RAMAKRISHNA MISSION VIDYAMANDIRA

Belur Math, Howrah – 711 202

ADMISSION TEST – 2014; CHEMISTRY (Honours)

Date : 20-06-2014   **Full Marks : 50**   Time: 01·30 p.m – 03·30 p.m

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Instructions for the candidate

Each question is carrying **1 mark**. Candidates have to select the correct choice by **black/ blue** pen only in the **Optical Mark Recognition (OMR)** to be provided during the written test. Marking should be **dark** and should completely fill one blank box against the corresponding question number. Incomplete filling or multiple filling of boxes will reject the answer to that question. Once an answer is marked in OMR, there is no scope to alter the choice. Doing rough work or using erasers, blades, whiteners etc. on the Optical Mark Recognition (OMR) is strictly prohibited.

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1. Which of the following methods is not suitable for the synthesis of acetophenone—
   a) Aromatic electrophilic substitution
   b) Aromatic nucleophilic substitution
   c) Using phenyl magnesium bromide
   d) Using methyl magnesium bromide

2. The priority order of some functional groups in naming organic molecule by IUPAC method is as follows—
   a) $-COOH > -SO_3H > -CN > -CHO$
   b) $-COOH > -CN > -SO_3H > -CHO$
   c) $-COOH > -CHO > -CN > -SO_3H$
   d) $-COOH > -SO_3H > -CHO > -CN$

3. The state of hybridisation of C–2, C–3, C–5 in $CH_3COC \equiv CCH_3$ respectively is as follows—
   a) sp^2, sp, sp^3
   b) sp^3, sp, sp^2
   c) sp^2, sp^3, sp
   d) sp^3, sp^2, sp

4. You are asked to synthesise parabromoaniline form aniline. The minimum number of steps required is—
   a) one
   b) two
   c) three
   d) four

5. The order of the rate of aromatic electrophilic substitution of the following compounds is—
   a) Phenol > Toluene > Fluorobenzene > Chlorobenzene
   b) Phenol > Toluene > Chlorobenzene > Fluorobenzene
   c) Phenol > Fluorobenzene >Toluene > Chlorobenzene
   d) Toluene > Phenol > Chlorobenzene > Fluorobenzene

6. Which one of the followings will show geometrical isomerism—
   a) 2-Buene
   b) 2-Butanol
   c) 2-Butyne
   d) 3-Butenol

7. Which of the following statements is incorrect?
   a) A pair of enantiomeric compounds will have the same melting points
   b) A pair of enantiomeric compounds will have the same solubility in ethyl alcohol
   c) A pair of enantiomeric compounds will have identical optical rotations
   d) A pair of enantiomeric compounds may have different drug activity

8. Ethyl 3-oxobutanoate when reduced by $NaBH_4$ the product formed is
   a) Ethyl 3-hydroxybutanoate
   b) 4-Hydroxy-2-butanone
   c) Butane-1, 3-diol
   d) 3-oxobutanoic acid

9. Which of the following compounds will react with methyl magnesium bromide
   a) But-2-yne
   b) But-1-en-3-yne
   c) 1,3-Butadiene
   d) But-2-ene

10. When toluene is converted to *p*-Aminobenzoic acid, the steps involved are in order—
    a) Nitration, oxidation, reduction
    b) Oxidation, nitration, reduction
    c) Nitration, reduction, oxidation
    d) Reduction, nitration, oxidation

11. The correct IUPAC nomenclature of : $ClCH_2CH_2CH(Br)CH_2CH_2I$ is—
    a) 1-chloro-3-bromo-5-iodopentane
    b) 3-Bromo-1-chloro-5-iodopentane
    c) 1-Iodo-3-bromo-5-chloropentane
    d) None of the above

12. Which one of the following compounds would react with PhMgBr to produce Ph_2CHOH—
    a) CH_2O
    b) $PhCO_2H$
    c) $HCO_2C_2H_5$
    d) PhCHO

13. Which one of the following reagents can differentiate between glucose and fructose?
    a) Bromine water
    b) Tollen's reagent
    c) Fehling's solution
    d) None of these

14. Which of the following statements is not generally true—
    a) C = C undergoes electrophilic addition reaction
    b) C = O undergoes nucleophilic addition reaction
    c) C = C is weaker than C = O
    d) C = O has lower dipole than C = C

15. What is the number of primary alcohols possible with the molecular formula $C_5H_{12}O$?
   a) 5   b) 4   c) 3   d) 2

16. Which of the following species is well known?
   a) PCl_6^- b) PbI_4 c) PI_5 d) PBr_6^-

17. Which of the following element(s) has or have a positive value of electron affinity?
   a) All of these Ne   b) Ne   c) Zn   d) Ba

18. Which of the following molecules has the least value of ionization energy?
   a) NO   b) N_2 c) O_2 d) NO_2

19. Which of the following compounds has the lowest melting point?
   a) $AlBr_3$ b) $HgCl_2$ c) $CaCl_2$ d) $AlCl_3$

20. $_1^3H$ is prepared by the reaction—
   a) $_3^6Li + _0^1n \rightarrow _2^4He + _1^3H$ b) $_3^7Li + _0^1n \rightarrow _2^4He + _1^3H + _0^1n$
   c) $_5^{10}B + _2^4He \rightarrow _6^{11}C + _1^3H$ d) $_2^3He + _1^2H \rightarrow 2_1^1H + _1^3H$

21. An inorganic substance liberates O_2 when heated, turns an acid solution of KI violet, and reduces acidified $KMnO_4$. The substance is
   a) H_2O_2 b) SO_2 c) KNO_3 d) $Pb(NO_3)_2$

22. Ozone is a powerful oxidizing agent. It is—
   a) Second only to F_2 in oxidizing power   b) Second only to O_2 in oxidizing power
   c) Second only to Cl_2 in oxidizing power   d) Second only to MnO_4^- in oxidizing power

23. Calgon, used as a water softner, has the formula—
   a) $Na_2[Na_4(PO_3)_6]$ b) $Na_4[Na_2(PO_3)_6]$ c) $Na_2[Na_4(PO_4)_5]$ d) $Na_4[Na_2(PO_4)_6]$

24. Which of the following pairs have almost identical geometry?
   a) NH_3 and H_3O^+ b) H_3O^+ and BF_3 c) NH_4^+ and H_3O^+ d) H_2O and NH_3

25. Which of the following ions does not exist?
   a) B^{3+} b) Al^{3+} c) Pb^{2+} d) Tl^+

26. Which of the following bonding pattern or patterns can be expected from in its compounds?
   a) All of these   b) $= C =$ c) $\rangle C :$ d) $\rangle C =$

27. Which of the following molecules contains the maximum number of P–H bonds?
   a) H_3PO_2 b) H_3PO_4 c) H_3PO_3 d) $H_4P_2O_7$

28. All the halogens are coloured. The colours arise due to—
   a) absorption of light which causes an electron to jump from the ground state to a higher state
   b) emission of light due to transfer of an electron from a higher state to the ground state
   c) strong oxidising power of the halogens
   d) weak Van der Waals forces among the halogen molecules

29. The conductivity of pure HF is comparable with that of—
   a) pure water   b) pure H_2SO_4 c) dilue HNO_3 d) pure acetone

30. The molar mass of glucose is 180 g mol^{-1} and N_A is the Avogadro constant. Which one of the following statements is not correct?
   a) An aqueous 0.5 M solution of glucose is prepared by dissolving 90 g of glucose to give 1000 cm^3 of solution.
   b) 1.00 mmol amount of glucose has a mass of 180 mg.
   c) 0.0100 mol of glucose comprises of 0.0100 x 24 x N_A atoms.
   d) 100 cm^3 of a 0.10 M solution contain 18 g of glucose.

31. Which structure describes best the crystal system of iron in which the coordination number is 8?
   a) simple cubic   b) body-centered cubic
   c) hexagonal closest packing   d) cubic closest packing

32. For the 1st order reaction $N_2O_5 \rightarrow NO_2 + O_2$
   a) the concentration of the reactants decreases exponentially with time
   b) the half-life of the reaction decreases with increasing in temperature
   c) the half-life of the reaction depends on the initial concentration of the reactants
   d) the reaction proceeds to 99.6% completion after eight half-life duration

33. The reaction of sulphonation of naphthalene (A) is under consideration : As the reaction proceeds it is observed that the α-sulphonation (B) is the primary process though in the mixture β-sulphonated (C) naphthalene is also found in little amount. With prolonged treatment i.e sulphonation for long duration with heating leads to the β-sulphonated compound as the major product. The inter-conversion between α and β product is not considered. Which of the following options regarding the above reaction is/are correct?

a)   b)   c)   d) both a and b
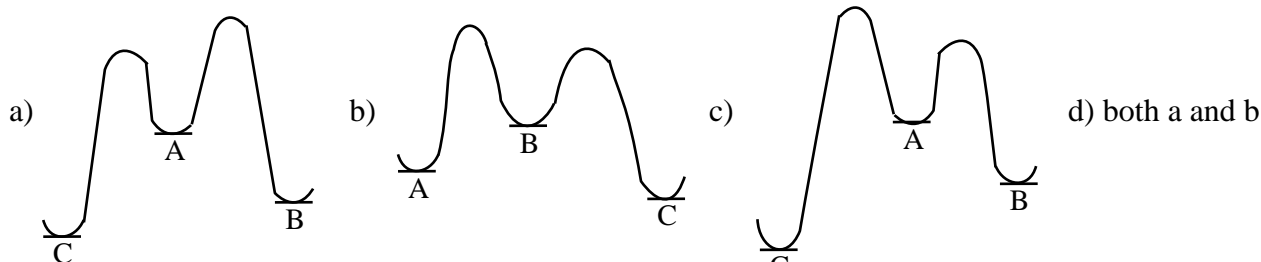
34. For the dimerization reaction $2C_5H_6$ (g) $\rightarrow C_{10}H_{12}$ (g), a typical kinetics is followed assuming the ideal behavior of the gases which is plotted as follow:
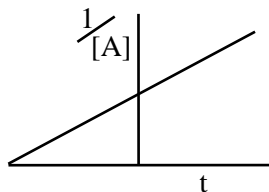

[A is the reactant, here C_5H_6].

Pick up the correct choice(s) from the followings.

a) The reaction is completed in finite time

b) $1/P_A = 1/P_A^0 + Bt$

c) The reaction is a second order reaction

d) The order of the reaction is fractional

35. Here is a cell reaction $Pb(s) + Hg_2SO_4(s) \rightarrow 2Hg(l) + PbSO_4(s)$. Choose the appropriate cell diagram from followings

a) $Pb(s)|\ PbSO_4(s)|Hg_2SO_4(s)|Hg(l)$

b) $Pb(s)|\ PbSO_4(s)|K_2SO_4(aq)|Hg_2SO_4(s)|Hg(l)$

c) $Hg(l)|\ Hg_2SO_4(s)|K_2SO_4(aq)|PbSO_4(s)|Pb(s)$

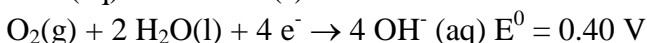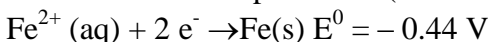d) $Hg(l)|\ Hg_2SO_4(s)|PbSO_4(s)|Pb(s)$

Statement for Question 36 and 37. Corrosion of metals is associated with electrochemical reactions. This also applies for the formation of rust on iron surfaces, where the initial electrode reactions usually are:

Fe(s) $\rightarrow Fe^{2+}$ (aq) + 2 e–

$O_2(g)$ + 2 $H_2O(l)$ + 4 e– $\rightarrow$ 4 OH⁻ (aq)
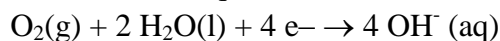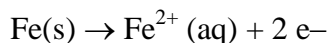
An electrochemical cell in which these electrode reactions take place is constructed. The temperature is 25 °C. The cell is represented by the following cell diagram:

Fe(s) | Fe^{2+} (aq) || OH⁻ (aq), $O_2(g)$ | Pt(s)

Standard electrode potentials (at 25 °C):

Fe^{2+} (aq) + 2 e⁻ $\rightarrow$ Fe(s) $E^0 = -0.44$ V

$O_2(g)$ + 2 $H_2O(l)$ + 4 e⁻ $\rightarrow$ 4 OH⁻ (aq) $E^0 = 0.40$ V

36. The standard electromotive force (the standard cell voltage) at 25 °C and the overall reaction are

a) -0.04 and 2 Fe + O_2 + 2 $H_2O \rightarrow$ 2 Fe^{2+} + 4 OH⁻

b) 0.04 and Fe + ½ O_2 + $H_2O \rightarrow Fe^{2+}$ + 2 OH⁻

c) 0.84 and 2 Fe + O_2 + 2 $H_2O \rightarrow$ 2 Fe^{2+} + 4 OH⁻

d) 0.44 and 2 Fe + O_2 + 2 $H_2O \rightarrow$ 2 Fe^{2+} + 4 OH⁻

37. The E of the cell for the condition $[Fe^{2+}]$ = 0.15, $p(O_2)$ = 0.7 bar, $pH_{right\ hand\ half\ cell}$ = 9.0 is

a) -2.19V   b) 2.19V   c) -1.19 V   d) 1.19V

38. 3.00 mol of CO_2 gas expands isothermically (in thermal contact with the surroundings; temperature = 15°C) against a fixed external pressure of 1.00 bar. The initial and final volumes of the gas are 10.0 dm^3 and 30.0 dm^3, respectively.

Choose the correct option for the change of entropy for both system and the surroundings,

a) $\Delta S_{sys} > 0\ \Delta S_{sur} = 0$ b) $\Delta S_{sys} < 0\ \Delta S_{sur} > 0$ c) $\Delta S_{sys} > 0\ \Delta S_{sur} < 0$ d) $\Delta S_{sys} = 0\ \Delta S_{sur} = 0$

39. When an ideal, monatomic gas expands reversibly from V_1 to V_2, a work is performed by the system, W = -∫pdV. [W and p are the work and the pressure of the gas, respectively]

The gas will perform less work in an adiabatic expansion than in an isothermal expansion. Is this because the adiabatic expansion is characterized by

a) The volume of the gas is constant

b) The expansion is always reversible

c) No heat is supplied to the gas

d) All are correct

40. For an ideal gas, consider only P-V work in going from an initial state A to the final state C. The final state C can be reached by either of the two paths, mentioned as, (i) A to B with constant P followed by B to C with constant V and (ii) A to C by simultaneous change in P and V. Which of the following choice(s) is (are) correct? [W is work and S is the entropy]

a) $\Delta S_{A\to C} = \Delta S_{A\to B} + \Delta S_{B\to C}$ and $W_{A\to C} = W_{A\to B} + W_{B\to C}$

b) $\Delta S_{A\to B\to C} = \Delta S_{A\to B}$ and $W_{A\to C} = W_{A\to B} + W_{B\to C}$

c) $\Delta S_{A\to C} = \Delta S_{A\to B} + \Delta S_{B\to C}$ and $W_{A\to C} = W_{A\to B\to C}$

d) $\Delta S_{A\to C} = \Delta S_{A\to B} + \Delta S_{B\to C}$ and $W_{A\to B} = W_{A\to C} - W_{B\to C}$

41. The molar solubility, 's', of $Th(IO_3)_4$ as a function of the solubility product K_{sp} of this sparingly soluble thorium salt is given by the equation

a) $s = (K_{sp}/128)^{1/4}$ b) $s = (K_{sp}/256)^{1/5}$ c) $s = 256\ K_{sp}^{1/4}$ d) $s = (K_{sp}/128)^{1/5}/2$

42. Which one of the following equations must be used for the exact calculation of $[H^+]$ of an aqueous HCl solution at any concentration, c_{HCl}? ($pK_w = 14$)

a) $[H^+] = c_{HCl}$ b) $[H^+] = c_{HCl} + K_w/[H^+]$ c) $[H^+] = c_{HCl} + K_w$ d) $[H^+] = c_{HCl} - K_w/[H^+]$

43. In 1.0 L saturated solution of AgCl ($K_{sp} = 1.6 \times 10^{-10}$) 0.1 mol of CuCl ($K_{sp} = 1.0 \times 10^{-6}$) is added. The resultant concentration of Ag^+ in the solution is 1.6×10^{-x}. What is the value of x?

a) 3   b) 5   c) 7   d) 4

44. $10.0\ cm^3$ of 0.50 M HCl and $10.0\ cm^3$ of 0.50 M NaOH solutions, both at the same temperature, are mixed in a calorimeter. A temperature increase of 'dT' is recorded. Estimate the temperature increase if $5.0\ cm^3$ of 0.50 M NaOH were used instead of $10.0\ cm^3$. Thermal losses are negligible and the specific heats of both solutions are taken as equal.

a) ½ dT   b) ⅔ dT   c) ¾ dT   d) dT

45. Which of the following is a possible explanation for the fact that Cp is always greater than Cv?

a) Some of the energy is used to expand the container in order to maintain constant pressure.

b) A rigid container does not conduct heat as well as one that can change shape.

c) There are generally more moles of gas when the pressure is kept constant than when the volume is kept constant.

d) There are generally fewer moles of gas when the pressure is kept constant than when the volume is kept constant.

46. According to MO theory

a) O_2^+ is paramagnetic and the bond order is greater than O_2 b) O_2^- is diamagnetic and the bond order is less than to O_2

c) O_2^+ is diamagnetic and the bond order is less than O_2 d) O_2^+ is diamagnetic and the bond order is more than O_2

47. For a d-electron, the orbital angular momentum is

a) $6\hbar$ b) $\sqrt{2}\hbar$ c) $\hbar$ d) $\sqrt{6}\hbar$

48. The ratio of the radii of the first three Bohr orbit is

a) 1:5:33   b) 1:2:3   c) 1:8:27   d) 1:4:9

49. What is (are) not correct about the two Na D-line?

a) The excited sodium atoms give rise to intense red emission

b) The difference in energy between the two lines is equal to the difference between two excited states (term symbols)

c) This results from an electronic transition from the 3p excited state configuration to the 3s ground state configuration

d) The states involved are all of spin multiplicity 2.

50. The relation between the quantum numbers and the electron distribution in orbitals is followed by simple rules. Which is not the rule from followings?

a) The type of orbital is determined by the quantum number, 'l'

b) There are n types of orbitals in the nth energy levels

c) The electrons should fill the orbitals according to aufbau principle

d) No two electrons in different atoms have all four quantum numbers identical