

Chemistry, 2012 EC, entrance exam, version 1

Grade 12 · Chemistry · 2012 E.C.

Time allowed: 120 minutes

Questions: 77

Total marks: 77

Name _____ Grade _____ ID No. _____ Date _____

1. According to World Health Organization (WHO), the standard for the concentration of alcohol used to prevent COVID-19 virus is 70%. How much water has to be added to prepare the standard alcohol for 1L of 96% alcohol? (1)
 - A. 1371.4 ml
 - B. 371.4 L
 - C. 371.4 ml
 - D. 30 ml
2. In which of the following solvents would you expect the solubility of NaCl to be greatest? (1)
 - A. Carbon tetrachloride (CCl₄)
 - B. Water (H₂O)
 - C. Methanol (CH₃OH)
 - D. Methanol (CH₃OH)
3. Which of the following substances might stabilize a colloidal suspension of oil in water? (1)
 - A. Sodium stearate NaCO₂(CH₂)₁₆CH₃
 - B. Sodium bicarbonate (NaHCO₃)
 - C. H₂O
 - D. CaCl₂
4. How many moles of unknown weak acid (HA) in a 100 L solution are required to produce a solution with pH = 2? (1)
 Ka of the unknown weak acid (HA) = 5×10^{-3} .
 - A. 3×10^{-3}
 - B. 0.3×10^{-3}
 - C. 3
 - D. 0.3
5. If different processes are used to bring about the same change the enthalpy changes during these processes are the same, this is the statement of (1)
 - A. Hess's law
 - B. Standard Enthalpy
 - C. 1st law thermodynamics
 - D. 2nd law thermodynamics
6. Which of the following 0.1 M solutions has the lowest pH? (1)
 - A. NaNO₂
 - B. KClO₄
 - C. NH₄Cl
 - D. NH₃
7. The pH of a 0.1 M weak base B is 9. What is the K_b for B? (1)
 - A. 9.2×10^{-4}
 - B. 2×10^{-6}
 - C. 1×10^{-4}
 - D. 1×10^{-9}
8. Addition of HCl to an aqueous buffer solution containing NH₃ and NH₄Cl cause which of the following to occur? (1)
 I. pH of the solution increase II. pH of the solution decrease III. NH₄⁺ concentration increase IV. NH₃ concentration increase
 - A. I
 - B. II
 - C. I and III
 - D. II and III
9. What is the equivalence point pH of the solution formed by the titration of 50 mL of 0.15 M CH₃COOH using 25 mL of 0.3 M NaOH? [Use log 7.5 = 0.87, K_b of acetate ion = 5.6×10^{-10}] (1)
 - A. 7.44
 - B. 6.22
 - C. 8.44
 - D. 8.87

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10. The solubility of a particular salt in water is 9.9 g/mL at room temperature. If 11.1 g is completely dissolved in one milliliter of water, the solution is (1)
- A. Saturated
B. Supersaturated
C. Unsaturated
D. Dilute
-
11. The hybrid orbitals in a molecule of methane are oriented (1)
- A. Towards the corners of a tetrahedron centered on the carbon atom.
B. Towards the corners of a cube centered on the carbon atom.
C. Towards the corners of a triangle centered on the carbon atom.
D. Towards the corners of a rectangle centered on the carbon atom.
-
12. Which one of the following best describes chemical equilibrium? (1)
- A. Concentrations of products are higher than concentration of reactants.
B. Forward and reverse reactions continue with no effect on the concentration of reactants and products.
C. Reactions stop only when reactants have been converted to products.
D. Forward and reverse reactions have stopped so that the concentration of the reactants equals the concentration of products.
-
13. Based on the Valence shell electron pair repulsion (VSEPR) theory which of the following would have a tetrahedral arrangement of electrons around the central atom? (1)
- A. BH₃
B. NO₂⁻
C. CO₃²⁻
D. SiH₄
-
14. When the 1s-orbitals of two hydrogen atoms combine to form a hydrogen molecule, then which molecular orbitals are formed? (1)
- A. One bonding molecular orbital only.
B. Two bonding molecular orbitals.
C. One bonding molecular orbital and one antibonding molecular orbital.
D. Two antibonding molecular orbitals.
-
15. Which of the following solid substances contains positive ions immersed in a sea of mobile electrons? (1)
- A. O₂
B. Cu
C. CuO
D. SiO₂
-
16. Which one of the following compounds contains both covalent and ionic bond? (1)
- A. CCl₄
B. KCl
C. MgCl₂
D. NH₄Cl
-
17. Oxygen, nitrogen and fluorine bond with hydrogen to form molecules. These molecules are attracted to each other by (1)
- A. Coordinate covalent bonds
B. Electro covalent bond
C. Ionic bonds
D. Hydrogen bonds

18. Given the reaction: $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$. Which statement best describes the energy changes as bonds are formed and broken in this reaction. (1)
- A. The forming of the H-Cl bond releases energy.
B. The forming of the H-Cl bond absorbs energy.
C. The breaking of the H-H bond releases energy.
D. The breaking of the Cl-Cl bond releases energy.
-
19. The reaction $\text{CHCl}_3(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow \text{CCl}_4(\text{g}) + \text{HCl}(\text{g})$ has the rate law: $\text{Rate} = k[\text{CHCl}_3][\text{Cl}_2]$. If the concentration of CHCl_3 is increased by a factor of five while the concentration of Cl_2 is kept the same, the rate will be (1)
- A. Stay the same
B. Increased by a factor of five
C. Decreased by a factor of five
D. Doubled
-
20. What are the four quantum numbers of $4d^6$ orbital? (Options in table) (1)
- A. $n=4, l=1, m_l=1, m_s=\pm 1/2$
B. $n=4, l=2, m_l=-2, m_s=-1/2$
C. $n=4, l=0, m_l=0, m_s=-1/2$
D. $n=4, l=2, m_l=1, m_s=-1/2$
-
21. Lava is a foam colloid. The dispersed phase and dispersion medium are respectively: (1)
- A. gas-liquid
B. solid-gas
C. liquid-gas
D. gas-solid
-
22. Which of the following salts would form an acidic solution? I. KCl II. NaF III. NH_4Cl IV. CaCO_3 (1)
- A. I and III
B. I and IV
C. III and IV
D. only III
-
23. Which of the following is a Lewis acid but not a Brønsted acid? (1)
- A. HBr
B. BBr_3
C. NH_3
D. CH_4
-
24. What is the percentage dissociation of a 0.1 M unknown weak acid (HA) solution? [Use K_a of HA = 9×10^{-9}] (1)
- A. $9 \times 10^{-9}\%$
B. $3 \times 10^{-9}\%$
C. $9 \times 10^{-2}\%$
D. $3 \times 10^{-2}\%$
-
25. A chemist adds water to 120 mL of a 6 M solution of HCl until the final volume is 2 L. What is the molarity of the resulting solution? (1)
- A. 0.94 M
B. 2.3 M
C. 0.36 M
D. 8.7 M
-
26. Which of the following is the correct increasing order of the atomic size of Mg^+ , Na , Si^{3+} , and Al^{2+} ? (1)
- A. $\text{Na} < \text{Mg}^+ < \text{Al}^{2+} < \text{Si}^{3+}$
B. $\text{Si}^{3+} < \text{Al}^{2+} < \text{Mg}^+ < \text{Na}$
C. $\text{Al}^{2+} < \text{Mg}^+ < \text{Na} < \text{Si}^{3+}$
D. $\text{Si}^{3+} > \text{Al}^{2+} > \text{Na} > \text{Mg}^+$
-
27. The standard enthalpy of formation of Nitrogen (N_2) is? (1)
- A. 1
B. 0
C. -1
D. 4

28. We have three aqueous solutions of NaCl labeled 'A', 'B', and 'C' with concentrations 0.1 m, 0.01 m, and 0.001 m, respectively. The van't Hoff factor for these solutions will be (1)
- A. $i_A < i_B < i_C$ B. $i_A > i_B > i_C$
C. $i_A = i_B = i_C$ D. $i_A < i_B > i_C$
29. Which of the following is TRUE for the sublimation of solid carbon dioxide at room temperature and pressure? (1)
- A. Change in Enthalpy is negative, and change in Entropy is positive.
B. Change in Entropy is negative, and change in Enthalpy is positive.
C. Change in Enthalpy and change in Entropy are positive.
D. Change in Gibbs free energy is positive.
30. Electrons exist only at fixed levels of potential energy. However, if an atom absorbs sufficient energy, a possible result is that (1)
- A. An electron may move to an electron shell farther out from the nucleus.
B. An electron may move to an electron shell closer to the nucleus.
C. The atom would become a positively charged or cation.
D. The atom may become radioactive isotopes.
31. Consider this equilibrium reaction in a sealed container: $\text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{H}_2\text{O}(\text{l})$. Which one of the following will be the effect on the equilibrium of increasing the temperature from 20°C to 30°C? (1)
- A. More of the water will be in the gaseous state at equilibrium.
B. More of the water will be in the liquid state at equilibrium.
C. At equilibrium the rate of condensation will be greater than the rate of evaporation.
D. At equilibrium the rate of evaporation will be greater than the rate of condensation.
32. Which one of the following best describes the formation of pi (π) bond? (1)
- A. They are formed by sideways overlap of parallel orbitals.
B. They are formed by the axial overlaps of orbitals.
C. They are formed by the sideways overlaps of an s and p orbital.
D. They are formed by the axial overlaps of either s or p orbital.
33. Which one is the function of iron in the Haber process? (1)
- A. It shifts the position of equilibrium towards the products.
B. It decreases the rate of reactions.
C. It provides an alternative reaction pathway with lower activation energy.
D. It reduces the enthalpy change of the reaction.
34. Which types of solid materials are typically hard, have high melting points and poor electrical conductivities? I. Ionic II. Metallic III. Covalent-network (1)
- A. I and II only B. I and III only
C. II and III only D. I, II, and III
35. For the reaction: $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$, at a certain temperature the equilibrium concentrations in mol/L are $[\text{H}_2]=0.2$, $[\text{I}_2]=0.2$, $[\text{HI}]=2.0$. Then based on this data, which one is the equilibrium constant K_c ? (1)
- A. 0.002 B. 20
C. 10 D. 100

36. Which statement is correct about the effect of adding a catalyst to a system at equilibrium? I. The rate of the forward reaction increases. II. The rate of reverse reaction increases. III. The yield of the products increases. (1)
- A. I only
B. III only
C. I and II only
D. I, II and III
-
37. For the reaction: $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$, $K_c = 8 \times 10^{-4} \text{ mol/cm}^3$? Actually units: $8 \times 10^{-4} \text{ mol/cm}^3$? That is huge; likely 8×10^{-4} ? Given options: $[\text{N}_2\text{O}_4] = 8 \times 10^{-2} \text{ mol/cm}^3$, find $[\text{NO}_2]$. $K_c = [\text{NO}_2]^2 / [\text{N}_2\text{O}_4] = 8 \times 10^{-4}$? That would give $[\text{NO}_2]^2 = 8 \times 10^{-4} \times 8 \times 10^{-2} = 6.4 \times 10^{-5}$, $[\text{NO}_2] = 8 \times 10^{-3}$, not matching options. If $K_c = 8 \times 10^{-4}$, then $[\text{NO}_2]^2 = 8 \times 10^{-4} \times 8 \times 10^{-2} = 6.4 \times 10^{-5}$, $[\text{NO}_2] = 8 \times 10^{-3}$. Option C: 8.0×10^{-3} . So likely $K_c = 8 \times 10^{-4}$. (1)
- A. 8.0×10^{-1}
B. 8.0×10^{-2}
C. 8.0×10^{-3}
D. 4.5×10^{-4}
-
38. For the reaction: $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_6(\text{g})$, $\Delta H = -137 \text{ kJ}$. Which statement about the information is correct? (1)
- A. The total energy of the bonds broken in the reactants is greater than the total energy of the bonds formed in the products.
B. The bonds broken and the bonds made are of the same strength.
C. The total energy of the bonds broken in the reactants is less than the total energy of the bonds formed in the products.
D. No conclusion can be made about the sums of the bond enthalpies.
-
39. Under what conditions can we absolutely say a system is at equilibrium at constant temperature and pressure? (1)
- A. Change in Enthalpy is equal to Zero.
B. Change in Gibbs free energy is equal to Zero.
C. Change in Entropy is greater than Zero
D. Change in Enthalpy is greater than Zero.
-
40. Which of the following substances would you expect to have the highest entropy at 1 atm of pressure? (1)
- A. 1 mol of $\text{H}_2\text{O}(\text{l})$
B. 1 mol of $\text{H}_2\text{O}(\text{s})$
C. 0.5 mol of ethanol in 0.5 mol of $\text{H}_2\text{O}(\text{l})$
D. a gaseous solution of 0.5 mol of $\text{CH}_4(\text{g})$ and 0.5 mol of $\text{H}_2\text{O}(\text{g})$
-
41. Which of the following is capable of acting both as an oxidizing and reducing agent? (1)
- A. SnCl_2
B. H_2O_2
C. NaF
D. KMnO_4
-
42. Which of the following is NOT true about the anode of an electrolytic cell? (1)
- A. Oxidation occurs at it.
B. It is assigned as the positive pole.
C. Cations in solution move away from the surface of the electrode as the redox reaction occurs.
D. It is deficient in number of electrons.
-
43. The reaction $\text{MnO}_4^- + \text{C}_2\text{O}_4^{2-} \rightarrow \text{MnO}_2 + \text{CO}_3^{2-}$ is not balanced. If the reaction is balanced using basic medium, the coefficient of OH^- and H_2O will be respectively? (1)
- A. 4 and 2
B. 2 and 4
C. 2 and 3
D. 3 and 2

44. In which of the following aqueous solution can water be oxidized and O_2 forms at the anode and water is reduced and H_2 forms at the cathode? (1)
- A. KBr
B. $MgSO_4$
C. $AgNO_3$
D. NaBr
45. If you want to plate out an iron spoon with silver metal, then which of the following is TRUE? (1)
- A. The electrolyte must contain silver ion
B. The iron spoon must be set at the anode
C. The silver metal must be the cathode
D. The material to be plated must be the anode
46. The standard state of water is? (1)
- A. Steam
B. Liquid
C. Ice
D. Vapour state
47. What type of bond you observe in phenol other than 5 C-H bond? (1)
- A. 3C=C, 3C-C and 1O-H
B. 3C=C, 3C-C, 1C-O and 1O-H
C. 6C-C, 1C-O and 1O-H
D. 4C=C, 2C-C, 2C-O and 1O-H
48. Which batteries are faced with leak out and environmental problem respectively? (1)
- A. Nickel-cadmium and fuel cells
B. Nickel-cadmium and dry cells
C. Dry cells and Mercury cells
D. Dry cells and fuel cells
49. When the compounds below are listed in order of decreasing boiling point (highest to lowest) which one is the correct order? 1. Ethane 2. Fluoroethane 3. Ethanol 4. Ethanoic acid (1)
- A. 4,3,1,2
B. 3,4,1,2
C. 4,3,2,1
D. 2,1,3,4
50. Which one of the following is the formal charge on each atom in dichloromethane (CH_2Cl_2)? (1)
- A. C=0, H=+1, Cl=-1
B. C=0, H=0, Cl=0
C. C=0, H=+1, Cl=-1
D. C=-2, H=+1, Cl=+1
51. Which one of the following species has the same molecular geometry: CO_2 , H_2O , $BeCl_2$, and N_2O ? (1)
- A. CO_2 and N_2O
B. H_2O and N_2O
C. CO_2 and $BeCl_2$
D. CO_2 , $BeCl_2$, and N_2O
52. Which hybridization change does the carbon atom undergo in the combustion of methane? $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ (1)
- A. $sp \rightarrow sp^2$
B. $sp^3 \rightarrow sp$
C. $sp^2 \rightarrow sp^3$
D. $sp^2 \rightarrow sp$
53. The number of sigma and pi bonds present in benzene (C_6H_6) molecule is (1)
- A. 12 sigma and 3 pi
B. 3 sigma and 12 pi
C. 18 sigma and 6 pi
D. 6 pi and 18 sigma

54. Which one of the following characteristics applies to PCl_3 ? I. Nonpolar molecule II. Polar bonds III. Trigonal-pyramidal molecular geometry IV. sp^2 hybridized (1)
- A. I and II
B. II and III
C. I, II and III
D. I, II, III and IV
-
55. According to molecular orbital theory, which one of the following species is most likely to exist? (1)
- A. He_2
B. Be_2
C. Ne_2
D. Li_2
-
56. According to molecular orbital theory, what is the bond order of O_2 ? (1)
- A. 1
B. 2
C. 2.5
D. 1.5
-
57. Which of the following data gives the most precise measurement? (1)
- A. 3.0
B. 3.00
C. 3.000
D. 3.0000
-
58. Which one is the correct order of increasing Cl-A-Cl bond angle in the following species where A is central atom: I. BCl_3 , II. SiCl_4 , III. SCl_2 , IV. PCl_3 ? (1)
- A. $\text{III} < \text{IV} < \text{II} < \text{I}$
B. $\text{II} < \text{III} < \text{I} < \text{IV}$
C. $\text{IV} < \text{I} < \text{II} < \text{III}$
D. $\text{I} < \text{II} < \text{III} < \text{IV}$
-
59. What substance is reduced in an alkaline-cell battery? (1)
- A. Zn(s)
B. $\text{Zn}^{2+}(\text{aq})$
C. $\text{NH}_4^+(\text{aq})$
D. $\text{MnO}_2(\text{s})$
-
60. When iron is 'galvanized', what metal is used to coat iron? (1)
- A. Al
B. Mn
C. Zn
D. Cr
-
61. What is E° for the following balanced reaction? $\text{Zn(s)} + \text{Pb}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Pb(s)}$. Given reduction potentials: $\text{Zn}^{2+}/\text{Zn} = -0.763 \text{ V}$, $\text{Pb}^{2+}/\text{Pb} = -0.126 \text{ V}$. (1)
- A. $+0.637 \text{ V}$
B. -0.889 V
C. -0.637 V
D. $+0.889 \text{ V}$
-
62. The value of E° for the reaction $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)} + \text{Zn}^{2+}(\text{aq})$ is 1.10 V . What is the value of E_{cell} when the concentrations of Cu^{2+} and Zn^{2+} are equal to 0.025 M ? (1)
- A. 1.10 V
B. 0.95 V
C. 1.15 V
D. 0.80 V
-
63. Natural rubber is a polymer of (1)
- A. butadiene
B. isoprene
C. neoprene
D. styrene
-
64. Why the name given NYLON 66 co-polymer? This is because (1)
- A. It is discovered in 1966
B. Both the monomers have 6 carbons each
C. The longest chain contains 6 carbons
D. It is the sixth polymer

65. Bakelite is obtained from phenol by reacting with (1)
- A. HCHO
B. $(\text{CH}_2\text{OH})_2$
C. CH_3CHO
D. CH_3COCH_3
-
66. The froth-flotation process in metallurgy involves which of the following? (1)
- A. mining of an ore
B. smelting of iron
C. concentration of an ore
D. reduction of metal ion
-
67. Which of the following substances are added to natural rubber to toughen it? (1)
- A. Calcium
B. Carbon
C. Nitrogen
D. Sulfur
-
68. Which will be the best method to decrease the random uncertainty of a measurement in an acid-base titration? (1)
- A. Repeat the titration
B. Use a different titrant
C. Use a different analyte
D. Use a different indicator
-
69. Which of the following is the most important type of solute-solvent interaction in solution NaCl(s) in water? (1)
- A. Dispersion
B. Ion-dipole
C. Dipole-dipole
D. Hydrogen bonding
-
70. Which of the following hydride orbital is favoring the formation of see-saw? (1)
- A. sp^3d
B. sp^3d^2
C. sp^3
D. sp^3d^3
-
71. A neutral molecule having the general formula AX_3 has one unshared pair of electrons on A. Which is the hybridization of A? (1)
- A. sp^3
B. sp^3d
C. sp^3d^2
D. sp^3d^3
-
72. For lithium, enthalpy of sublimation = +161 kJ/mol, first IE = +520 kJ/mol. Dissociation energy of F_2 = +154 kJ/mol, electron affinity of F = -328 kJ/mol. Lattice energy of LiF = -1047 kJ/mol. The overall enthalpy of formation for LiF is: (1)
- A. -617 kJ/mol
B. 2134 kJ/mol
C. -694 kJ/mol
D. 2066 kJ/mol
-
73. Which of the following statements is correct about hydrogen cyanide (HCN)? (1)
- A. It has linear geometry with C as central atom.
B. It has bent or angular geometry with C as central atom.
C. It has trigonal planar geometry with N as central atom.
D. It has bent or angular geometry with N as central atom.
-
74. Which one of the following electromagnetic radiations has the highest energy? (1)
- A. X-rays
B. Gamma rays
C. UV rays
D. Microwaves
-
75. When electrons fall down from the higher energy level to the first excited state, the spectral lines correspond to: (1)
- A. Pfund series
B. Paschen series
C. Lyman series
D. Balmer series

76. The maximum number of electrons in p-orbital with $n=6$, $m_l=0$ is

(1)

- A. 2
B. 16
C. 6
D. 14

77. Which of the following electrons, identified only by their n and l quantum numbers, have the highest energy?

(1)

- A. $n=3, l=2$
B. $n=4, l=1$
C. $n=4, l=2$
D. $n=3, l=0$

— END OF EXAMINATION —

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