

Chemistry, 2007 EC, entrance exam

Grade 12 · Chemistry · 2007 E.C.

Time allowed: 120 minutes

Questions: 71

Total marks: 71

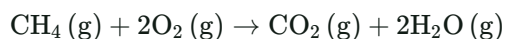
Name _____ Grade _____ ID No. _____ Date _____

1. According to valence bond theory. Which orbitals on bromine atoms overlap in the formation of the bond in Br_2 ? (1)
 - A. 3s
 - B. 3P
 - C. 4s
 - D. 4P
2. The type of compound that is most likely to contain a covalent bond is one that is (1)
 - A. A solid metal
 - B. Composed of only non-metals
 - C. Composed of a metal from the far left and a non-metal from far right of the periodic table
 - D. Held together by the electrostatic forces between oppositely charged ions.
3. The first step of the scientific method involves (1)
 - A. Forming a hypothesis
 - B. Making observations.
 - C. Performing an experiment.
 - D. Predicting the result of an experiment
4. The process of solute particles being surrounded by solvent particles is known as (1)
 - A. Saturation
 - B. Agglomeration
 - C. Solvation
 - D. Dehydration
5. Which one of the following represents an acceptable possible set of quantum numbers (in the order n, l, m_l, m_s) for an electron in an atom? (1)
 - A. 2, 1, 0, 0
 - B. 2, 0, 2, +1/2
 - C. 2, 1, -1, 1/2
 - D. 2, 0, 1, -1/2
6. Of the three types of radioactivity characterized by Rutherford, which of the following are particles? (1)
 - A. γ - rays
 - B. β - rays
 - C. α - rays and β - rays
 - D. α - rays, β - rays, and γ - rays
7. Which kind of energy is converted in a galvanic cell? (1)
 - A. Chemical energy is converted into electrical energy.
 - B. Chemical energy is converted to heat.
 - C. Chemical energy is obtained from heat.
 - D. Electrical energy is converted into chemical energy.
8. The conversion of nitrogen gas to nitrates by bacteria is called (1)
 - A. Nitrification
 - B. Nitrogen fixation
 - C. Excretion
 - D. Denitrification
9. According to the Arrhenius concept, an acid is a substance that (1)
 - A. Is capable of donating one or more H^+ to any solvent.
 - B. Causes an increase in the concentration of H^+ in aqueous solutions.
 - C. Can accept a pair of electrons to form a coordinate covalent bond.
 - D. Reacts with the solvent to form the cation formed by auto ionization of that solvent.

19. The decreasing order of electrochemical characteristics of some metals is given as: $\text{Mg} > \text{Al} > \text{Zn} > \text{Cu} > \text{Ag}$. What will happen if a copper spoon is used to stir a solution of aluminium nitrate $(\text{Al}(\text{NO}_3))_3$? (1)

A. There is no reaction
B. The solution becomes blue
C. The spoon will get coated with aluminium
D. An alloy of copper and aluminium is formed.

20. What hybridization change does the carbon atom undergo in the combustion of methane? (1)



A. $\text{sp} \rightarrow \text{sp}^2$
B. $\text{sp}^2 \rightarrow \text{sp}^3$
C. $\text{sp}^3 \rightarrow \text{sp}$
D. $\text{sp}^2 \rightarrow \text{sp}$

21. Which of the following ionic compounds has the greatest lattice energy? (1)

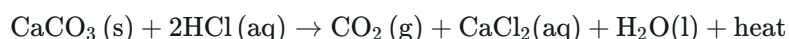
A. LiF
B. LiCl
C. LiBr
D. LiI

22. Consider the three electromagnetic waves shown below. Which of the electromagnetic waves has the highest frequency? (1)

[Figure: A scanned drawing of FOUR sinusoidal waves stacked vertically, all spanning the same horizontal width and each labelled with a numeral on its left. Wave 1 (top): about 7 complete cycles, small amplitude. Wave 2: about 7 complete cycles, noticeably larger amplitude than wave 1. Wave 3: about 4 to 5 complete cycles, large amplitude, the longest wavelength of the four. Wave 4 (bottom): roughly 15 tightly packed cycles, small amplitude, by far the shortest wavelength. No axes, units or values are marked.]

A. 1
B. 2
C. 3
D. 4

23. Considering the reaction below, in which of the following will the effect of concentration and temperature simultaneously cause an increase in the rate at which products are formed? (1)



A. Decrease $[\text{HCl}]$ and decrease temperature.
B. Increase $[\text{HCl}]$ and increase temperature.
C. Increase $[\text{HCl}]$ and decrease temperature.
D. Grind up the CaCO_3 and decrease temperature.

24. The wave number of an electromagnetic radiation is $1 \times 10^5 \text{ cm}^{-1}$. The frequency of the radiation would be (1)

A. $3 \times 10^8 \text{ s}^{-1}$
B. $3 \times 10^6 \text{ s}^{-1}$
C. $3 \times 10^{10} \text{ s}^{-1}$
D. $3 \times 10^{15} \text{ s}^{-1}$

25. For the gas phase reaction (1)



the value of K changes with the

A. Change in pressure
B. Introduction of NO
C. Change in concentration of N_2
D. Change in temperature.

26. In the reaction $(2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3, K_{\text{eq}} = 100)$. What will be the concentration of O_2 , if the concentration of SO_2 is the same as that of SO_3 ? (1)

A. $[\text{O}_2] = [\text{SO}_2]$
B. $[\text{O}_2] = 0.01\text{M}$
C. $[\text{O}_2] = 100\text{M}$
D. $[\text{O}_2] = 0.1\text{M}$

27. The decomposition of nitrosyl chloride was studied as

(1)



The following data were obtained where $\text{Rate} = -\Delta[\text{NOCl}]/\Delta t$. What is the rate law in the above decomposition?

[Figure: A bordered two-column data table sitting between the "Rate" line and the question sentence. Left column heading: $[\text{NOCl}]_0$ (molecules/cm³). Right column heading: Initial Rate (molecules/cm³.s). Four data rows, in this printed order: 3.0×10^{16} and 5.98×10^4 ; 2.0×10^{16} and 2.66×10^4 ; 1.0×10^{16} and 6.64×10^3 ; 4.0×10^{16} and 1.66×10^5 .]

A. $r = k[\text{NOCl}]^2$

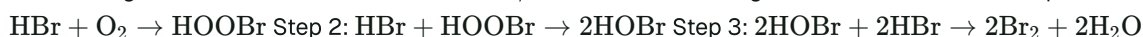
B. $r = K[\text{NOCl}]$

C. $r = K[\text{NOCl}][\text{NO}]$

D. $r = k[\text{NOCl}][\text{Cl}]$

28. Considering the mechanism for a reaction below, which of the following statements is correct? Step 1:

(1)



A. Br₂ is a reactant

B. HBr is a product

C. HOBr is a catalyst

D. HOBr is a reaction intermediate

29. The acid-base indicator bromocresol green is a weak acid. The yellow acid and blue base forms of the indicator are present in equal concentrations in a solution when the PH is 4.68. What is the PKa of bromocresol green?

(1)

A. 4.48

B. 4.68

C. 5.68

D. 6.68

30. A lipid is any substance of biochemical origin that is

(1)

A. Soluble in both water and non-polar solvents.

B. Insoluble in both water and non-polar solvents.

C. Soluble in water but insoluble in non-polar solvents.

D. Soluble in non-polar solvents and insoluble in water.

31. A solution in an electrolytic cell contains Cu²⁺ ($E^0 = 0.34\text{V}$), Ag⁺ ($E^0 = 0.80\text{V}$), and Zn²⁺ ($E^0 = 0.76\text{V}$). If the voltage is initially very low and slowly increased, in which order will the metals be plated out on to the cathode?

(1)

A. $\text{Zn}^{2+} > \text{Cu}^{2+} > \text{Ag}^+$

B. $\text{Cu}^{2+} > \text{Zn}^{2+} > \text{Ag}^+$

C. $\text{Ag}^+ > \text{Zn}^{2+} > \text{Cu}^{2+}$

D. $\text{Ag}^+ > \text{Cu}^{2+} > \text{Zn}^{2+}$

32. What is the molality of a 5g hydrogen peroxide (H₂O₂) in 100mL solution that is used for hair bleaching?

(1)

A. 0.015M

B. 0.15M

C. 1.5M

D. 3M

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

(1)

A. 2

B. 6

C. 16

D. 14

34. How many unpaired electrons are there in the Lewis structure of a N³⁻ ion?

(1)

A. 0

B. 1

C. 2

D. 3

35. Which of the following transitions will emit maximum energy in the hydrogen atom?

(1)

A. $n = 4 \rightarrow n = 3$

B. $n = 4 \rightarrow n = 2$

C. $n = 2 \rightarrow n = 1$

D. $n = 3 \rightarrow n = 2$

36. what is the IUPAC name for the compound (1)
[Figure: A scanned condensed structural formula on one line: (CH3)2CHCH2CHCOH. A double-bonded O is drawn ABOVE the final carbon of the COH group (two short parallel vertical strokes joining the C to the O), making that group a carboxyl. A single vertical bond descends from the chain (drawn at the junction between the CH2 and the following CH) to a CH3 group written below the line. No other labels, charges or stereochemistry are shown.]
- A. 2, 4-dimethylpentanoic acid
B. 1, 1, 3-trimethylbutanoic acid
C. 1-hydroxy-2, 4-dimethyl pentanone
D. 2-carboxyisohexane

37. The connectional equilibrium constant expression (K_c) for the system (1)
- $$2\text{ICl (s)} \rightleftharpoons \text{I}_2 \text{ (s)} + \text{Cl}_2 \text{ (g)}$$

is

- A. $[\text{I}_2][\text{Cl}_2]/[\text{ICl}]^2$
B. $[\text{I}_2][\text{Cl}_2]/2[\text{ICl}]$
C. $[\text{Cl}_2]$
D. $([\text{I}_2] + [\text{Cl}_2])/2[\text{ICl}]$
38. Which of the following compound does NOT follow the octet rule? (1)
- A. CS_2
B. PBr_3
C. IBr
D. BrF_5

39. Chemically, fats and oils are (1)
- A. Acids
B. Alcohols
C. Esters
D. Alkenes

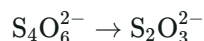
40. The reaction $\text{A} + 3\text{B} \rightarrow 2\text{C} + \text{D}$ is first order with respect to reactant A and second order with respect to reactant B. if the concentration of A is doubled and the concentration of B is halved, the rate of the reaction would by a factor of . (1)
- A. Increases, 2
B. Decreases, 2
C. Increases, 4
D. Decreases, 4

41. The molecular geometry of H_3O^+ ion is (1)
- A. Linear
B. Tetrahedral
C. Bent
D. Trigonal pyramidal

42. What is the final concentration of Cl^- ion when 250ml of 0.20M CaCl_2 solution is mixed with 250ml of 0.4M KCl solution? (Assume additive volumes) (1)
- A. 1.6M
B. 0.4M
C. 0.20M
D. 0.60M

43. Which of the following is used in the reaction called saponification? (1)
- A. Strong base
B. Strong acid
C. Hydrogen
D. Nickel

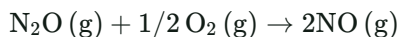
44. How many electrons will appear when the following half-reaction is balanced? (1)



- A. 3
B. 2
C. 4
D. 1
45. pK_a values of three acids x, y and z are 4.5, 3.5 and 6.5, respectively. Which of the following represents the correct order of acid strength? (1)
- A. $x > y > z$
B. $z > x > y$
C. $y > x > z$
D. $z > y > x$

46. Standard electrode potential for $\text{Sn}^{4+}/\text{Sn}^{2+}$ couple is +0.15V and that for the Cr^{3+}/Cr couple is -0.74V. These two couples in their standard state are connected to make a spontaneous reaction. The cell potential will be (1)
- A. +1.83V
B. +1.19V
C. +0.89V
D. +0.18V

47. The enthalpies of formation of gaseous N_2O and NO at 298K are 82 and 90KJ/mol, respectively. The enthalpy change for the reaction (1)

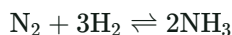


is

- A. -8KJ
B. 98KJ
C. -74KJ
D. 8KJ
48. The following data were collected at the end point of a titration performed to find the molarity of an HCl solution. Volume of acid (HCl) used = 14.4ml Volume of base (NaOH) used = 22.4ml Molarity of standard base (NaOH) = 0.20M On the basis of the above data, what is the molarity of the acid solution? (1)
- A. 1.6M
B. 0.64M
C. 0.31M
D. 0.13M

49. The hybridization of the central atom in the XeF_4 molecule is (1)
- A. Sp^2
B. Sp^3
C. Sp^3d
D. Sp^3d^2

50. For the reaction. (1)



The rate of disappearance of H_2 is $0.01 \text{ mol L}^{-1} \text{ min}^{-1}$. The rate of appearance of NH_3 would be

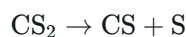
- A. $0.01 \text{ mol L}^{-1} \text{ min}^{-1}$
B. $0.02 \text{ mol L}^{-1} \text{ min}^{-1}$
C. $0.007 \text{ mol L}^{-1} \text{ min}^{-1}$
D. $0.002 \text{ mol L}^{-1} \text{ min}^{-1}$
51. Bakelite is obtained from phenol by reacting with (1)
- A. HCHO
B. $(\text{CH}_2\text{OH})_2$
C. CH_3CHO
D. CH_3COCH_3

52. In which one of the following numbers are all of the zeros significant? (1)
- A. 100.09009
B. 0.14329
C. 0.1
D. 0.003002

53. An aqueous solution contains 0.100M NaOH at 25.0°C . The PH of the solution is? (1)
- A. 0.1
B. 1
C. 7
D. 13

54. The solubility of oxygen gas in water at 25°C and 1.0 atm pressure of oxygen is 0.41g/L. the solubility of oxygen in water at 3.0 atm and 25°C is g/L. (1)
- A. 0.014
B. 0.31
C. 0.041
D. 0.123

55. The decomposition of carbon disulphide, CS_2 , to carbon mono sulphide, CS , and sulphur is first order with $K = 2.8 \times 10^{-7} \text{ s}^{-1}$ at 1000°C . What is the half-life of the reaction below at 1000°C ? (1)



- A.** $5.0 \times 10^7 \text{ s}$ **B.** $4.7 \times 10^{-6} \text{ s}$
C. $3.8 \times 10^5 \text{ s}$ **D.** 2.5×10^6

- 56.** The PK_a of a weak monoprotic acid is 4.8. What should be the ratio of $[\text{Acid}]/[\text{Salt}]$ of a buffer, if $\text{PH} = 5.8$ is required? (1)

- A. 0.1
B. 1
C. 2
D. 10

57. The dissolution of water in octane (C_8H_{18}) is prevented by (1)

- A. Dipole-dipole attraction between octane molecules.
B. Hydrogen bonding between water molecules.
C. London dispersion forces between octane molecules.
D. Repulsion between like charged water and octane molecules.

- 58.** At 445°C , K_c for the following reaction is 0.020. (1)



A mixture of H_2 , I_2 , and HI in a vessel at 445°C has the following concentrations: $[\text{HI}] = 2.0\text{M}$, $[\text{H}_2] = 0.5\text{M}$ and $[\text{I}_2] = 0.10\text{M}$, which one of the following statements concerning the reaction quotient, Q_c , is true for the above system?

- A. Q_c is less than K_c ; more HI will be produced.
- B. Q_c is greater than K_c ; more HI will be produced.
- C. Q_c is less than K_c ; more H_2 and I_2 will be produced.
- D. Q_c is greater than K_c ; more H_2 and I_2 will be produced.

59. Natural rubber is a polymer of (1)

- A. Butadiene
B. Isoprene
C. Neoprene
D. Styrene

60. Which of the following statements is true? (1)

- A.** All forms of electromagnetic radiation are visible.
- B.** Radio waves have shorter wavelength than visible light.
- C.** Ultraviolet light has longer wavelengths than visible light.
- D.** The frequency of radiation increases as the wavelength decreases.

61. If the enthalpy change for a certain reaction $A \rightarrow B$ is -2KJ at 300K , what would be the entropy change in the surroundings? (1)

- A. 6.67 J/K B. 40 J/K
C. -3.6×10^6 J/K D. 3.6×10^6 J/K

- 62.** During the electrolysis of an aqueous solution of copper sulphate using platinum electrodes, the reaction takes place at the anode is

- A. $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$
 B. $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$
 C. $2\text{H}_2\text{O} \rightarrow 4\text{H}^+ + \text{O}_2 + 4\text{e}^-$
 D. $4\text{H}^+ + \text{O}_2 + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}$

63. What is the major product of the reaction?

(1)

[Figure: The stem carries a reaction scheme: a benzene ring (hexagon with three inner double-bond lines) drawn on the left. At the ring carbon on the upper right an acetyl group is attached, drawn as a bond up to a carbon that carries a double-bonded O above it and a plain bond out to the right (a methyl). At the ring carbon immediately below that one (the ortho position) a bond runs down-right to the label Br. To the right of the structure a long horizontal reaction arrow points right, with NaOH written above it and nothing written below it. The four options are pictures, all built on the same benzene ring with a substituent at the top-right ring carbon and another at the ortho position below it. A: top-right substituent is a carbon double-bonded to O above and single-bonded out to the right to the label ON; ortho substituent is Br. B: top-right substituent is a carbon double-bonded to O above and single-bonded to OH; ortho substituent is OH. C: top-right substituent is a carbon double-bonded to O above and single-bonded to ON; ortho substituent is OH. D: top-right substituent is a single carbon carrying three OH labels (one drawn up-left, one up-right, one to the right); ortho substituent is Br.]

- A. [structure] benzene ring carrying a C(=O)-ON group and, on the adjacent (ortho) ring carbon, Br
B. [structure] benzene ring carrying a C(=O)-OH group and, on the adjacent (ortho) ring carbon, OH
C. [structure] benzene ring carrying a C(=O)-ON group and, on the adjacent (ortho) ring carbon, OH
D. [structure] benzene ring carrying a carbon bearing three OH groups and, on the adjacent (ortho) ring carbon, Br

64. Which of the following is an acceptable IUPAC name for the organic compound shown below?

(1)

[Figure: A scanned skeletal (zig-zag) structure of a carboxylic acid, drawn left to right. At the far left a carbon bears two methyl groups drawn as short bonds going up-left and down-left (an isopropyl end). From that branch carbon the chain zig-zags right through four further vertices (up, down, up, down) and ends at a carbon that carries a double-bonded O drawn above it and a bond to the right to the label OH. Counting the branch carbon plus one of its two methyls into the longest chain gives an eight-carbon acid chain with a methyl substituent on the carbon next to the far end. No numbers, stereochemistry or other labels are drawn.]

- A. Octanoic acid
B. 7-methyl heptanoic acid
C. δ - methyl heptanoic acid
D. 7 - methyl octanoic acid

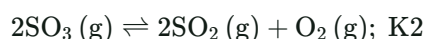
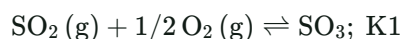
65. Which of the following describes the balanced molecular equation when perchloric acids is mixed with solid iron (III) hydroxide?

(1)

- A. $\text{HCl}_4(\text{aq}) + \text{Fe}(\text{OH})_3(\text{s}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{FeClO}_4(\text{aq})$ B. $3\text{HClO}_4(\text{aq}) + \text{Fe}(\text{OH})_3(\text{s}) \rightarrow 3\text{H}_2\text{O}(\text{l}) + \text{Fe}(\text{ClO}_4)_3$
C. $3\text{HOClo}_2(\text{aq}) + \text{Fe}(\text{OH})_3(\text{s}) \rightarrow 3\text{H}_2\text{O}(\text{l}) + \text{Fe}(\text{ClO}_3)_3(\text{aq})$ D. $\text{HClO}_2(\text{aq}) + \text{Fe}(\text{OH})_3(\text{s}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{Fe}(\text{ClO}_3)$

66. At 298 K the following two gaseous equilibrium involving SO_2 , SO_3 and O_2 are established.

(1)



Which of the following equilibrium expression is correct?

- A. $K_1 = K_2$
B. $K_2 = K_1^2$
C. $K_2 = 1/K_1^2$
D. $K_2 = 1/K_1$

67. A compound is formed by the combination of V and X as follows. What is empirical formula for the compound?

(1)

[Figure: A small, low-resolution scanned strip showing five Lewis electron-dot symbols side by side, each a capital letter surrounded by dots. Left to right: V with a single dot above it (1 valence electron); W with two dots above it (2 valence electrons); X with two dots above, one dot to the left, one dot to the right and one dot below (5 valence electrons); Y with two dots above, one dot to the left, one dot to the right and two dots below (6 valence electrons); Z with two dots above, two dots to the left, one dot to the right and two dots below (7 valence electrons). Only V and X are referred to in the question.]

- A. VX
B. V_2X
C. V_3X
D. VX_2

68. ΔH for solid to liquid transitions for compound A is 2.73Kcal/mol and for compound B is 3.0 Kcal/mol. The melting point for compound A is 0°C and the melting point for compound B is 30°C . the entropy changes ΔS_A and ΔS_B at the two transition temperatures are related as (1)

A. $\Delta S_A = \Delta S_B$

B. $\Delta S_A < \Delta S_B$

C. $\Delta S_B < \Delta S_A$

D. $\Delta S_A = 300\Delta S_B/273$

69. Which of the following metals forms a volatile compound that is taken as an advantage for its extraction? (1)

A. CO

B. Fe

C. Ni

D. W

70. A 0.1M solution of HCl is dissolved in water. What species of ions are present at equilibrium, and what will be their equilibrium concentrations? (1)

A. $[\text{H}_3\text{O}^+] = 0.1\text{M}$ $[\text{OH}^-] = 10^{-13}\text{M}$ $[\text{Cl}^-] = 0.1\text{M}$

B. $[\text{H}_3\text{O}^+] = 0.1\text{M}$ $[\text{OH}^-] = 0.1\text{M}$ $[\text{Cl}^-] = 0.1\text{M}$

C. $[\text{H}_3\text{O}^+] = 0.1\text{M}$ $[\text{OH}^-] = 10^{-13}\text{M}$ $[\text{Cl}^-] = 0\text{M}$

D. $[\text{H}_3\text{O}^+] = 10^{-13}\text{M}$ $[\text{Cl}^-] = 0.1\text{M}$ $[\text{OH}^-] = 0.1\text{M}$

71. The following bases and their conjugate acids (as the chlorides) are available in the laboratory: NH_3 ($K_b = 1.8 \times 10^{-5}$), $\text{C}_6\text{H}_5\text{NCH}_3\text{CH}_2\text{NH}_2$ ($K_b = 6.4 \times 10^{-4}$) and CH_3NH_2 ($K_b = 4.4 \times 10^{-4}$). Which of these acid-base pairs are the best to prepare a buffer solution having a PH of about 9? (1)

A. NH_3 + conjugate acid

B. $\text{C}_6\text{H}_5\text{N}$ + conjugate acid

C. CH_3NH_2 + conjugate acid

D. $\text{CH}_3\text{CH}_2\text{NH}_2$ + conjugate acid

— END OF EXAMINATION —

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