THE OPEN UNIVERSITY OF SRI LANKA
Certificate in laboratory Technology
FINAL EXAMINATION - 2009 / 2010
PSC1222 — Basic Chemistry for Laboratory Practice

Duration: Two hours
Date and time: 30th June, 2010 from 1.30 p.m. to 3.30 p.m.

Instructions to students

This question paper consists of three pages and six questions. **Answer any four questions.**

1. Think that a 0.2 M acetic acid (CH$_3$COOH) solution and a 0.1 M potassium hydroxide (KOH) solution are placed in front of you.
   (a) Give one physical property and one chemical property of each solution that would enable you to identify them separately.

   (08 marks)

   (b) Why do we categorize acetic acid as a weak acid and potassium hydroxide as a strong base?

   (10 marks)

   (c) The dissociation constant (K$_a$) of acetic acid is 1.8 x 10^{-4} mol dm^{-3}.
       (i)   Write an expression for the equilibrium constant K$_a$.
       (ii)   What is the concentration of hydrogen ions if the concentration of CH$_3$COO$^-$ ions is 1 x 10^{-7} mol dm^{-3}?

   (22 marks)

   (d) Calculate the pH of a 0.1 M KOH solution.   (10 marks)

   (e) (i)   Write the balanced equation for the reaction between CH$_3$COOH and KOH.
        (ii)   What will happen to the pH of this solution if 0.2 M acetic acid solution is added?
        (iii)   Calculate the volume of 0.02 M acetic acid required to neutralize 25.00 cm^3 of 0.2 M KOH (show the steps clearly).

   (35 marks)

   (f) Comment on the following statement.
   "Change in the colour of an acid – base indicator does not mean that the solution is changed from acidic to basic or *vice versa*."

   (15 marks)

2. A radioactive isotope "X" decays by giving off an alpha particle and $^{222}_{86}Rn$ is formed.

(a) Write a balanced equation for the nuclear reaction. (10 marks)

(b) 0.04 g of $^{222}_{86}Rn$ decayed and only 0.01 g of $^{222}_{86}Rn$ was left after 8 years. What is the half life of this isotope?
(10 marks)

(c) What is the difference between nuclear fission and nuclear fusion?
(20 marks)

(d) "Shorter the half life more dangerous the radioisotope would be". Comment on this statement.
(10 marks)

(e) Four types of fire extinguishers are known depending on the contents in them. What are they?
(08 marks)

(f) What is meant by "hazardous chemicals". (10 marks)

(g) Identify the danger/risk(s) associated with the following substances.
   (i) Potassium chlorate
   (ii) Benzene
   (iii) Sulfuric acid
(12 marks)

(h) The most serious fires or floods usually begin in unoccupied laboratories because something has been left on inadvertently or incorrectly. What would you check before you leave the laboratory?
(12 marks)

(j) Identify the following symbols.

(i)   (ii)
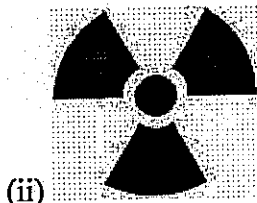
(08 marks)

3. Nimal was asked to determine the amount of potassium present in the solid fertilizer "Kapruka". He was given a box containing 50 packets (500 g each) of fertilizer "Kapruka". He analysed five random samples and the results obtained were (ppm), 272, 275, 273, 275, 272

(a) Briefly describe how Nimal had taken the random samples. (15 marks)

(b) Find the mean value of the potassium content. (10 marks)

(c) As stated on the cover of the packet, the amount of potassium should be 375 ppm.
   (i) What is the absolute error of the mean?

   (ii) Suggest two errors that would have taken place causing this large error.
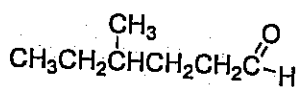
(15 marks)

(d) Even when a small amount of the fertilizer was dissolved in water in order to analyse the potassium amount, some undissolved solid was left. Nimal thinks that this undissolved solid must be a potassium salt and it must be the reason for getting low potassium values. Do you agree with him? Give reasons for your answer.
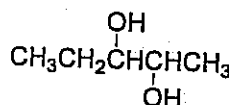
(10 marks)

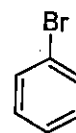(e) An alcohol A, has the molecular formula C_3H_8O. Draw the two isomers for A.

(10 marks)

(f) Give IUPAC names of the following compounds.

$$CH_3CH_2CHCH_2CH_2C\overset{O}{\underset{}{\diagup}}H$$ with CH_3 branch

B

$$CH_3CH_2CHCHCH_3$$ with OH, OH

C

Br on benzene ring

D

(15 marks)

(g) Explain briefly.
   (i) Organic reactions should not be carried out near open flames.
   (ii) Water and chloroform shaken in a separating funnel together, separated out into two layers on standing.
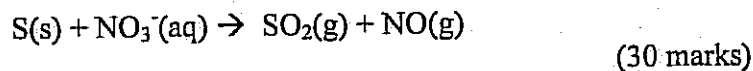
(16 marks)

(h) Name three common organic reagents.

(09 marks)

3

4. (a) Show that $CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g)$ **is a redox reaction**

(30 marks)

(b) Balance the following redox reaction in acidic solution by using half reaction method.

$$S(s) + NO_3^-(aq) \rightarrow SO_2(g) + NO(g)$$

(30 marks)

(c) Write down the two cathodic reactions (reduction reactions) possible when a piece of Zn is placed in a HCl solution containing oxygen.

(10 marks)

(d) Explain why the presence of salt greatly enhances the rusting of metals.

(10 marks)

(e) Explain how a sacrificial coating prevent corrosion on a metal

(10 marks)

(f) Briefly explain how anodic protection of a metal prevents corrosion.

(10 marks)

5. (a) (i) Write the symbols for the following elements
   (I) Zinc
   (II) Fluorine
   (III) Phosphorous
   (IV) Lead

(12 marks)

(ii) The most abundant isotope of silver is $^{107}_{47}Ag$
   (I) How many protons, neutrons and electrons are present in this isotope
   (II) What is the symbol of another isotope of silver with 62 neutrons?

(18 marks)

(b) (i) Which of the following pairs of elements are likely to form an ionic compound?
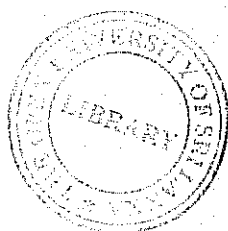   (I) Sodium and Chlorine
   (II) Oxygen and Iodine
   (III) Calcium and fluorine
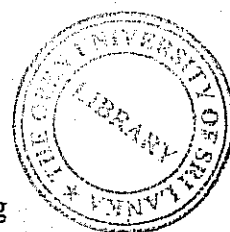   (IV) Sodium and Neon
   (V) Sodium and Magnesium

(20 marks)

(ii) Classify each of the compounds as ionic or covalent.
   (I) Na_2SO_4 (II) N_2 (III) N_2O (IV) CF_4 (V) PCl_5

(10 marks)

(c) Calculate the empirical formula for a compound that gives the following analysis.

29.1% Na   40.5% S   30.4% O

(Relative atomic mass of Na = 23.00 ; S = 32.06 ; O = 16.00)

(20 marks)

(d) How many moles of substance are present in the following compounds?

(i)   0.250 g of $CaCO_3$

(ii)   5.30 g of Na_2CO_3

(Relative atomic mass for Ca = 40;   C = 12 ;   Na = 23 ;   O = 16)

(20 marks)

6. (a) Write the formula for the following compounds
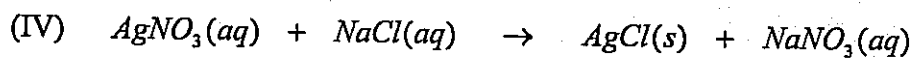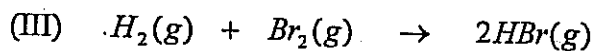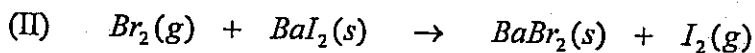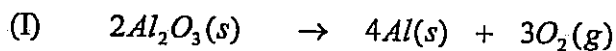   (i) Calcium chloride
   (ii) Magnesium sulphate
   (iii) Carbon tetrachloride
   (iv) Dinitrogen oxide
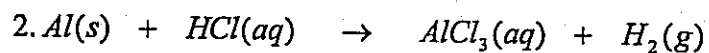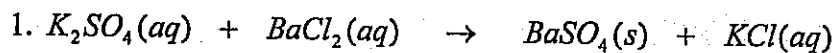
(20 marks)

(b) (i) Classify each reaction as combination, decomposition, single replacement and double replacement.

(I) $2Al_2O_3(s)$ → $4Al(s)$ + $3O_2(g)$

(II) $Br_2(g)$ + $BaI_2(s)$ → $BaBr_2(s)$ + $I_2(g)$

(III) $H_2(g)$ + $Br_2(g)$ → $2HBr(g)$

(IV) $AgNO_3(aq)$ + $NaCl(aq)$ → $AgCl(s)$ + $NaNO_3(aq)$

(20 marks)

(ii) Balance the following equations.

1. $K_2SO_4(aq)$ + $BaCl_2(aq)$ → $BaSO_4(s)$ + $KCl(aq)$

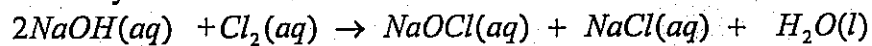2. $Al(s)$ + $HCl(aq)$ → $AlCl_3(aq)$ + $H_2(g)$

(10 marks)

(c) (i) What is the concentration of a solution of potassium hydroxide containing 0.030 mol in 100 ml.

(10 marks)

(ii) Aqueous solution of sodium hypochlorite (NaOCl) is prepared by reaction of sodium hydroxide with chlorine.

$$2NaOH(aq) + Cl_2(aq) \rightarrow NaOCl(aq) + NaCl(aq) + H_2O(l)$$

How many grams of NaOH are needed to react with 25.0 g of Cl_2?
(Relative atomic mass for Na = 23, O = 16, Cl = 35.5, H = 1)

(15 marks)

(d) (i) A person with fever has a temperature of 102^0F. What would be the reading In Celsius thermometer?

(10 marks)

(ii) A flask is filled when 19.6 g of water is added to it.
Taking the density of water to be 1.00 g/cm^3, calculate the volume of the flask.

(15 marks)