

FE/CH/1119B 22/03/2020

# EEE CONSORTIUM

# CHEMISTRY THEORY

**CLASS**: **XI**  **MAX.MARKS**: **70**

**DATE :** **20 February, 2020** **TIME**: **3 hours**

**General Instructions**

(a.) All questions are compulsory.

(b.) Section A: Q.no. 1 to 20 are very short answer questions (objective type) and carry 1 mark each.

(c.) Section B: Q.no. 21 to 27 are short answer questions and carry 2 marks each.

(d.) Section C: Q.no. 28 to 34 are long answer questions and carry 3 marks each.

(e.) Section D: Q.no. 35 to 37 are also long answer questions and carry 5 marks each.

(f.) There is no overall choice. However an internal choice has been provided in two questions of two marks, two questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.

(g.) Use log tables if necessary, use of calculators is not allowed.

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|  | **SECTION A** |  |
|  | ***Read the given statement and answer the following questions 1 to 5 that follow:***  When sodium is dissolved in liquid ammonia, a solution of deep blue colour is obtained. |  |
| **1.** | Formulate the reaction for the above explanation. | **1** |
| **2.** | Why does the solution turn blue in colour? | **1** |
| **3.** | What is the covalency of sodium in the above complex? | **1** |
| **4.** | What happens when BF3 reacts with NH3? | **1** |
| **5.** | Why does boron trifluoride behave as a Lewis acid? | **1** |
|  | ***Questions 6 to 10 are one word answers:*** |  |
| **6.** | The ionization of hydrochloric in water is given below:  HCl(aq) + H2O (*l)* ↔ H3O+ (aq) + Cl- (aq)  Label two conjugate acid-base pairs in this ionization. | **1** |
| **7.** | Which of the following orbitals has the lowest energy?  4*d*, 4*f*, 5*s*, 5*p* | **1** |
| **8.** | Calculate the enthalpy change for the following reaction:  CH4(g) +2O2(g) CO2(g)+ 2H2O(g)  (Given the enthalpies of formation of CH4 ,CO2, H2O are -74.8 KJ/mol ,  -393.5 KJ/mol and -286.2 KJ/mol.) | **1** |
| **9.** | What is the unit for molality? | **1** |
| **10.** | What are the total number of angular nodes and radial nodes present in 3p orbital? | **1** |
|  | ***Questions 11 to 15 are multiple choice questions:*** |  |
| **11.** | 25 mL of 3.0M HCl are mixed with 75 mL of 4.0M HCl. If the volumes are additive, the molarity of the final mixture will be   1. 4.0 M (b) 3.75 M (c) 4.25 M (d) 3.50 M | **1** |
| **12.** | In which of the following pairs, the two species are isostructural:  (a) BrO3 – and XeO3 (b) SF4 and XeF4  (c) SO3 2– and NO3–  (d) BF3 and NF3 | **1** |
| **13.** | Arrange the following in the increasing order of stability  CH3**+**, CH3CH2**+**, (CH3)2CH**+**, (CH3)3C**+**  a. CH3**+>** CH3CH2**+ >** (CH3)2CH**+>** (CH3)3C**+**  b. (CH3)3C**+>** (CH3)2CH**+ >** CH3CH2**+ >** CH3**+**  c. (CH3)3C**+<** (CH3)2CH**+ <** CH3CH2**+ <** CH3**+**  d. CH3**+<** CH3CH2**+ <** (CH3)2CH**+<** (CH3)3C**+** | **1** |
| **14.** | Give the structure and hybridization of methyl carbocation;   1. Planar,sp2 2. Tetrahedral,sp3 3. Pyramidal sp2 4. Bent,sp3 | **1** |
| **15.** | The correct IUPAC name for the following compound is-     1. 1-Chloro-2-nitro-4-methylbenzene 2. 1-Chloro-4-methyl-2-nitrobenzene 3. 2-Chloro-1-nitro-5-methylbenzene 4. m-Nitro-p-chlorotoluene | **1** |
|  | ***Questions 16 to 20:***  (A) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.  (B) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.  (C) Assertion is correct, but reason is wrong statement.  (D) Assertion is wrong, but reason is correct statement. |  |
| **16.** | **Assertion** (A): Zinc reacts with H2SO4 to give H2 gas but Copper does not.  **Reason**(R): Zinc has higher reduction potential than copper. | **1** |
| **17.** | **Assertion** (A): pH of a neutral solution is always 7.  **Reason** (R): pH of solution depends upon temperature. | **1** |
| **18.** | **Assertion** (A): The oxidation number of S in H2SO5 is + 8.  **Reason** (R): All oxygen atom are not having -2 oxidation state | **1** |
| **19.** | **Assertion** (A): The temperature at which vapour pressure of a liquid is equal to the external pressure is called the boiling temperature.  **Reason** (R): At high altitudes atmospheric pressure is high. | **1** |
| **20.** | **Assertion** (A): A liquid crystallizes into a solid and is accompanied by decrease in entropy.  **Reason** (R)**:** In crystals, molecules organize in an ordered manner. | **1** |
|  | **SECTION B** |  |
| **21.** | Which of the following molecules will have zero dipole moment? SiCl4, H2O, CO2, BF3, NH3? | **2** |
| **22.** | Explain why N2 has greater bond dissociation energy than N2+ whereas O2 has lesser bond dissociation energy than O2+.  **OR**   1. Draw the Lewis structure of H2SO4. 2. All the C—O bonds in carbonate ion (CO3) 2-are equal in length. Explain. | **2** |
| **23.** | 1. A gas that follows Boyle’s law, Charle’s law and Avogadro’s law is called an ideal gas. Under what conditions a real gas would behave ideally 2. Two different gases ‘A’ and ‘B’ are filled in separate containers of equal capacity under the same conditions of temperature and pressure. On increasing the pressure slightly, the gas ‘A’ liquefies but gas B does not liquefy even on applying high pressure until it is cooled. Explain this phenomenon. | **2** |
| **24.** | 1. How can you predict that the net reaction proceeds in the forward direction by comparing the value of *Kc* and *Qc*? 2. What is the description of the given graph? | **2** |
| **25.** | Consider the elements: Cs, Ne, I and F  (a) Identify the element that exhibits only negative oxidation state.  (b) Identify the element that exhibits only positive oxidation state.  (c) Identify the element that exhibits neither the negative nor does the positive oxidation state. | **2** |
| **26.** | Balance the following ionic equations    **OR**  Balance the following ionic equations | **2** |
| **27.** | 1. Beryllium and Magnesium does not impart colour to the flame in the flame test. Explain? 2. Lithium resembles magnesium in some of its properties. Give reasons for this resemblance. | **2** |
|  | **SECTION C** |  |
| **28.** | The density of 3 molal solution of NaOH is 1.110 g mL-1. Calculate the molarity of the solution.  **OR**   1. How are 0.50 m Na2CO3 and 0.50 M Na2CO3 different? 2. In the reaction: 2A + 4B 🡪 3C + 4D when 5 moles of A react with 6 moles of B, then   (i) Which is the limiting reagent? (ii) Calculate the amount of C formed. | **3** |
| **29.** | The mass of an electron is 9.1 × 10–31 kg. If its kinetic energy is 3.0 × 10–25 J, calculate its wavelength. | **3** |
| **30.** | Give reasons:  (a) Cations are smaller than their parent atom.  (b) Ionization enthalpy of oxygen is lower than that of nitrogen.  (c) Period 2 has 8 elements | **3** |
|  | .**OR**  Assign the position of the element having outer electronic configuration  (a) ns2 np4 for n = 3  (b) (n - 1)d2 ns2 for n = 4, and  (c) (n - 2) f 7 (n - 1)d1 ns2 for n = 6, in the periodic table. | **3** |
| **31.** | Match the term given in Column I with the equation given in Column II | **3** |
| **32.** | Calculate the pH of0.02M chloroacetic acid(ClCH2COOH), if Ka of acid is 1.36 x10-3. Also calculate pKa and Kb of its conjugate base. | **3** |
| **33.** | (I) Which is expected to be more stable: O2N CH2 CH2O– and CH3CH2O– and why?  (II)Explain why (CH3)3C+ is more stable than CH3CH2**+** and CH3**+** is the least stable cation. | **3** |
| **34.** | (a) Represent the equation for the conversion of benzene to toluene.  (b) An alkene ‘A’ on ozonolysis gives a mixture of ethanal and pentan-3-one.Write the structure and IUPAC name of ‘A’ | **3** |
|  | **SECTION D** |  |
| **35.** | 1. What type of curve is obtained when at constant temperature we plot PV vs P. 2. Derive the ideal gas equation. 3. A 5L flask contains 10g of SO3 and 1g of He at 20◦C. Calculate the total pressure of SO3 and He in the vessel.   **OR**   1. Define Dalton’s law.? Derive an expression to show the relation between partial pressure of a gas and its mole fraction. 2. A vessel of 120 ml capacity contains a certain amount of gas at 298 K and 1.2 bar pressure. The gas is transferred to another vessel of volume 180 ml at 298K. What will be its pressure? | **5** |
| **36.** | (a) Explain the following:- (i) Why do trihalides of Group 13 elements fume in the moist air?  (ii) Why does boron not form B3+ ions?  (iii)Aluminium forms [AlF6 ]3– but boron does not form [BF6] 3– ion. Why?  (b) draw the structure of following (I) cross linked silicone (ii) dimer of AlCl3  **OR**  (a) Explain the following:-   1. Suggest reasons why the B—F bond lengths in BF3 (130pm) and BF4 – (143 pm) differ. 2. Account for the fact that aluminium chloride exists as a dimer. 3. Although diamond is covalent, yet it has very high melting point.   Solution: Diamond has three dimensional network structure involving strong carbon-carbon bonds. These bonds are difficult to break and therefore, the melting point of diamond is a very high.  (b) Draw the structures of following :-(i) SiO2 (ii) borazine | **5** |
| **37.** | (a) Arrange 2,2 – dimethylbutane, 3-methylpentane and n-hexane in the ascending order of their boiling point.What information do you use to prioritize the above compounds?  (b) Write the chain terminating reaction of chlorination of methane and account for the formation of ethane?  (c ) How would you increase the polarity of trans 2,3-dichlorobut-2-ene by making suitable structural modifications.  **OR** |  |
|  | (a) Suggest a suitable reactant to react with ethyl bromide to produce butane by Wurtz reaction. Give equation for the same.  (b) Accomplish the conversion of ethyne to benzene.  (c) What modifications would you make in the structure of benzene so that it produces 1, 2-dichlorocyclohexane upon chlorination? Give equation? | **5** |

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# EEE CONSORTIUM

**CLASS**: **XI**  **MAX.MARKS**: **70**

**TIME**: **3 hours**

**CHEMISTRY THEORY MARKING SCHEME**

|  |  |  |
| --- | --- | --- |
|  | **SECTION A** |  |
| **1.** | Na +(x+y) NH3 → [Na (NH3) x)] + + [e(NH3) y]- | **1** |
| **2.** | Due to ammoniated electrons. | **1** |
| **3.** | Covalency of Na is x | **1** |
| **4.** | BF3 + NH3→ BF3 : NH3 | **1** |
| **5.** | The central boron atom has sextet of electrons. | **1** |
|  | ***Questions 6 to 10 are one word answers:*** |  |
| **6.** | HCl/Cl- and H2O/H3O+ | **1** |
| **7.** | 5s | **1** |
| **8.** | **∆Ho = ∆Ho(pro)- ∆Ho(react)**  **= -891.1KJ** | **1** |
| **9.** | mol/kg | **1** |
| **10.** | Number of angular nodes = 1=1  Number of radial nodes = n - l -1 = 3-1 - 1 = 1 | **1** |
|  | ***Questions 11 to 15 are multiple choice questions:*** |  |
| **11.** | (b) 3.75 M | **1** |
| **12.** | (a) BrO3–and XeO3 | **1** |
| **13.** | CH3**+<** CH3CH2**+ <** (CH3)2CH**+<** (CH3)3C**+** | **1** |
| **14.** | Planar,sp2 | **1** |
| **15.** | 1-Chloro-4-methyl-2-nitrobenzene | **1** |
|  | ***Questions 16 to 20:***  (A) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.  (B) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.  (C) Assertion is correct, but reason is wrong statement.  (D) Assertion is wrong, but reason is correct statement. |  |
| **16.** | **A** is correct but **R** is wrong | **1** |
| **17.** | Both **A** and **R** are correct and **R** is not the correct explanation of **A.** | **1** |
| **18.** | (c) | **1** |
| **19.** | A is true but R is false. | **1** |
| **20.** | (i) | **1** |
|  | **SECTION B** |  |
| **21.** | SiCl4, CO2 and BF3 will have zero dipole moment. | **2** |
| **22.** | **OR**  a) Lewis structure of sulphuric acid  b) Resonance structure of carbonate ion | **2** |
| **23.** | a) Low pressure and high temperature  b) Gas ‘A’ is at or below its critical temperature and gas ‘B’ is at a temperature higher than critical temperature. | **2** |
| **24.** | a) *Q*c < *K*c  b) The reaction is at equilibrium | **2** |
| **25.** | (a) F: being most electronegative; shows only a –ve oxidation state of –1.  (b) Cs: Alkali metals have only one electron in their valence shell and hence exhibits only +1 oxidation state.  (c) Ne: because | **2** |
| **26.** | **OR** | **2** |
| **27.** | a.) Due to high ionization enthalpy the removal of the electrons becomes difficult.  b) Due to same ionisation enthalpy and similar charge to radius ratio. | **2** |
|  | **SECTION C** |  |
| **28.** | Ans. 0.50 m Na2CO3 means that 0.50 moles of Na2CO3 are dissolved in 1000 g of water. 0.50 M Na2CO3 solution means that 0.50 moles of Na2CO3 are dissolved in 1000    **OR**  3 molal solution of NaOH means that 3 mols of NaOH are dissolved in1000 g of solvent.  Mass of Solution = Mass of Solvent + Mass of Solute  = 1000 g + (3 × 40 g) = 1120 g  Volume of Solution = 1120mL/ 1.110=1.009ml  Molarity=Number of moles of solute/Volume of solution in litre  = 3 mol/1009.00x1000  = 2.97 M | **3** |
| **29.** |  | **3** |
| **30.** | (a) Cations have lesser electrons, while their nuclear charge remains the same. The remaining electrons are, therefore held more tightly by the protons in the nucleus and thus their radii.are smaller than the parent atoms.  (b) Due to electron electron repulsion in 2p orbital of oxygen.  (c) Second period elements fill 2s and 2p orbitals from left to right which makes up 8 electrons.  **OR**  (a) 3rd period and 16th group  (b) 4th period and 4th group element.  (c) 6th period. It belongs to group 3 of the periodic table since all f-block  elements belong to group 3. | **3** |
| **31.** | (A) – (r) (B) – (r), (s) (C) – (q) (D) – (p) | **3** |
| **32.** | pH= -1/2 log(CKa)  =-1/2 log(0.02 x 1.36 x10-3)  = 2.283  We know ,pKa =-log Ka  = 2.866  Ka x Kb =Kw  Kb =Kw/Ka  =10-14/1.36 x10-3  = **­7.35 x 10-12** | **3** |
| **33.** | (I) O2NCH2CH2O– is more stable than CH3CH2O– because –NO2 group has –I inductive effect and tends to disperse the –ve charge on the O-atom. This results into stability. However, CH3CH2 – group has + I effect and tends to intensify the – ve charge and therefore, destabilizes it.  (II) | **3** |
| **34.** | (a) Image result for Convert benzene to toluene.  (b) | **3** |
|  | **SECTION D** |  |
| **35.** | a) Graph  b) *V ∞ 1 /P*  *V ∞ T*  *V ∞ n*  *V ∞ n T / P*  *V = n RT / P*  *PV = n RT*  ***c)*** *N SO3 = 10 / 80 = 0.125*  *N He = 1 / 4 = 0.25*  *Total = 0.375*  *Ptotal =  n RT = 0.375 × 0.083 × 298 = 1.823 bar*  **OR**   1. *Pressure exerted by water vapour.* 2. *P1 V1 = P2 V2*   *P2 = 1.2 × 120 / 180 = 0.8 bar* | **5** |
| **36.** | (i)    (ii)Boron has very small size and has very high sum of three ionisation enthalpies (IE1 + IE2 + IE3). Therefore, it cannot lose its three electrons to form B3+ ions.  (iii) Boron does not have vacant d-orbitals in its valence shell and hence cannot extend its octet. It cannot showcovalency more than four. However, Al has vacant d-orbitals in its valence shell and can show a covalency of six.  (b)  (i) (ii)  C:\Users\HP\AppData\Local\Temp\SNAGHTMLd4881a9.PNG  **OR**  (i)BF3 is a planar molecule in which B is sp2 hybridised. It has empty 2p-orbital. Because of similar sizes of B and F, back bonding occurs in which a lone pair is transferred from F to empty p-orbital of B forming p- p bond. As a result, B–F acquires some double bond character. On the other hand, in BF4 – ion, B is sp3 hybridised and forms four B–F single bonds. It does not have vacant p-orbital available to accept the electrons from F atom and hence in BF4 –, the B–F bond is purely single bond. Since double bond is shorter than single bond, therefore, the B–F bond length in BF3 is shorter (130pm) than B–F bond length in BF4 – (143 pm).  (ii)In AlCl3, there are six electrons around Al and are two less than the octet. So, Al in AlCl3 is electron  whereas Cl atom has a lone pair of electrons to donate. Therefore, each Al atom completes its octet by accepting a lone pair from Cl atom of another aluminium chloride molecule. Thus, it forms a dimer.  (b) (i) (ii) | **5** |
| **37.** | (a), n-hexane, 3-methylpentane, 2,2 – dimethylbutane.Boiling point is more when surface area is more.  (b) Formation of ethane is a result of the termination of chain reactions taking  place as a result of the consumption of reactants as:  http://www.saralstudy.com/upload/Images/question_images/chemistry/11th_chemistry_13_1_1_1524652609_43.png  Hence, by this process, ethane is obtained as a by-product of chlorination of methane.  (c) polarity of trans 2,3-dichlorobut-2-ene is increased by changing it into cis  isomer.  Image result for cis and trans isomers of 2,3-dichlorobut-2-ene  [OR]  (a)    (b)  (c) Cyclohexene. Image result for chlorination of cyclohexene | **5** |

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