

THE OPEN UNIVERSITY OF SRI LANKA
ADVANCED CERTIFICATE IN LABORATORY TECHNOLOGY
FINAL EXAMINATION-THEORY- 2022/23
CYC2604 — CHEMISTRY IN LABORATORY TECHNOLOGY



Date: 19/03/2023 (Sunday)

Time: 9 am- 11 am

Duration: Two hours

Instructions to students

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

- 1) a) The most abundant isotope of silver $^{107}_{47}\text{Ag}$ is
- How many protons, neutrons and electrons are present in this isotope?
 - What is the symbol of another isotope of silver with 62 neutrons? (10 marks)
- b) Nitrogen is made up of two isotopes, N-14 (atomic weight = 14.003 amu) and N-15 (atomic weight = 15.000 amu). Atomic weight of N is 14.007 amu, what is the percentage (%) abundance of each isotope? (15 marks)
- c) How many moles of substance are present in the following compounds?
- 0.250 g of CaCO_3
 - 5.30 g of Na_2CO_3
- (Relative atomic mass for Ca = 40; C = 12 ; Na = 23 ; O = 16) (10 marks)
- d) Classify each reaction as combination, decomposition, single replacement and double replacement. (20 marks)
- $2\text{Al}_2\text{O}_3(s) \rightarrow 4\text{Al}(s) + 3\text{O}_2(g)$
 - $\text{Br}_2(g) + \text{BaI}_2(s) \rightarrow \text{BaBr}_2(s) + \text{I}_2(g)$
 - $\text{H}_2(g) + \text{Br}_2(g) \rightarrow 2\text{HBr}(g)$
 - $\text{AgNO}_3(aq) + \text{NaCl}(aq) \rightarrow \text{AgCl}(s) + \text{NaNO}_3(aq)$
- e) Balance the following equations. (20 marks)
- $\text{C}_2\text{H}_4(g) + \text{O}_2(g) \rightarrow \text{CO}_2(g) + \text{H}_2\text{O}(g)$
 - $\text{Si}_2\text{H}_6 + \text{H}_2\text{O}(l) \rightarrow \text{Si}(\text{OH})_4 + \text{H}_2(g)$
 - $\text{Al}(s) + \text{Cl}_2(g) \rightarrow \text{AlCl}_3(s)$
 - $\text{KClO}_3(s) \rightarrow \text{KCl}(s) + \text{O}_2(g)$
- f) Aqueous solution of sodium hypochlorite (NaOCl) is prepared by reaction of sodium hydroxide with chlorine.
- $$2\text{NaOH}(aq) + \text{Cl}_2(aq) \rightarrow \text{NaOCl}(aq) + \text{NaCl}(aq) + \text{H}_2\text{O}(l)$$
- 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) (10 marks)

- g) i. What do you understand by the term “molality” of a solution?
 ii. What is the molality of a solution containing 5.0 g of NaCl dissolved in 25.0 g of water?(Indicate the correct units) (15 marks)

- 2) a) Distinguish the insensitive and extensive properties as two separate lists out of the following parameters.
 Temperature, Weight, Boiling point, Length, Concentration, Volume (6 marks)

- b) According to the Newton's second law of motion, the force can be defined using the following equation.

$$\text{Force} = \text{Mass of the object} \times \text{acceleration}$$

- i. What is the SI unit of force? (4 marks)
 ii. Derive the dimension of force. (10 marks)
- c) “Molarity” and “Molality” are two different composition measurements in chemistry.
 i. Define “Molarity” and “Molality” separately. (10 marks)
 ii. In a particular experiment, mass of 15 g of KOH will be dissolved in 100 g of a solvent with the intention of making a solution of 250 ml total volume.
 (Relative atomic masses of K-39, O-16, H-1)
 Find the molarity of this solution.
 Find the molality of this solution. (20 marks)

- d) Gross sampling, corning and quartering, and flushing are three different sampling methods that are widely used in a particular laboratory. Find the best sampling method for the following cases out of these three sampling methods. (15 marks)
 i. to analyze a blood sample –
 ii. to analyze a powdered mineral sample –
 iii. to analyze a gas sample -

- e) The end point values obtained of five replicate titrations were 12.00 cm^3 , 12.10 cm^3 , 12.20 cm^3 , 11.90 cm^3 , and 12.00 cm^3 .
 i. What is the mean endpoint of this titration? (5 marks)
 ii. It has been proven that the true end point of this titration should be 15.00 cm^3 .
 Find the absolute error of the mean end point value calculated in part (i) above. (10 marks)
 iii. Explain the accuracy and precision of these results. (10 marks)

- f) List down the following solvents in the order of increasing polarity. (10 marks)
 Hexane, Isopropanol, Chloroform, Water

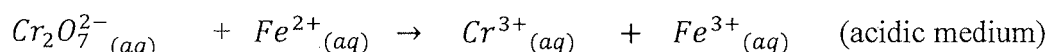
- 3) a) 0.5 M acetic acid (CH_3COOH) solution and a 0.3 M potassium hydroxide (KOH) solution are placed in front of you.
 Give two chemical properties of each solution that would enable you to identify them separately. (10 marks)
 b) The dissociation constant (K_a) of 0.5 M HNO_2 acid is $4.5 \times 10^{-4} \text{ mol dm}^{-3}$. Write an expression for the equilibrium constant K_a . (10 marks)
 c) Calculate the pH of a 0.1 M NaOH solution. (10 marks)
 d) Calculate the volume of 0.02 M HCl solution required to neutralize 25.00 cm^3 of 0.01 M KOH (show the steps clearly). (20 marks)

e) Do you agree with the following statements? Give reasons for your answer. (20 marks)

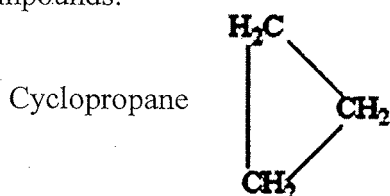
- The lime water in the laboratory was not suitable to test for carbon dioxide gas.
- Gas bubbles will release when an aspirin tablet is dissolved in water.

f) Arrange the following in the order of increasing pH.
 Boric acid ($K_a = 5.8 \times 10^{-10} \text{ mol dm}^{-3}$), Carbonic acid ($K_a = 4.3 \times 10^{-7} \text{ mol dm}^{-3}$),
 H_2SO_4 , HNO_3 , formic acid ($1.8 \times 10^{-4} \text{ mol dm}^{-3}$) (10 marks)

g) Balance the following redox equation using the "half-cell reaction" method. (20 marks)



4) a) Cyclopropane is the simplest saturated cyclic compound. The chemical structure of cyclopropane is given below. Similarly draw the chemical structures of following two cyclic compounds. (10 marks)



- cyclobutane
- cyclohexane

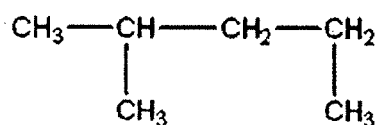
b) Describe the following properties of alkanes, alkenes and alkynes separately. (15 marks)

- Saturation nature
- General formula
- Type of bonds available
- Suffix that used to end the name
- The simplest compound

c) Classify the compounds given below into classes according to the functional group present in them. (15 marks)

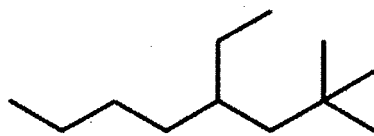
- $\text{CH}_3\text{CH}_2\text{COCH}_3$
- CH_3COOH
- $\text{C}_2\text{H}_5\text{OH}$
- $\text{C}_2\text{H}_5\text{NH}_2$
- $\text{CH}_3\text{CH}=\text{O}$

d) Name the following compounds according to the IUPAC nomenclature. (25 marks)

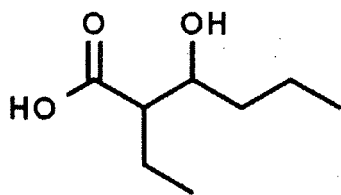


i.

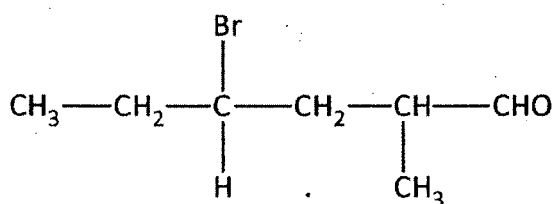
ii.



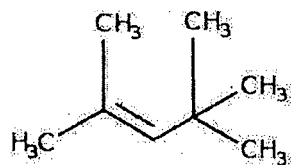
iii.



iv.

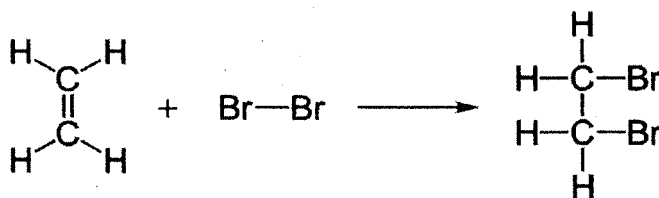


v.



- e) Draw the chemical structures of following aromatic compounds. (25 marks)
- para-bromoaniline
 - methylbenzene
 - meta-bromonitrobenzene
 - 1,2-dibromobenzene
 - 4-bromo-1-chloro-2-nitrobenzene

- f) i. Name the four basic types of organic reactions. (8 marks)
- ii. State the type of chemical reaction that has been involved in the following reaction. (2 marks)



- 5) a) What is meant by "incompatible chemicals"? (06 marks)
- b) Identify the danger/risk(s) associated with the following substances.
- Carbon tetrachloride
 - Naphthylamine
 - Picric acid
- (06 marks)

c) Identify the following symbols.

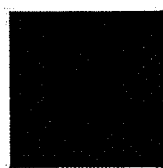
(16 marks)



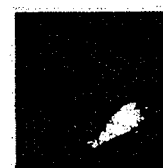
i.



ii



iii.



iv.

- d) How would you store a chemical which is air sensitive/react with oxygen? (5 marks)
- e) When you buy a chemical from a reputed company what are the information (5 factors) you can obtain from a proper label on the bottle/container? (15 marks)
- f) Name four factors which we should label on the bottle of a new solution we have prepared in the laboratory? (12 marks)
- g) Write down 3 factors that need to be considered when you select glassware? (15 marks)
- h) How would you clean-up an acid spill? (10 marks)
- i) What do you mean by “pyrophoric substances”? Give **two** examples for the pyrophoric substances. (15 marks)
- 6) a) Determine the oxidation number of each element in the following compounds. (12 marks)
- i. CO ii. PCl_3 iii. MnO_4^-
- b) “When a piece of Zn wire is placed in an aqueous solution of $CuSO_4$ an oxidation-reduction reaction takes place”.
- i. Write down half-cell reactions for the above oxidation-reduction process. (8 marks)
- ii. Write down the net reaction occur in the above process. (10 marks)
- c) Write down two common methods that used to prevent corrosion in metals. (10 marks)
- d) Write down separately the two cathodic reactions takes place when rusting of iron under following conditions,
- i. In the presence of oxygen and water
- ii. at low pH values (10 marks)
- e) Define the term “isotope”. (10 marks)
- f) The common isotope radium $^{222}_{88}Rn$, has a half- life of 1600 years. How long will take for the amount remaining to be 0.025 g if we start with 0.200 g? (20 marks)
- g) Give the standard notations of the following particles/rays. What is the most harmful component out of these particles/radiations? (20 marks)
- i. alpha particle
- ii. beta particle
- iii. gamma radiation
- iv. positron