Answer Key
Exam – S.Y.B.Sc. Sem IV CBCS April 2019
Subject – Chemistry Paper II
Exam Date – 27.04.2019
Q.P. code - 65416

1. (A)   Select the correct option and complete the following sentences. (any **twelve**)   **12**

(i)   There are _____ crystal system and _____ Bravais lattices.
(a) **7 ,14**   (b) 14,7   (c) 7,7

(ii)   The total number of effective atoms in body centered cubic system is ____.
(a) 4   **(b) 2**   (c) 3

(iii)   A _____ accelerates a reaction by decreasing the energy of activation of the reaction.
(a) **catalyst**   (b) inhibitor   (c) pressure

(iv)   The enzyme which can catalyse the conversion of _____ into glucose is maltase.
(a) **maltose**   (b) invertase   (c) zymase

(v)   The _____ equation for diffraction of X-rays is $n\lambda= 2d\sin\theta$.
(a) **Bragg's**   (b) Plank's   (c) de-Broglie

(vi)   The total number of effective atoms in _____ system is 2.
(a) face centred cubic   (b) **bodycentred cubic**   (c) simple cubic.

(vii)   pKa range for strongly acidic cation is in between **(c) -4 to 1**.
(a) 1 to 6   (b) 6 to 11.5   (c) -4 to 1

(viii)   The cation is strongly acidic if z^2/r is in between **(a) 0.1 to 0.16**.
(a) 0.1 to 0.16   (b) 0.01 to 0.04   (c) 0.04 to 0.1

(ix)   Pure phosphoric acid is **(c) white** crystalline solid.
(a) yellowish   (b) greyish   (c) white

(x)   **(a) H_2SO_4** acid is responsible for acid rain.
(a) H_2SO_4 (b) HCl   (c) CH_3COOH

(xi)   pKa values are greater than 14 for **(a) non acidic** cation.
(a) non acidic   (b) weakly acidic   (c) feebly acidic

(xii)   **(b) H_2SO_4** is called king of chemicals.
(a) HNO_3 (b) H_2SO_4 (c) H_3PO_4

(xiii)   Two moles of _____ diketone are required in Hantzsch synthesis of pyridine.
(a) 1,3-   (b) 1,4-   (c) 1,5-

(xiv)   Electrophilic substitution reaction in furan takes place at position _____ .
(a) **2 and 5**   (b) 3 and 5   (c) 3

(xv)   Sulphonation of furan can be carried out by action of ____ .
(a) H_2SO_4 *(b) SO₃ and pyridine*   (c) oleum

(xvi)   Benzene diazonium chloride when reduced with $NaHSO_3$ gives **phenyl hydrazine.**
(a) phenyl hydrazine   (b) phenyl hydrazone   (c) hydrazobenzene

(xvii) Nitration of aniline mainly gives **p- and m-nitroaniline** as major products.
      (a) o- and p-nitroaniline   (b) m- and o-nitroaniline   (c) p- and m-nitroaniline

(xviii) Reaction of aniline with bromine water at room temperature gives **2,4,6-tribromoaniline**.
      (a) 2- bromoaniline   (b) 4-bromoaniline   (c) 2,4,6-tribromoaniline

(B) State whether the following statements are true or false. (any **three**)   **3**
  (i) As temperature increases the rate of reaction decreases and the energy of activation increases.- **FALSE**
  (ii) Sodium chloride crystallises in the face centred cubic lattice form. - **TRUE**
  (iii) Hydrolysis of hydrated cation renders the solution basic. - **FALSE**
  (iv) Phosphoric acid is a mineral acid.   - **TRUE**
  (v) Friedel - Crafts reaction of the furan can be carried out by using $AlCl_3$. - **FALSE**
  (vi) Pyrrolidine is a stronger base than pyrrole. - **TRUE**

(C) Match the column. (any **five**)   **5**

(i)	Inhibitor - **i**	(a)	Zn^{2+}
(ii)	Promoter - **d**	(b)	Al^{3+}
(iii)	Weakly acidic cation - **a**	(c)	$K_b = 54 \times 10^{-5}$
(iv)	Moderately acidic cation - **b**	(d)	Increases activity of catalyst
(v)	Dimethyl amine -**c**	(e)	Ba^{2+}
(vi)	Aniline - **g**	(f)	Face centred cubic
		(g)	$K_b = 3.8 \times 10^{-10}$
		(h)	$K_b = 37 \times 10^{-5}$
		(i)	Retards rate of reaction

2. Attempt any **four** of the following.   **20**
  (A) What are (100), (110) and (111) planes for the body-centred cube?
      i) **Drawing and explanation of (100) plane-1.5 marks**
      ii) **Drawing and explanation of (110) plane-1.5 marks**
      iii) **Drawing and explanation of (111) plane-1.5 marks**
      iv) **All correct- 0.5 marks**

  (B) How are X-rays used to determine the interplanar distances in cubic crystals?
      i) **Diagram with explanation of X-ray spectrometer -02 marks**
      ii) **Determine the interplanar distances in cubic crystals -03 marks**

  (C) Derive Michalis-Menten equation for enzyme catalysis.
      i) **Reaction with differential equation – 01 mark**
      ii) **Steady state approximation -01 mark**
      iii) **Concentration of free enzyme- 01 mark**
      iv) **Michalies-Menten equation -01 mark**
      v) **Case i and ii – 01 mark**

(D) Explain characteristic features of a catalysis.
   i)   **Catalyst lowers the energy of activation -01 mark**
   ii)   **The catalyst does not change either the position or the magnitude of the equilibrium constant-01 mark**
   iii) **A catalyst remains unchanged in mass and chemical composition at the end of the reaction-01 mark**
   iv)   **A small quantity of catalyst is sufficient -01 mark**
   v)   **The catalyst does not initiate the reaction-01 mark**

(E) An inorganic salt of molecular weight 74.36 and density $1.874 \times 10^3 Kg.m^{-3}$ crystallises in a form like NaCl. Calculate the length of the edge of the unit cell if Avogadro's number is 6.023×10^{23} molecules mol^{-1}.
   i)   **Given terms-0.5 mark**
   ii)   **Formula -0.5 mark**
   iii) **Correct value substitution -01 mark**
   iv)   **Calculation of 2d100 value -02 marks**
   v)   **Correct answer with unit – 01 mark**

(F) Explain the kinetics of acid-base catalysis.
   i)   **Acid-Base catalysis explanation – 03 marks**
   ii)   **Two examples – 02 marks.**

3. Attempt any **four** of the following.   **20**
   (A) Explain the process of hydration of cation with suitable diagram. How can cation render acidity to the solution?
      (i)   **Diagram of hydration and or diagram to furnish H^+ - 1 mark**
      (ii)   **Reason for H^+ furnishment – 1 mark**
      (iii) **General Chemical equation - 1 mark**
      (iv)   **Explanation of diagram and equation – 1 mark**
      (v)   **Example – 1 mark**
   (B) Explain the relationship between pK_a, acidity and Z^2/r ratio of monoatomic cations by means of graphical presentation.
      (i)   **Plot – 2 mark**
      (ii)   **Different types – 3 mark**
   (C) With the help of predominance diagrams explain non acidic cations and feebly acidic cations with suitable examples.
      (i)   **Example – ½ mark**
      (ii)   **Predominance diagram – 1 mark**
      (iii) **Explanation – 1 mark**
             For each type viz. – non acidic cations and feebly acidic cations
   (D) Write Latimer equation to calculate hydration energy of anion and explain the terms involved in it. Using this equation, calculate ΔH_{hyd} for F^- ion. (Given radius of F^- ion is 119pm.)
      (i)   **Latimer equation – 1 mark**
      (ii)   **Terms   - 1 mark**

(iii)   **Substitution   - 1 mark**
        (iv)   **Calculation and answer with unit - - 479kJ/mol   - 2 mark**
   (E)   Write physical properties of sulphuric acid.
         Five physical properties – 1 mark each
   (F)   Write a note on uses of phosphoric acid.
         Five uses – 1 mark each

4. Attempt any **four** of the following.
    (A)   (i) Give the preparation of a) 2-chlorothiophene, b) 2-nitrothiophene and   **3**
               c) thiophene-2-sulphonic acid from thiophene.
                Conditions in preparation – 1 mark each
          (ii) Discuss aromaticity of furan.   **2**
               Huckel's Rule – 1 mark,
               Explanation (furan satisfy Huckel's Rule)– 1 mark
    (B)   (i) Explain Chichibabin reaction of pyridine.   **3**
               Reaction – 2 mark, **Description - 1mark**
          (ii) Give the carbylamine reaction of primary amines.   **2**
               Description 1mk, reaction 1mk
    (C)   (i) 'Pyridine gives nucleophilic substitution at 2,4 and 6 positions'. Explain. **3**
               Resonance structure of Pyridine – 1 mark, Description -2 mark
          (ii) How is primary amine obtained by reductive amination of aldehyde and   **2**
               ketone?
               Reaction of Aldehyde with NH_3 , H_2/Ni   1mk
               Reaction of ketone with NH_3 , H_2/Ni   1mk
    (D)   (i) Write a note on Hofmann exhaustive methylation (HEM).   **3**
               Reaction 5 steps 2 ½ mk, description ½ mk
          (ii) Give Paal-Knorr synthesis for the preparation of pyrrole.   **2**
               Starting material, Reagent, Reaction Condition, Product - ½ X 4 mark
    (E)   (i) How will you distinguish between ethyl amine, diethyl amine and triethyl amine **3**
               using nitrous acid?
               Ethylamine to Ethanol - 1mk, diethyl amine to N-Nitrosoamine - 1mk ,
               Triethylamine to Triethyl ammonium nitrite - 1 mk
          (ii) Explain Vilsmeier-Haack reaction of pyrrole.   **2**
               Formation of Iminium salt – 1 mark
               Formation of 2- Formyl pyrrole – 1 mark
    (F)   (i) Give azo-coupling reaction of benzene diazonium chloride with a) Phenol and **3**
               b) N,N-dimethyl aniline.
               Reaction with phenol (with description) – 1 ½ mk,
                Reaction with N,N-Dimethyl aniline (with description) – 1 ½ mk
          (ii) How is hydrazobenzene prepared from nitrobenzene?   **2**
               Reaction with description of nitrobenzene with Zn dust and aqs. NaOH to
               Hydrazobenzene - 1 ½ mk

5. Attempt any **four** of the following.
    (A)   Sodium chloride has a facecentred cubic lattice and the length of the cube edge is   **5**
          6.56A^o. Calculate d_{110} and d_{111}.

(B)   Write a note on activity of nano particles as a catalyst.   **5**

(C)   With the help of suitable predominance diagram, explain the behaviour of F^- and S^{2-} in aqueous solution.   **5**

(D)   Write a note on acid rain.   **5**

(E)   (i) Describe Hofmannn degradation of amides.   **3**

      (ii) How is chlorobenzene obtained by Sandmeyer reaction?   **2**

(F)   (i) Explain Diel's-Alder reaction of furan.   **3**

      (ii) Why is pyridine more basic than pyrrole?   **2**

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