AIEEE Solved Paper - 2011

Chemistry

CODE P

INSTRUCTIONS

1. Immediately fill in the particulars on this page of the Test Booklet with Blue/Block Ball Point Pen, Use of pencil is strictly prohibited.
2. The answer Sheet is kept inside this Test Booklet. When you are directed to pen the Test Booklet, take out the Answer Sheet and fill in the particulars carefully.
3. The test is of **3 hours** duration.
4. The Test Booklet consists of **90** questions. The maximum marks are **360**.
5. There are **three** parts in the question paper A, B, C consisting of **Chemistry, Physics** and **Mathematics** having 30 questions in each part of equal weight age. Each question is allotted 4 (four) marks for each correct response.
6. *Candidates will be awarded marks as stated above in instruction No. 5 for correct response of each question ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
7. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 6 above.
8. Use Blue/Black Ball Point Pen only for writing particulars/marking responses on **Side–1** and **Side–2** of the Answer Sheet. **Use of pencil is strictly prohibited.**
9. No candidate is allowed to carry any textual material, printed to written, bits of papers, pager, mobile phone, any electronic device, etc., except the Admit Card inside the examination hall/room.
10. Rough work is to be done on the space provided for this purpose in the Test Booklet only. This space is given at the bottom of each page and in 3 pages (Page 21 – 23) at the end of the booklet.
11. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.
12. The CODE for this Booklet is P. Make sure that the CODE printed on Side–2 of the Answer Sheet is the same as that on this booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the answer sheet.
13. **Do not fold or make any stray marks on the Answer Sheet.**
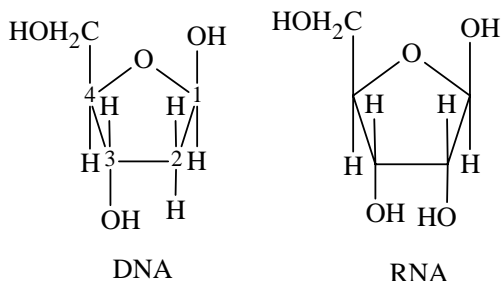
CHEMISTRY

1. The presence or absence of hydroxyl group on which carbon atom of sugar differentiates RNA and DNA?
   (1) 1st (2) 2nd
   (3) 3rd (4) 4th

Key: (2)

Sol.:

DNA   RNA

2nd carbon in DNA do not have OH group.

2. Among the following the maximum covalent character is shown by the compound
   (1) $FeCl_2$ (2) $SnCl_2$
   (3) $AlCl_3$ (4) $MgCl_2$

Key: (3)

Sol.: Higher the positive oxidation state higher will be the covalent character.

3. Which of the following statement is wrong?
   (1) The stability of hydride increases from NH_3 to BiH_3 in group 15 of the periodic table.
   (2) Nitrogen cannot from $d\pi$ - $p\pi$ bond.
   (3) Single N – N bond is weaker than the single P – P bond.
   (4) N_2O_4 has two resonance structures.

Key: (1)

Sol.: As we move down the group, tendency to from covalent bond with small H decreases hence M-H bond enthalpy decreases.

4. Phenol is heated with a solution of mixture of KBr and $KBrO_3$. The major product obtained in the above reaction is :
   (1) 2-Bromophenol
   (2) 3-Bromophenol
   (3) 4-Bromophenol
   (4) 2, 4, 6-Tribromophenol

Key: (4)

Sol.: $5K Br + KBrO_3 + 3H_2O \rightarrow 3Br_2 + 6KOH$
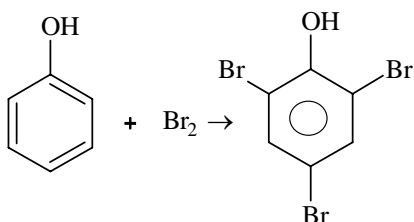
5. A 5.2 molal aqueous solution of methyl alcohol, CH_3OH, is supplied. What is the mole fraction of methyl alcohol in the solution?

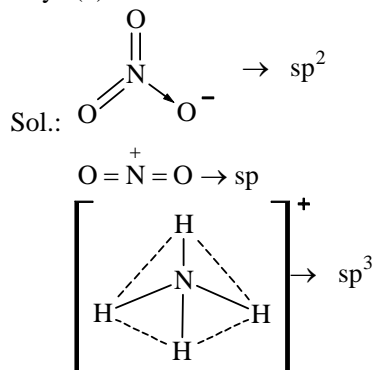(1) 0.100   (2) 0.190
(3) 0.086   (4)` 0.050

Key: (3)

Sol.: 5.2 mole of CH_3OH in 1000 gram water i.e. in $\dfrac{1000}{18}$ mole H_2O mole fraction of CH_3OH =

$$\dfrac{5.2}{5.2 + \dfrac{1000}{18}} = 0.086 .$$

6. The hybridization of orbitals of N atom in NO_3^-, NO_2^+ and NH_4^+ are respectively :

(1) sp, sp^2, sp^3 (2) sp^2, sp, sp^3
(3) sp, sp^3, sp^2 (4) sp^2, sp^3, sp

Key: (2)

Sol.:

$\rightarrow sp^2$

$O = \overset{+}{N} = O \rightarrow sp$

$\rightarrow sp^3$

7. Ethylene glycol is used as an antifreeze in a cold climate. Mass of ethylene glycol which should be added to 4 kg of water to prevent it from freezing at –6°C will be : (K_f for water = 1.86 K kg mol^{-1}, and molar mass of ethylene glycol = 62 g mol^{-1})

(1) 804.32 g   (2) 204.30 g
(3) 400.00 g   (4) 304.60 g

Key: (1)

Sol.: $\Delta T_f = kf.m = 0 - (- 6) = 1.86$ m

$m = \dfrac{6}{1.86}$ i.e., $= \dfrac{6}{1.86}$ mole in 1 kg.

There for $\dfrac{6}{1.86} \times 4$ mole in 4 kg.

$Wt = \dfrac{6}{1.86} \times 4 \times 62 = 804.32$ gram.

8. The reduction potential of hydrogen half-cell will be negative if :

(1) $p(H_2) = 1$ atom and $[H^+] = 2.0$ M
(2) $p(H_2) = 1$ atm and $[H^+] = 1.0$ M
(3) $p(H_2) = 2$ atm and $[H^+] = 1.0$ M
(4) $p(H_2) = 2$ atm and $[H^+] = 2.0$ M

Key: (3)

Sol.: $2H^+ + 2e^- \longrightarrow H_2 \,(g)$

$$E_{H^+/H_2} = E^\circ_{H^+/H_2} - \dfrac{0.0059}{2} \log \dfrac{P_{H_2}}{|H^+|^2}$$

$$= 0 - \dfrac{0.59}{2} \log \dfrac{P_{H_2}}{|H^+|^2}$$

For the negative value of E_{H^+/H_2}

By $\dfrac{P_{H_2}}{\left[H^+\right]^2}$ should be +ve i.e $P_{H_2} > |H^+|$

9. Which of the following reagents may be used to distinguish between phenol and benzoic acid?

(1) Aqueous NaOH   (2) Tollen's reagent
(3) Molisch reagent   (4) Neutral $FeCl_3$

Key: (4)

Sol.: $FeCl_3$ forms violet complex with phenol whereas it forms buff coloured ppt with Benzoic Acid.

10. Trichloroacetaldehyde was subjected to Cannizzaro's reaction by using NaOH. The mixture of the products contains sodium trichloroacetate and another compound. The other compound is :

(1) 2, 2, 2-Trichloroethanol
(2) Trichloromethanol
(3) 2, 2, 2-Trichloropropanol
(4) Chloroform

Key: (1)

Sol.:
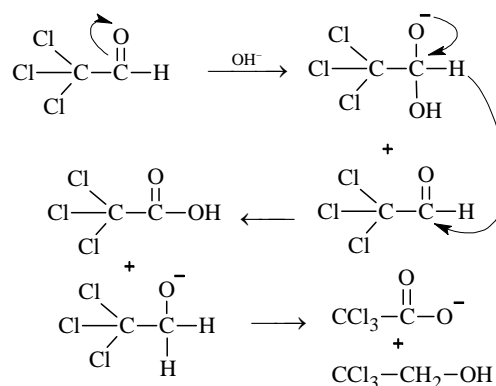
11. Which one of the following orders presents the correct sequence of the increasing basic nature of the given oxides?

(1) $Al_2O_3 < MgO < Na_2O < K_2O$

(2) $MgO < K_2O < Al_2O_3 < Na_2O$
(3) $Na_2O < K_2O < MgO < Al_2O_3$
(4) $K_2O < Na_2O < Al_2O_3 < MgO$

Key: (1)

Sol.: Metallic property increases down the group and decreases across a period when moved from left to right.

12. A gas absorbs a photon of 355 nm and emits at two wavelengths. If one of the emissions is at 680 nm, the other is at:
(1) 1035 nm   (2) 325 nm
(3) 743 nm   (4) 518 nm

Key: (3)

Sol.: Energy of absorbed photon = Sum of the energies of emitted photons

$$\frac{hc}{355 \times 10^{-9}} = \frac{hc}{680 \times 10^{-9}} + \frac{hc}{x}$$

$\Rightarrow$ $x = 742.77 \times 10^{-9}$ m i.e. 743 nm.

13. Which of the following statements regarding sulphur is incorrect?
(1) S_2 molecule is paramagnetic.
(2) The vapour at 200°C consists mostly of S_8 rings.
(3) At 600°C the gas mainly consists of S_2 molecules.
(4) The oxidation state of sulphur is never less than +4 in its compounds.

Key: (4)

Sol.: Oxidation state of sulphur ranges between –2 to +6 in different compounds.

14. The entropy change involved in the isothermal reversible expansion of 2 mole of an ideal gas from a volume of 10 dm^3 to a volume of 100 dm^3 at 27°C is:
(1) 38.3 J mol^{-1} K^{-1} (2) 35.8 J mol^{-1} K^{-1}
(2) 32.3 J mol^{-1} K^{-1} (4) 42.3 J mol^{-1} K^{-1}

Key: (1)

Sol.: $\Delta s = 2.303 nR \log \dfrac{v_f}{v_i}$

$= 2.303 \times 2 \times 8.314 \log \dfrac{100}{10}$

$= 38.294 \approx 38.3 \text{ J mol}^{-1}\text{K}^{-1}$.

15. Which of the following facts about the complex $[Cr(NH_3)_6]Cl_3$ is wrong?
(1) The complex involves d^2sp^3 hybridisation and is octahedral in shape.
(2) The complex is paramagnetic.
(3) The complex is an outer orbital complex
(4) The complex gives white precipitate with silver nitrate solution.
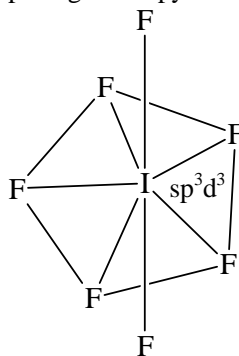
Key: (3)

Sol.: It is an inner orbital complex as the d-orbital involved in hybridization belongs to penultimate shell.

16. The structure of IF_7 is
(1) square pyramid
(2) trigonal bipyramid
(3) octahedral
(4) pentagonal bipyramid

Key: (4)

Sol.: pentagonal bipyramidal shape.

17. The rate of a chemical reaction doubles for every 10°C rise of temperature. If the temperature is raised by 50°C, the rate of the reaction increases by about :
(1) 10 times   (2) 24 times
(3) 32 times   (4) 64 times

Key: (3)

Sol.: rate of reactions increases by
(temp. coef.)$^{\text{no. of interval of 10ºC}}$
$= 2^5 = 32$ times.

18. The strongest acid amongst the following compounds is :
(1) CH_3COOH
(2) $HCOOH$
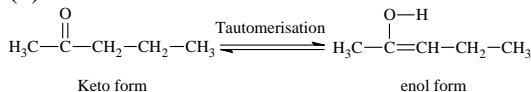(3) $CH_3CH_2CH(Cl)CO_2H$
(4) $ClCH_2CH_2CH_2COOH$

Key: (3)

Sol.: Presence of one –I effect chlorine at α-carbon increases the acid strength significantly.
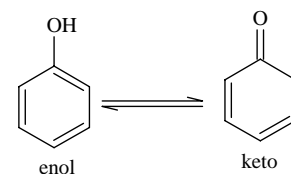
19. Identify the compound that exhibits tautomerism :
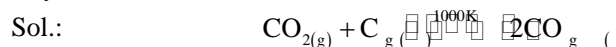(1) 2-butene   (2) Lactic acid
(3) 2-Pentanone   (4) Phenol

Key: (3)

Sol.:

4

20. A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted into CO on the addition of graphite. If the total pressure at equilibrium is 0.8 atm, the value of K is :
   (1) 1.8 atm   (2) 3 atm
   (3) 0.3 atm   (4) 0.18 atm

Key: (1)

Sol.:
$$CO_{2(g)} + C_{g\,(s)} \xrightarrow{1000K} 2CO_{g\,(}$$

   initial pressure   0.5 atm   0
   final pressure   (0.5–x) atm   2x atm
   total pressure at equil = $p_{CO_2} + p_{CO}$

   $\qquad$ =(0.5 – x) + 2x = 0.8 atm (Given)
   $\Rightarrow$ x = 0.3 atm.

   $\therefore$ Equil const $K_p = \dfrac{(p_{CO})^2}{p_{CO_2}}$

   $\qquad = \dfrac{(0.6)^2}{0.2} = 1.8$ atm.

21. In context of the lanthanoids, which of the following statements is not correct?
   (1) There is a gradual decrease in the radii of the members with increasing atomic number in the series.
   (2) All the members exhibit +3 oxidation state.
   (3) Because of similar properties the separation of lanthanoids is not easy.
   (4) Availability of 4f electrons results in the formation of compounds in +4 state for all the members of the series.

Key: (4)

Sol.: Lanthanoids exhibit +3 oxidation sate without an exception.

22. 'a' and 'b' are van der Waals' constants for gases. Chlorine is more easily liquefied than ethane because
   (1) a and b for $Cl_2 >$ a and b for C_2H_6
   (2) a and b for $Cl_2 <$ a and b for C_2H_6
   (3) a for $Cl_2 <$ a for C_2H_6 but b for $Cl_2 >$ b for C_2H_6
   (4) a for $Cl_2 >$ a for C_2H_6 but b for $Cl_2 <$ b for C_2H_6

Key: (4)

Sol.: Compressible gases have greater force of attraction and hence value of 'a' should be greater and reduced volume 'b' should be less.

23. The magnetic moment (spin only) of $[NiCl_4]^{2-}$ is :
   (1) 1.82 BM   (2) 5.46 BM
   (3) 2.82 BM   (4) 1.41 BM

Key: (3)

Sol.: Cl^- is a weak field ligand and therefore d^8 ion will have two unpaired electron.
   $\mu = \sqrt{n(n+2)}$ $\sqrt{2\;4}$ $= \sqrt{8} = 2.82$ B.M.

24. In a face centred cubic lattice, atom A occupies the corner positions and atom B occupies the face centre positions. If one atom of B is missing from one of the face centred points, the formula of the compound is :
   (1) A_2B (2) AB_2
   (3) A_2B_3 (4) A_2B_5

Key: (4)

Sol.: No. of atoms in the corners (A) = $8 \times \dfrac{1}{8} = 1$

   No. of atom at face centres (B) = $5 \times \dfrac{1}{2} = 2.5$

   Formula $AB_{2.5}$ i.e. A_2B_5

25. The outer electron configuration of Gd (Atomic No. : 64) is :
   (1) $4f^3\, 5d^5\, 6s^2$ (2) $4f^8\, 5d^0\, 6s^2$
   (3) $4f^4\, 5d^4\, 6s^2$ (4) $4f^7\, 5d^1\, 6s^2$

Key: (4)

Sol.: The configuration is $4f^7\, 5d^1\, 6s^2$.

26. Boron cannot form which one of the following anions?
   (1) BF_6^{3-} (2) BH_4^-
   (3) $B(OH)_4^-$ (4) BO_2^-

Key: (1)

Sol.: Boron's maximum covalency is 4.

27. Ozonolysis of an organic compound gives formaldehyde as one of the products. This confirms the presence of :
   (1) two ethylenic double bonds
   (2) a vinyl group
   (3) an isopropyl group
   (4) an actylenic triple bond
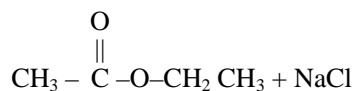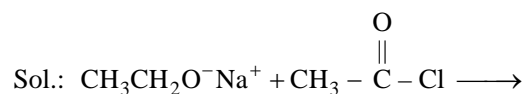
Key: (2)

Sol.: Compound must have $-C = CH_2$ group in order to give formaldehyde as one of the products.

28. Sodium ethoxide has reacted with ethanoyl chloride. The compound that is produced in the above reaction is :
   (1) Diethyl ether
   (2) 2-Butanone
   (3) Ethyl chloride
   (4) Ethyl ethanoate

Key: (4)

Sol.: $CH_3CH_2O^- Na^+ + CH_3 - \overset{\overset{\displaystyle O}{\displaystyle \|}}{C} - Cl \longrightarrow$

$CH_3 - \overset{\overset{\displaystyle O}{\displaystyle \|}}{C} - O - CH_2 \, CH_3 + NaCl$

Nucleophilic acyl substitution.

29. The degree of dissociation (α) of a weak electrolyte, A_xB_y is related to van't Hoff factor (i) by the expression
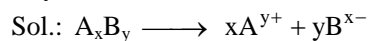
    (1) $\alpha = \dfrac{i-1}{(x+y-1)}$

    (2) $\alpha = \dfrac{i-1}{x+y+1}$

    (3) $\alpha = \dfrac{x+y-1}{i-1}$

    (4) $\alpha = \dfrac{x+y+1}{i-1}$

Key: (1)

Sol.: $A_xB_y \longrightarrow xA^{y+} + yB^{x-}$

$\quad 1-\alpha \qquad\quad x\alpha \qquad y\alpha$

Van't Hoff factor 'i' = 1 - α + xα + yα

$\therefore \quad \alpha = \dfrac{i-1}{(x+y-1)}$

30. Silver Mirror test is given by which one of the following compounds?

    (1) Acetaldehyde   (2) Acetone

    (3) Formaldehyde   (4) Benzophenone

Key: (1) or (3)

Sol.: $R - CHO + Ag(NH_3)_2^+ + OH^- \rightarrow$

$\qquad\qquad\qquad RCOO^- + Ag + NH_4^+ .$