

THE OPEN UNIVERSITY OF SRI LANKA
PSC 1222-BASIC CHEMISTRY FOR LABORATORY PRACTICE - 2015/2016
HOME ASSIGNMENT

- Write brief, focused answers.
- Marks will be deducted if the answers are copied by another person.
- Write the answers to all questions in blank sheets.
- Copy the relevant tables separately when you answer the questions.
- Deadline for the home assignment – 18th September 2015.
- Submission of the home assignment should be done by mailing it (preferably by registered post) to the address given below on or before the deadline date.
- Please write down your address on the back side of the last page of the answer script.

Ms. D.D.D.H. Alwis,
The Co-ordinator/ PSC1222
Department of Chemistry
The Open University of Sri Lanka
Nawala
Nugegoda

1. (a) Briefly explain what are elements and compounds? (10 marks)
- (b) Silicon, iron, aluminum and oxygen are the four most abundant elements on earth. Write down the symbols of those elements and which element is the most abundant on earth? (10 marks)
- (c) Indicate the numbers of protons, neutrons and electrons in $^{35}_{17}\text{Cl}$ and $^{80}_{35}\text{Br}^-$. (09 marks)
- (d) What elements are in the following substances?
 CO_2 , CaCO_3 , $\text{C}_6\text{H}_{12}\text{O}_6$, NaOH , and N_2O_5 (15 marks)
- (e) What is the chemical formula for a compound that contains two atoms of hydrogen, one atom of sulfur and four atoms of oxygen? (06 marks)
- (f) (i) Explain, how does the ionic bond is form? (08 marks)
- (ii) Which of the following molecule/s has an ionic bond?
 CO , CaBr_2 , HBr , Cl_2 (10 marks)
- (iii) Draw the dot and cross diagram to show how the ionic bond is formed in the above molecule/s you have selected in Q1 (f) (ii). (16 marks)
- (g) (i) Write down the formula of sodium carbonate. (06 marks)
- (ii) What is the mass of sodium carbonate required to dissolve in 0.5 dm^3 of water to give a sodium carbonate solution of concentration 1.5 mol dm^{-3} . (10 marks)

2. (a) The mass of an element enables the relative abundance of each isotope of the element to be determined. Data relating to the mass spectrum of bromine, atomic number 35, appear below.

Mass number of isotope	Relative abundance (%)
79	50.5
81	49.5

- (i) Define the term isotope. (07 marks)
- (ii) Write down the conventional symbols for the two isotopes of bromine. (08 marks)
- (iii) Calculate the relative/ average atomic weight of bromine. (20 marks)

(b) The two principle isotopes of lithium have masses of 6.01513 and 7.01601 amu, respectively. The atomic weight of lithium is 6.941. Calculate the percent abundances of the two isotopes.

(25 marks)

(c) Calculate the molar concentrations of the following solutions,

- (i) 1.5 mol C₂H₅OH in 4.80 L of water (10 marks)
- (ii) 10.0 ml of pure glycerol, C₃H₈O₃ (density 1.26 g/ cm³), in 250.0 ml of water

(10 marks)

(d) (i) Balance the following equation,



(ii) What is the volume of 0.0102 M Ba(OH)₂(aq), in milliliters required to titrate 10.00 ml of 0.0526 M HNO₃(aq) (show all the steps)? (10 marks)

3. (a). (i) What is a random sample? (10 marks)

(ii) Hardness in water is one major problem in North & East areas in Sri Lanka. In order to understand the relationship between the hardness level and the soil type it was necessary to analyse the amount of calcium in well water and the soil nearby. Suggest suitable methods to obtain random samples of water from a well and the soil of 1 m wide stripe around the well. (20 marks)

(iv) For the analysis of the well water, the analyst wanted to pipette 25.0 ml of water into a conical flask. Give one example of a random error and systematic error that can take place when pipetting. (10marks)

(v) Give two differences of systematic and random errors. (08 marks)

(vi) The above analysis was done using the same pipette and the pipetted volume for five times are (ml), 25.0, 25.01, 25.03, 25.01, 25.05

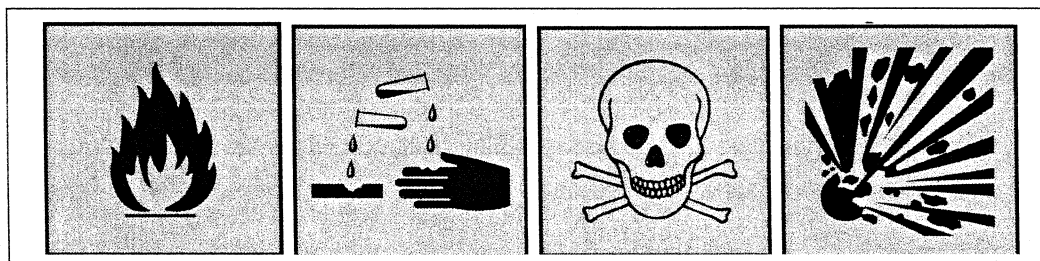
Calculate the absolute error of the mean. (12 marks)

- (b) Explain the following.
1. When we warmed a saturated solution of NaCl the undissolved salts particles disappeared.
 2. When we warmed a solution of HCl the concentration decreased.
 3. The substance "X" dissolves in water but not in ether. The substance X is a polar substance and can be a halide or a nitrate. (30 marks)

- (c) Name the products and underline any precipitates formed at room temperature in each of the following reaction.
1. Sodium hydroxide and sulfuric acid
 2. Barium carbonate and calcium sulfate (10 marks)

- (4) (a) Define the term Hazard chemicals and name three of them. (12 marks)

(b) The four most common safety symbols are given below. Name them and briefly describe them with two examples for each symbol.



(32 marks)

- (c) (i) When you buy a chemical from a reputed company what are the information you can obtain from a proper label on the bottle/container? (10 marks)
- (ii) What is the information which we should label on the bottle of a new solution we have prepared in the laboratory? (10 marks)
- (d) (i) What is meant by the term "fractional distillation". (10 marks)
- (ii) In order to have a better separation of the components in a crude oil which type of distillation set up a student can used. Draw a diagram to illustrate it and identify all the components in it. (16 marks)
- (e) How would you clean-up an acid spill? (10 marks)

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Certificate in Laboratory Technology 2015/2016

PSC1222 - Basic Chemistry for Laboratory Practice

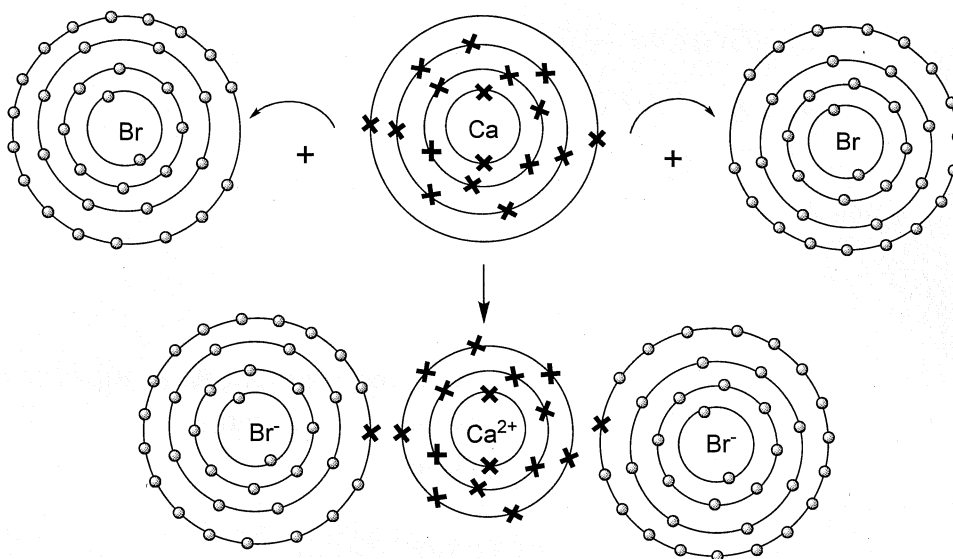
Home Assignment –Answer Guide

1.

- (a) An element is a substance which **cannot be further reduced to a simpler substance** by ordinary processes, and is made up of particles of one kind only. (05 marks)
Many **elements combined to form compounds.** (05 marks)
- (b) Si, Fe, Al and O (08 marks)
Oxygen (02 marks)
- (c) No. of protons: 17 no: of electrons: 17 no: of neutrons: 18 (03 marks)
No of protons: 35 no: of electrons: 36 no: of neutrons: 45 (06 marks)
- (b) C and O (02 marks)
Ca, C and O (4.5 marks)
C, H and O (4.5 marks)
Na, O and H (02 marks)
N and O (02 marks)
- (e) A compound with two hydrogen atoms, one sulfur atom and four oxygen atoms would have the formula H_2SO_4 . (06marks or zero)
- (f) (i) Ionic bonds are formed when a metal losses an electron to a nonmetal. (08 marks)
(ii) The **only bond between a metal and a nonmetal** is the bond formed between calcium and bromine (10 marks)

(iii)

(16 marks)



Formation of Ca^{2+} , Br^- ions

(g) (i) Na_2CO_3

(06 marks)

$$\begin{aligned} \text{(ii) Amount of mol} &= 0.5 \text{ dm}^3 \times 1.5 \text{ mol dm}^{-3} \\ &= 0.75 \text{ mol} \\ \text{Molar mass of Na}_2\text{CO}_3 &= 106 \text{ g mol}^{-1} \\ \text{Mass of Na}_2\text{CO}_3 &= 0.75 \text{ mol} \times 106 \text{ g mol}^{-1} \\ &= 79.5 \end{aligned}$$

(10 marks)

(2) (a) (i) Atoms of the **same element having different masses** are called isotopes. (07 marks)

(ii) ${}^{79}_{35}\text{Br}$, ${}^{81}_{35}\text{Br}$ (08 marks)

$$\begin{aligned} \text{(iii) The relative/average atomic weight} &= 79 \times 50.5/100 + 81 \times 49.5/100 \\ &= 79 \times 0.505 + 81 \times 0.495 \\ &= 79.9 \end{aligned}$$

(20 marks)

(c) Relative abundance of 6.01513 is x %, then other isotope 7.01601 is (100 - x) %

$$6.941 = \left(6.01513 \times \frac{x}{100} \right) + \left(\frac{100-x}{100} \times 7.01601 \right)$$

$$x = 7.5 \%$$

Therefore, other isotope has,

$$100 - x = 100 - 7.5$$

$$= 92.5 \%$$

(25 marks)

$$\begin{aligned} \text{(d) (i) Concentration of C}_2\text{H}_5\text{OH} &= \frac{1.5 \text{ mol}}{4.80 \text{ dm}^3} \\ &= 0.3125 \text{ mol dm}^{-3} \end{aligned}$$

(15 marks)

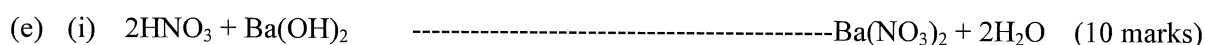
(ii) $d = \frac{m}{v}$ and $m = dv$

$m = 1.26 \text{ g cm}^{-3} \times 10 \text{ cm}^3 = 12.6 \text{ g}$

Molar mass of $\text{C}_3\text{H}_8\text{O}_3 = (36 + 8 + 48) = 92 \text{ g mol}^{-1}$

Number of moles of $\text{C}_3\text{H}_8\text{O}_3 = \frac{12.6 \text{ g}}{92 \text{ g mol}^{-1}} = 0.136 \text{ mol}$

Concentration of $\text{C}_3\text{H}_8\text{O}_3 = \frac{0.136 \text{ mol}}{250 \times 10^{-3} \text{ dm}^3} = 0.54 \text{ mol dm}^{-3}$ (15 marks)



(ii) Molar ratio $\text{HNO}_3 : \text{Ba}(\text{OH})_2 = 2 : 1$

Number of moles of HNO_3 consumed = $\frac{0.0526 \text{ mol}}{1000 \text{ ml}} \times 10.00 \text{ ml}$
 $= 0.00053 \text{ mol or } 5.3 \times 10^{-4} \text{ mol}$

Number of moles of $\text{Ba}(\text{OH})_2$ required = $\frac{0.00053 \text{ mol}}{2}$
 $= 0.00026 \text{ mol or } 2.6 \times 10^{-4} \text{ mol}$

So required volume of $\text{Ba}(\text{OH})_2 = \frac{2.6 \times 10^{-4} \text{ mol}}{0.0102 \text{ mol dm}^{-3}}$
 $= 0.0255 \text{ dm}^3$
 $= 25.50 \text{ cm}^3$ (10 marks)

(3) (a) (i) The sample that is chosen in such a way that each member or item has an equal chance of being selected in the sample. (That means the items are chosen in random manner) is called as random sample. It truly represents the whole population. (10 marks)

(ii) Well water: Take samples from several depth, then mix and get the sample. (10 marks)

Soil : Take several soil samples from several depth right around the well and mix well. Then follow coining and quartered method. (10 marks)

(iii) Random error: Temperature change (05 marks)
 Systematic error: Reading error (05 marks)

(iv)

Random error	Systematic error
Cannot be eliminated	Can be eliminated
Cannot identify	Can be identified
Value vary	Value constant
It has both negative and positive impacts	Only one side effect (positive or negative)

(08 marks)

$$\begin{aligned} \text{v. Mean} = \bar{x} &= \frac{25.0 + 25.01 + 25.03 + 25.01 + 25.05}{5} \\ &= 25.02 \text{ ml} \end{aligned}$$

$$\begin{aligned} \text{Absolute error of the mean} &= \bar{x} - T \\ &= (25.02 - 25.00) \text{ ml} \\ &= 0.02 \text{ ml} \end{aligned} \quad (12 \text{ marks})$$

- (b) (i) When temperature increases solubility of undissolved salt particles also increases. (10 marks)
- (ii) HCl is a gas, when temperature is increases solubility of gas is decreases, then amount of escape molecules also decreases. Therefore concentration of HCl decreases. (10 marks)
- (iii) Substance X is polar, since water is polar, therefore both halides and nitrates dissolve in water. (10 marks)
- (c) (i) Na_2SO_4 and H_2O
- (ii) BaSO_4 and CaCO_3 (10 marks)
- (4) (a) Hazardous chemicals are the substances that are toxic, corrosive, irritant, reactive and cancer causing, thereby poses a threat to health and environment. (06 marks)

Examples: Aniline, nitro benzene, benzene, benzoyl chloride, bromine, Iodine, chloroform, lead etc (06 marks)

(b)

Safety symbols	Description	Examples
Flammable	Any solid, liquid, vapour or gas or gas that can be ignited readily, which create serious hazardness.	Acetone, benzene, methanol, ethanol, cyclohexane, glacial acetic acid, Isopropyl alcohol.
Corrosive	Liquid cause visible destruction or irreversible alteration in living tissue by chemical action at site of contact.	HCl, HNO_3 , H_2SO_4 , NaOH, ammonia, glacial acetic acid, phosphoric acid
Poisonous material	A material other than gas toxic to human health.	Aniline, phenol, chloroform, calcium cyanide, CCl_4 , nitrobenzene, Isocyanate,
Explosive	A material able to produce or continuous release of pressure, gas or heat when subject to pressure or high temperature.	Barium azide, trinitro toluene (TNT).

(32 marks)

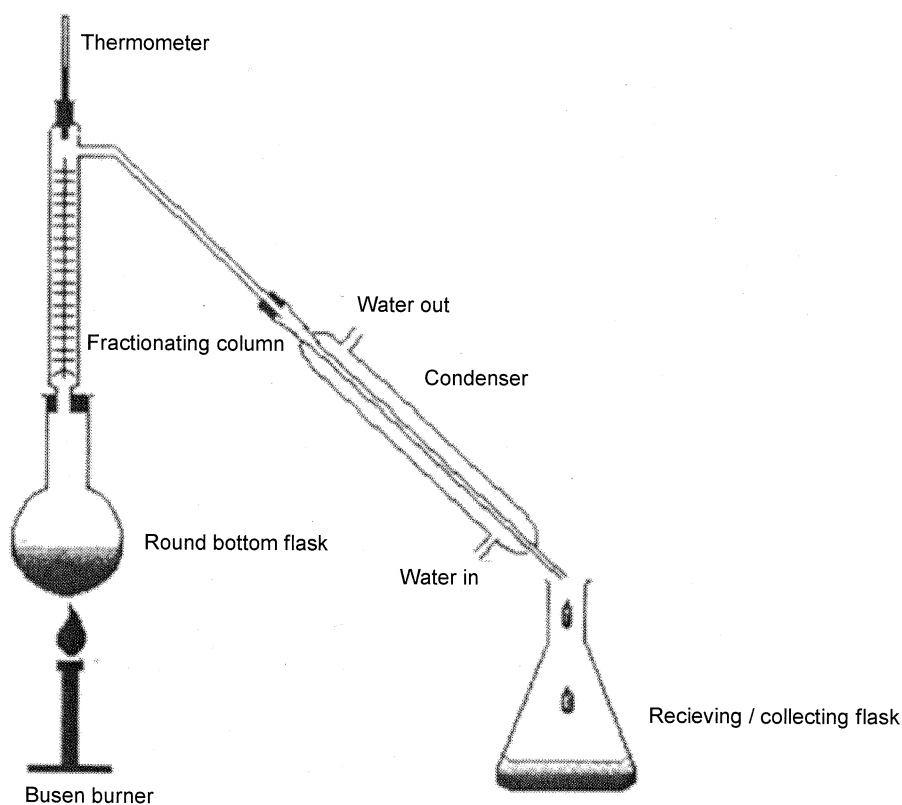
(c) (i) Name of the compound, the quantity, molecular weight, chemical abstract service number (CAS number), minimum assay, maximum levels of impurities and warning symbol.

(10 marks)

(ii) Date of preparation, solvent(s) used, name and the quantity of the solute. (10 marks)

(d) (i) Distillation is used to purify a liquid by separating it from a non – volatile or less – volatile material. When a liquid contains a mixture of different compounds with different boiling points, they can be separated in to individual compounds when the mixture is carefully distilled. The process is known as “Fractional distillation”. (10 marks)

(ii) set up for Fractional distillation (04 marks)



(12 marks)

(e) Acid spills should be neutralized with a suitable base before discarding the waste in to a drain or sink using a large amount of water. (10 marks)