188.906 Lr	188.906 Ac	188.906 La	188.906 Ce	188.906 Pr	188.906 Nd	188.906 Pm	188.906 Sm
190.23 Lu	190.23 Lr	190.23 Ac	190.23 La	190.23 Ce	190.23 Pr	190.23 Nd	190.23 Pm	190.23 Sm
192.22 Lu	192.22 Lr	192.22 Ac	192.22 La	192.22 Ce	192.22 Pr	192.22 Nd	192.22 Pm	192.22 Sm
195.08 Lu	195.08 Lr	195.08 Ac	195.08 La	195.08 Ce	195.08 Pr	195.08 Nd	195.08 Pm	195.08 Sm
196.97 Lu	196.97 Lr	196.97 Ac	196.97 La	196.97 Ce	196.97 Pr	196.97 Nd	196.97 Pm	196.97 Sm
200.59 Lu	200.59 Lr	200.59 Ac	200.59 La	200.59 Ce	200.59 Pr	200.59 Nd	200.59 Pm	200.59 Sm
204.39 Lu	204.39 Lr	204.39 Ac	204.39 La	204.39 Ce	204.39 Pr	204.39 Nd	204.39 Pm	204.39 Sm
207.2 Lu	207.2 Lr	207.2 Ac	207.2 La	207.2 Ce	207.2 Pr	207.2 Nd	207.2 Pm	207.2 Sm
208.98 Lu	208.98 Lr	208.98 Ac	208.98 La	208.98 Ce	208.98 Pr	208.98 Nd	208.98 Pm	208.98 Sm
210 Lu	210 Lr	210 Ac	210 La	210 Ce	210 Pr	210 Nd	210 Pm	210 Sm
212 Lu	212 Lr	212 Ac	212 La	212 Ce	212 Pr	212 Nd	212 Pm	212 Sm
214 Lu	214 Lr	214 Ac	214 La	214 Ce	214 Pr	214 Nd	214 Pm	214 Sm
216 Lu	216 Lr	216 Ac	216 La	216 Ce	216 Pr	216 Nd	216 Pm	216 Sm
218 Lu	218 Lr	218 Ac	218 La	218 Ce	218 Pr	218 Nd	218 Pm	218 Sm
220 Lu	220 Lr	220 Ac	220 La	220 Ce	220 Pr	220 Nd	220 Pm	220 Sm
222 Lu	222 Lr	222 Ac	222 La	222 Ce	222 Pr	222 Nd	222 Pm	222 Sm
224 Lu	224 Lr	224 Ac	224 La	224 Ce	224 Pr	224 Nd	224 Pm	224 Sm
226 Lu	226 Lr	226 Ac	226 La	226 Ce	226 Pr	226 Nd	226 Pm	226 Sm
228 Lu	228 Lr	228 Ac	228 La	228 Ce	228 Pr	228 Nd	228 Pm	228 Sm
230 Lu	230 Lr	230 Ac	230 La	230 Ce	230 Pr	230 Nd	230 Pm	230 Sm
232 Lu	232 Lr	232 Ac	232 La	232 Ce	232 Pr	232 Nd	232 Pm	232 Sm
234 Lu	234 Lr	234 Ac	234 La	234 Ce	234 Pr	234 Nd	234 Pm	234 Sm
236 Lu	236 Lr	236 Ac	236 La	236 Ce	236 Pr	236 Nd	236 Pm	236 Sm
238 Lu	238 Lr	238 Ac	238 La	238 Ce	238 Pr	238 Nd	238 Pm	238 Sm
240 Lu	240 Lr	240 Ac	240 La	240 Ce	240 Pr	240 Nd	240 Pm	240 Sm
242 Lu	242 Lr	242 Ac	242 La	242 Ce	242 Pr	242 Nd	242 Pm	242 Sm
244 Lu	244 Lr	244 Ac	244 La	244 Ce	244 Pr	244 Nd	244 Pm	244 Sm
246 Lu	246 Lr	246 Ac	246 La	246 Ce	246 Pr	246 Nd	246 Pm	246 Sm
248 Lu	248 Lr	248 Ac	248 La	248 Ce	248 Pr	248 Nd	248 Pm	248 Sm
250 Lu	250 Lr	250 Ac	250 La	250 Ce	250 Pr	250 Nd	250 Pm	250 Sm
252 Lu	252 Lr	252 Ac	252 La	252 Ce	252 Pr	252 Nd	252 Pm	252 Sm
254 Lu	254 Lr	254 Ac	254 La	254 Ce	254 Pr	254 Nd	254 Pm	254 Sm
256 Lu	256 Lr	256 Ac	256 La	256 Ce	256 Pr	256 Nd	256 Pm	256 Sm
258 Lu	258 Lr	258 Ac	258 La	258 Ce	258 Pr	258 Nd	258 Pm	258 Sm
260 Lu	260 Lr	260 Ac	260 La	260 Ce	260 Pr	260 Nd	260 Pm	260 Sm
262 Lu	262 Lr	262 Ac	262 La	262 Ce	262 Pr	262 Nd	262 Pm	262 Sm
264 Lu	264 Lr	264 Ac	264 La	264 Ce	264 Pr	264 Nd	264 Pm	264 Sm
266 Lu	266 Lr	266 Ac	266 La	266 Ce	266 Pr	266 Nd	266 Pm	266 Sm
268 Lu	268 Lr	268 Ac	268 La	268 Ce	268 Pr	268 Nd	268 Pm	268 Sm
270 Lu	270 Lr	270 Ac	270 La	270 Ce	270 Pr	270 Nd	270 Pm	270 Sm
272 Lu	272 Lr	272 Ac	272 La	272 Ce	272 Pr	272 Nd	272 Pm	272 Sm
274 Lu	274 Lr	274 Ac	274 La	274 Ce	274 Pr	274 Nd	274 Pm	274 Sm
276 Lu	276 Lr	276 Ac	276 La	276 Ce	276 Pr	276 Nd	276 Pm	276 Sm
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280 Lu	280 Lr	280 Ac	280 La	280 Ce	280 Pr	280 Nd	280 Pm	280 Sm
282 Lu	282 Lr	282 Ac	282 La	282 Ce	282 Pr	282 Nd	282 Pm	282 Sm
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310 Lu	310 Lr	310 Ac	310 La	310 Ce	310 Pr	310 Nd	310 Pm	310 Sm
312 Lu	312 Lr	312 Ac	312 La	312 Ce	312 Pr	312 Nd	312 Pm	312 Sm
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316 Lu	316 Lr	316 Ac	316 La	316 Ce	316 Pr	316 Nd	316 Pm	316 Sm
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