De Mazenod College Kandana

2016 July Term Test   Grade 12   2016 August

CHEMISTRY 1   Time : 2 hours

PART : A M.C.Q.

Answer all questions. Choose the correct or the most suitable answers for questions 1- 50 from the given choices and mark a cross (x) on the appr opriate number given in the answer script.
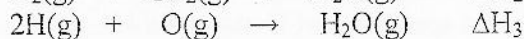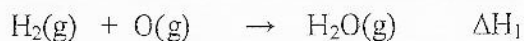
Avogadro's constant (N_A)	$= 6.022 \times 10^{23}$ mol^{-1}
Planck's constant	$= 6.624 \times 10^{-34}$ J s
Speed of light	$= 3 \times 10^{8}$ m s^{-1}
Universal gas constant	$= 8.314$ J mol^{-1} K^{-1}

1) In which of the following elements does a gaseous atom in ground state contain only four unpaired electrons?

   1) Ti   2) Cr   3) Fe   4) Co   5) Sn

2) The correct variation of the first ionsation energy of the elements Li, K, N, O, Ne and Ar is,

   1) K < Li < O < N < Ar < Ne.   2) Ne < Ar < N < O < Li < K.   3) K < Li < O < N < Ne < Ar.
   4) K < O < Li < N < Ar < Ne.   5) Li < N < O < K < Ar < Ne.

3) In an atom, what is the number of atomic orbitals in which an electron with principal quantum number, n = 3 and magnetic quantum number, $m_l = 0$ can exist?

   1) 1   2) 2   3) 3   4) 4   5) 5

4) One mole of N_2H_4 forms the compound Y by removing 10 moles of electrons. If all the "N" atoms in the initial compound are present in compound Y, what is the oxidation number of a "N" atom in Y?

   1) -3   2) -2   3) +1   4) +3   5) +5

5) Which of the following gives the electron pair geometry and hybridisation around an oxygen atom in H_2O_2 respectively?

   1) angular, sp^3 2) tetrahedral, sp^3 3) tetrahedral, sp^2 4) angular, sp   5) linear, sp

6) What is the molar ratio between ethanol (C_2H_5OH), and $KMnO_4$ when ethanol is oxidised to acetic acid (CH_3COOH) by $KMnO_4$ in acid medium?

   1) 3 : 2   2) 1 : 5   3) 4 : 5   4) 2 : 5   5) 5 : 4

7) When a sample of an alloy containing magnesium and aluminium in the molar ratio 1: 2 was reacted with excess hydrochloric acid, the volume of gas liberated under STP was 89.6 dm^3. What is the mass of aluminium in the sample of the alloy? (The molar volume of a gas at STP is 22.4 dm^{3}mol^{-1}. Mg = 24 , Al = 27)

   1) 54.0 g   2) 72.0 g   3) 81.0 g   4) 105.0 g   5) 108.0 g

8) The ascending order of the boiling point of the following compounds is,
   1) $SiH_4 < PH_3 < H_2S < HCl$ 2) $SiH_4 < PH_3 < HCl < H_2S$
   3) $HCl < H_2S < SiH_4 < PH_3$ 4) $HCl < H_2S < PH_3 < SiH_4$
   5) $H_2S < HCl < PH_3 < SiH_4$

9) The content of Cl^- in an aqueous solution of Karnellite is 1.065 g dm^{-3}. The concentration of Mg^{2+} in this solution in mol dm-3 units is (Mg = 24, Cl = 35.5, Ca = 40, K = 39, F = 19)
   1) 0.09   2) 0.03   3) 0.045   4) 0.04   5) 0.010

10) Which of the following compound gives out a yellow coloured product with NaOH(aq) and H_2O_2(aq) ?
   1) $Zn(OH)_2$ 2) $Cr(OH)_3$ 3) $Al(OH)_3$ 4) $Cu(OH)_2$ 5) $Mn(OH)_2$

11) The correct ascending order of the bond angles of the below mentioned species is,
   a) NH_3 b) NF_3 c) SO_2 d) PH_3
   1) a < b < d < c   2) b < a < d < c   3) d < b < a < c   4) a < b < c < d   5) b < c < d < a

12) Which one of the following compounds does not represent yellow colour ?
   1) Ag_3PO_4 2) K_2CrO_4 3) Na_2O_2 4) KO_2 5) NCl_3

13) Which one of the following compounds can be very easily get hydrolyzed?
   1) LiCl   2) BF_3 3) CBr_4 4) $FeCl_3$ 5) BrCl

14) Select the reaction, which does not produce SO_2 as a product?
   1) Reaction between hot conc. sulphuric acid and silver.
   2) Reaction between sodium sulphite and dil. sulphuric acid.
   3) Reaction between sodium hydrogensulphite and dil. slphuric acid
   4) Combustion of ferrous sulphide in air.
   5) Reaction between hydrogen sulphide and hydrogen peroxide.

15) Mass percentage of total salts in sea water is 3.5 %. Out of those salts 0.3 % is $CaCO_3$. Density of sea water is 1.08 g cm^{-3}. Molarity of $CaCO_3$ in sea water is, (Ca = 40, C = 12, O = 16)

   1) 1.05×10^{-2} mol dm^{-3} 2) 1.05×10^{-3} mol dm^{-3} 3) 1.08×10^{-3} mol dm^{-3}
   4) 1.134×10^{-3} mol dm^{-3} 5) 1.134×10^{-4} mol dm^{-3}

16) 25 cm^3 of FeC_2O_4 (aq) is titrated with 0.05 mol dm^{-3} standard $KMnO_4$ solution which is acidified with diluted sulphuric acid. Volume of $KMnO_4$ reacted at the end point is 30 cm^3. What is the concentration of Fe^{2+} in FeC_2O_4 solution ?
   1) 0.15 mol dm^{-3} 2) 0.75 mol dm^{-3} 3) 0.10 mol dm^{-3} 4) 0.02 mol dm^{-3} 5) 0.5 mol dm^{-3}

17) 23.7 g of NH_4HCO_3 (s) is heated up to 77^0C in a closed vessel. Pressure inside the vessel after complete dissociation of NH_4HCO_3 (s) is 4.157×10^5 Nm^{-2}. What is the volume of the vessel ? (Assume all the gaseous products behave ideally.) (H = 1.0 N = 14 C = 12 O = 16)
   1) 8.1 dm^3 2) 2.7 dm^3 3) 5.4 dm^3 4) 4.2 dm^3 5) 16.2 dm^3

18) Which one of the following statement is true about the Hydrogen emission spectrum.
   1) Gap between the lines of a line spectrum increases to the increasing direction of energy.
   2) Emission of radiation occurs during the electrons transfer from lower energy levels to upper energy levels.
   3) Lines of the Hydrogen spectrum diverge rapidly when increasing the frequency.
   4) There are lot of similarities between the emission spectrums of H atom and He^+ ion.
   5) Electron transfer from n = 3 to n = 1 is relative to the Hα line.

19) Mass of a molecule of gas A is twice the mass of a gas molecule B. Also the rms speed of gas A is twice the rms speed of B. The volumes of two samples of A and B are equal and also their number of molecules. What is the pressure ratio between A and B?
   1) 3 : 2   2) 5 : 3   3) 8 : 1   4) 2 : 11   5) 1 : 10

20) A substance which is not used to purify water is,
   (1) chlorine   (2) chlorine dioxide   (3) ozone   (4) hydrogen peroxide   (5)potash alum

21) Which of the following steps is most suitable as an initial step of conversion of SO_2 gas to H_2S ?
   1) $SO_2 + Mg \rightarrow$ 2) $SO_2 + H_2O_2 \rightarrow$ 3) $SO_2 + Cl_2 \rightarrow$
   4) $SO_2 + HI$ 5) $SO_2 + NaOH \rightarrow$

22) What can be the products between the reaction of $NH_4Cl(aq)$ and $Mg(s)$?
   1) $MgCl_2 + NH_3 + H_2$ 2) $Mg(OH)_2 + NH_3 + HCl$ 3) $MgCl_2 + NH_3$
   4) $Mg(OH)_2 + NH_3 + Cl_2$ 5) $Mg(OH)_2 + NH_3 + H_2 + Cl_2$

23) Which of the following can be used to distinguish between $KNO_2(aq)$ and $KNO_3(aq)$?
   1) Br_2/H_2O 2) KCNS   3) H_2S 4) Na_2S 5) $(NH_4)_2S$

24) Which one of the following gas has got the highest mole fraction in the atmosphere ?
   1) He   2) Ne   3) Ar   4) Kr   5) Xe

25) Which one of the following compounds forms acidic fumes with water ?
   1) CsCl   2) $CaCl_2$ 3) SiO_2 4) $AlCl_3$ 5) P_2O_5

26) Select the elemental pair which represents the most abundant s block element in the earth's crust and the most abundant group 2 element in sea water respectively.
   1) Ca Mg   2) Mg,Ca   3) Na, Ca   4) K,Mg   5) K, Ca

27) $[Na^+(aq)]$ of an aqueous solution of Na_2CO_3 is 57.50 ppm. The molarity of Na_2CO_3 in that particular solution is,
   1) 1.08×10^{-3} mol dm^{-3} 2) 0.54×10^{-3} mol dm^{-3} 3) 1.25×10^{-3} mol dm^{-3}
   4) 2.50×10^{-3} mol dm^{-3} 5) none of the above mentioned

28) $NaHCO_3$ sample (10.0 g) contaminated with non volatile impurities was heated to obtain a constant weight. Weight of the residue was 6.9 g . Mass percentage of $NaHCO_3$ present in the original sample was, (R.A.M., Na=23, C=12, H=1, O=16)
   1) 81%   2) 20%   3) 31%   4) 69%   5) None of the above mentioned

29) The molar enthalpies of the formation of H_2O (g) out of H_2 and O_2 under three different conditions are given as follows,

$$H_2(g) + O(g) \rightarrow H_2O(g) \quad \Delta H_1$$
$$H_2(g) + \tfrac{1}{2}O_2(g) \rightarrow H_2O(g) \quad \Delta H_2$$
$$2H(g) + O(g) \rightarrow H_2O(g) \quad \Delta H_3$$

Relationship among ΔH_1, ΔH_2, ΔH_3 is,

1) $\Delta H_3 < \Delta H_1 < \Delta H_2$ 2) $\Delta H_2 < \Delta H_1 < \Delta H_3$ 3) $\Delta H_3 < \Delta H_2 < \Delta H_1$
4) $\Delta H_1 < \Delta H_2 < \Delta H_3$ 5) $\Delta H_2 < \Delta H_3 < \Delta H_1$

30) Volume of gas evolved, in the reaction between 9.45 g of Al and excess amounts of NaOH at standard temperature and standard pressure was, (consider the evolved gas resembled the ideality and the molar volume of an ideal gas in standard temperature and pressures is 22.4 dm^3, R.A. M Al= 27)

1) 3.92 dm^3 2) 7.84 dm^3 3) 15.68 dm^3 4) 23.52 dm^3 5) 11.76 dm^3

Instructions for questions 31-40 are mentioned below,

1	2	3	4	5
Only (a) and (b) are correct	Only (b) and (c) are correct	Only (c) and (d) are correct	Only (a) and (d) are correct	One or different number of answers are correct

31) Which of the following statement(s) is / are true about the chemistry of compounds containing nitrogen?
(a) NH_3 can act as a weak base as well as an acid.
(b) An acid and a base are formed by the hydrolysis of NCl_3 .
(c) N_2O can be prepared by heating a mixture of NH_4Cl and $NaNO_3$.
(d) HNO_2 and HNO_3 are two very strong oxoacids formed by nitrogen.

32) What is / are the product (s) formed when sulphur is reacted with NaOH?
(a) Na_2S (b) Na_2SO_4 (c) H_2O (d) $Na_2S_2O_3$

33) Which of the following pairs has/have shape(s) different from the electron pair geometry around central atom in both species ?
a) $XeOF_4$, H_3O^+ b) SO_3, XeO_2F_2 c) PCl_6^-, XeO_4 d) $XeOF_4$, CH_3^-

34) Which of the following is/are true regarding the molecular kinetic theory of gases ?
a) The kinetic energy of an ideal gas molecule remains constant at constant temperature
b) The most probable kinetic energy increases when the temperature of a gas increases
c) The mean speed of an ideal gas molecule increases with increase of the temperature.
d) The mean square speed of gas molecules at constant temperature is proportional to the molar mass of the gas.

35) Which of the following is correct regarding graphite ?
   —(a) All carbon atoms of graphite show sp^2 hybridization
   (b) Each carbon atom has got an electron ,which doesn't involve in covalent bonding
   (c) All bonds in graphite can be identified as covalent
   (d) Graphite is the material which has got the highest melting and the highest boiling point

36) Which of the following statement/s is/are correct ?
   a) $\Delta S > 0$, for all spontaneous processes
   b) $\Delta H > 0$, for all spontaneous processes
   c) $\Delta G = 0$, for the forward and backward reactions of any process which is at equilibrium
   d) Both ΔS and ΔH can be either positive or negative for either forward or backward reaction in an equilibrium system

37) Which of the following statements is/are not true with regard to elements in the second period from Li to F?
   a) The highest negative electron affinity is shown by F
   b) Atomic radii decrease from Li to F
   c) The highest oxidation state is exhibited by N
   d) C is not capable of showing the valency of 2

38) Which of the following can be used to distinguish between $Na_2S(aq)$ and $Na_2SO_3(aq)$?
   a) $H+/K_2Cr_2O_7$ b) $Pb(CH_3COO)_2$ c) conc. HNO_3 d) $BaCl_2$

39) Which of the following solutions cannot be used to distinguish between SO_2 and CO_2 ?
   a) $K_2Cr_2O_7/H^+$ b) $KMnO_4$ c) litmus solution   d) $FeCl_3/H^+$

40) Which of the following statements is/are true for an electron that has quantum numbers $n = 3$ and $m_l = -2$?
   a) The electron is in the third main energy level
   b) The electron is in a d orbital
   c) The electron is in a p orbital
   d) The electron must have a spin quantum number $m_s = +1/2$

Instructions for the questions 41-50 as follows.

Choice	1st statement	2nd statement
1	True	True and clearly explains the 1st statement
2	True	True and doesn't explain the 1st statement
3	True	False
4	False	True
5	False	False

<div align="center">1st statement   2nd statement</div>

	1st statement	2nd statement
41	Entropy of 1 mol of NaBr(s) at 0 °C is zero.	The entropy of pure ionic compound at 0 °C is zero.
42	The nitride of Mg can be formed from the reaction between ammonia gas and Mg.	NH_3 can act as an oxidizing agent
43	Positive rays travel in a curved path in magnetic fields.	All sub atomic particles travel in cureved paths in magnetic fields.
44	The first electronic affinity of Fluorine is more exothermic than that of Chlorine.	The first electron affinity decreases gradually on moving down the group 17.
45	$SO_2(g)$ and $CO_2(g)$ can be separately identified by using lime water	$CO_2(g)$ gives a milky white precipitate with lime water.
46	NCl_3 can act as a bleaching agent in the presence of water	NCl_3 reacts with water and gives NH_3 and $HOCl$
47	The entropy of the surroundings goes down when water vapour condenses in a closed system	Heat given out by a system increases the thermal motion of particles in the surroundings.
48	$Fe^{2+}(aq)$ and $Fe^{3+}(aq)$ can be separately identified using H_2S	A black precipitate is obtained when H_2S is passed through ferrous and ferric ion solutions separately.
49	Sodium sulphite is used to absorb SO_2 gas emitted by some chemical industries	Sodium sulpahte is formed when SO_2 reacts with sodium sulphite
50	Li is the strongest reducing agent of group one	Radii are decreased when moving down the group.

CHEMISTRY II   Time : 2 hours

PART B - Essay   Answer all questions

5) (a) X canister with a piston has got $N_2(g)$ at 127 °C and 2×10^5 N m^{-2} pressure. Y canister has got $O_2(g)$ at 227 °C and 5×10^5 N m^{-2} pressure. Volume of the canister Y can be altered. They are connected by a tap A. Answer to the questions assuming $N_2(g)$ and $O_2(g)$ behave as ideal gases under the above given conditions.(R.A.M. O=16,N=14)

i) Which canister has got the highest gas mass prior to the opening of tap A?

ii) Which of the molecules has got the highest mean kinetic energy, prior to the opening of tap A?

iii) Which state will be occupied by the system if the tap A is opened?

iv) After opening of tap A, piston was pushed at its maximum level to deliver the gas of X, into Y. Then canister Y was kept at 227 ° C constant temperature. As a result of this process volume of canister Y was increased by 2 dm^3. Assuming the gases would not react with each other under the given conditions, calculate the following,

    a) Partial pressure of $N_2(g)$
    b) Partial pressure of $O_2(g)$
    c) Total pressure
    d) Mole fraction of $N_2(g)$

b) i) State the values with units of P,V,n,R and T which can be used in the ideal gas equation for 7 g of $N_2(g)$ at standard temperature and standard pressure. (Assume N_2 would behave as an ideal gas under the above conditions)

ii) Calculate the density of N_2 gas at 127 °C and 4.157×10^5 Pa.

c) i) Write an equation for the compressibility factor.
ii) Derive an equation for the root mean square velocity of an ideal gas including its molar mass using ideal gas equation and molecular kinetic equation.
iii) Plot the Maxwell-Boltzmann curve for ideal as molecules in a particular temperature. Half of the number of molecules is removed without changing the temperature. Plot a curve (using dotted lines......) on the same graph to represent that.

6) (a) Define the following standard enthalpies
    i.Standard enthalpy of atomization
    ii.Standard enthalpy of first electron affinity
    iii.Standard enthalpy of evaporation
   iv.Standard enthalpy of solution

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(b) Some of the standard enthalpy data are listed below,

|	
Standard enthalpy of formation of NaBr(s)	$= -361\ kJ\ mol^{-1}$
Standard enthalpy of the first electron affinity of Br(g)	$= -325\ kJ\ mol^{-1}$
Standard enthalpy of sublimation of Na(s)	$= +107\ kJ\ mol^{-1}$
Standard bond dissociation enthalpy of Br_2(g)	$= +194\ kJ\ mol^{-1}$
Standard enthalpy of the first ionization energy of Na(g)	$= +498\ kJ\ mol^{-1}$
Standard lattice enthalpy of NaBr(s)	$= -753\ kJ\ mol^{-1}$

i. Design an enthalpy diagram to represent the standard lattice enthalpy of sodium bromide. Label its steps using suitable symbols.

ii. Using the above diagram and the data, calculate the standard enthalpy of vaporization of bromine.

(c) i) Calculate the standard entropy change of the combustion of H_2(g) at room temperature(25 °C)

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$$
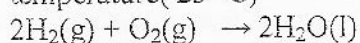
Standard entropies,	H_2O(l)	$= 69.9\ J/mol.K$
	O_2(g)	$= 205.0\ J/mol.K$
	H_2(g)	$= 130.6\ J/mol.K$

ii) If the $\Delta H^{\ominus}$ of the above reaction is $- 571.6\ kJ\ mol^{-1}$, comment on the spontaneity of the above mentioned combustion process, using Gibb's free energy.

iii) Entropy change of melting ice can be represented as follows,

$$H_2O(s) \rightarrow H_2O(l) \quad \Delta H^{\ominus} = +6\ kJ\ mol^{-1}$$
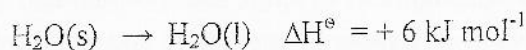
"It's a spontaneous process occurring at room temperature". Comment on this statement using your knowledge of entropy.

7) (a) A piece of pure magnesium was completely burnt in a mixture of N_2 and O_2 and the mixture of MgO and Mg_3N_2 so obtained had a mass of 1.8 g. When this mixture was heated with excess water and the product obtained ignited; only MgO was formed. The mass of this MgO was 2.0 g. Calculate the mole ratio MgO: Mg_3N_2 in the mixture formed by burning the piece of magnesium. (Ignore the reaction between MgO and water).(Mg = 24, O = 16, N = 14)

(b) When 20.0 g of a white solid X is heated, 4.4 g of an acidic gas A and 1.8 g of a neutral gas B are evolved, leaving behind a solid residue Y of mass 13.8 g. A turns lime water milky and B condenses into a liquid which changes anhydrous copper sulphate blue. The aqueous solution of Y is alkaline to litmus and gives 19.7 g of white precipitate Z with barium chloride solution. Z gives carbon dioxide with an acid. Identify A, B, X, Y and Z. (Ba = 137)

(c) You are provided an aqueous solution containing CO_3^{2-} ions and HCO_3^- ions. How would you qualitatively identify the presence of these two ions in the solution?

(d) Assume that you have provided a solid mixture containing KNO_3 and K_2CrO_4 and also you have supplied $Ba(NO_3)_2(aq)$, $CH_3COOH(aq)$ and $H_2O(l)$. Using these chemicals , identify the presence of KNO_3.

(e) You are provided with separate ^solid samples of KNO_3, $Pb(NO_3)_2$, $Ba(NO_3)_2$ and $Mg(NO_3)_2$. Show how you would identify the given sample. You are allowed only to heat the samples and use water. Write balanced chemical equations for the reactions involved.

8) (a) A metal M belongs to the s block of the periodic table. It burns with a yellow flame in the presence of excess oxygen gas to give a solid M_1. On treatment with cold water M_1 gives a clear basic solution M_2 and a covalent compound M_3. M_3 reacts with acidified Ag_2O to give a colourless diatomic gas M_4. Excess of M_2 reacts with the metal T to give a colourless diatomic gas M_5 and a water soluble compound M_6. The addition of dil. HCl drop wise to an aqueous solution of M_6 gives a white gelatinous precipitate M_7, which dissolves in excess acid. M_7 does not dissolve in dil. NH_4OH.

    I.   Identify M, T, M_1, M_2, M_3, M_4, M_5, M_6 and M_7
    II.   Predict the products of the reaction of M_1 with water.

(b) A mixture of ammonia and hydrazine is placed in a sealed container at 300 K. The total pressure is 0.5 atm. The container is heated to 1200 K, at which time both substances decompose completely according to the following equations,

$$2NH_3(g) \longrightarrow N_2(g) + 3H_2(g)$$

$$N_2H_4(g) \longrightarrow N_2(g) + 2H_2(g)$$
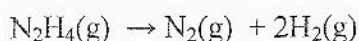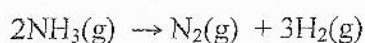
After the complete decomposition, the total pressure at 1200 K is found to be 4.5 atm. Find the mole percentage of hydrazine in the original mixture.

(c) X,Y and Z are three gases at room temperature. X reacts with Y forming a yellow solid. X reacts with Z forming the same yellow solid. Identify X, Y and Z. Give balanced chemical reactions to support your answers.

(d) Chemical formula of dolomite is given as $CaCO_3.MgCO_3$. How would you experimentally show the molar ratio between $CaCO_3$: $MgCO_3$ is 1:1?

(e) Write balanced chemical equations for each of the following to show their reducing and oxidizing capabilities.

    i) NH_3 ii) SO_2 iii) H_2S iv) H_2O_2