Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 Level First Semester Examination – Sep/Oct 2015
SCT 334-2 Analytical Techniques and Instrumentation

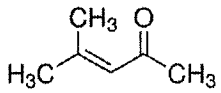
Uva Wellassa University

Number of questions: Four (04)
Answer all questions.
Number of pages: Two (02)
Time allocation: Two (02) hours
Total marks allocated: 100 marks

1.

a. What are the main types of molecular orbitals? Arrange the electronic transitions occur between these molecular orbitals in the order of lowest energy to highest energy required. (05 Mark)

b. Explain the possible electronic transitions occur in the molecule 4-methyl-3-penten-2-one showing an energy diagram.



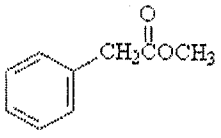
(10 Mark)

c. Compare the bathochromic shift and hypsochromic using examples (10 Mark)

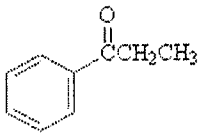
2.

a. Which molecule out of CO and N_2 absorbs energy from IR region? Justify your answer. (07 Mark)

b. In a laboratory, there are two chemical bottles of which the labels are missing. However, it knows that each bottle contains the following compounds, A and B, separately.



A



B

Explain how you would identify these chemicals using their corresponding IR spectra? (08 Mark)

15

c. Briefly describe how you would determine the amount of compound A in a given sample containing a mixture of compounds A and B (shown in question 2. b.) by an IR spectroscopy analysis. (10 Mark)

3.

a. Compare the excitation processes used in flame photometry and flame atomic absorption spectroscopy. (10 Mark)

b. What is the role of photomultiplier tube in the atomic absorption spectrometer? (07 Mark)

c. Describe how the water content in a gelatin sample is determined by using thermo-gravimetric analysis. (08 Mark)

4.

a. Sketch a mass spectrometer designating its main components. What action should be made to analyze the highest deflected ions and least deflected ion in the operation of the mass spectrometer? (08 Mark)

b. What pattern of peaks in their mass spectra would confirm the presence of chlorinated compounds? Explain your answer. (07 Mark)

c. Describe the use of relevant standards in identifying the components in a given sample by gas chromatography. (10 Mark)

Faculty of SCT
3rd year - 1st Semester
Analytical Techniques & Instrumentation.

Part B – 75 marks
Time allowed 1 hour and 30 minutes
Answer all questions (on separate booklet)

5.

a.

i. Name two causes that result in the broadening of atomic absorption lines. (1 mark)

ii. Name two background correction methods used in atomic absorption spectroscopy. (1 mark)

b.

i. Draw a schematic diagram of a hollow cathode lamp and label all the parts. (3 marks)

ii. Briefly describe ionization, sputtering, excitation, and emission processes in the hollow cathode lamp. (6 marks)

c. Describe how the signal amplification is achieved in the photomultiplier tube. (4 marks)

d. Briefly describe how the plasma is generated in an ICP-MS (inductively coupled plasma mass spectrometry) instrument. (5 marks)

e. Briefly describe how the quadrupole mass filter in ICP-MS achieves mass filtering. (5 marks)

6.

a. State the Le Châtelier's principle. (2 marks)

b. $2NOBr(g) \rightleftharpoons 2NO(g) + Br_2(g)$ $\Delta H = 16.3$ kJ $K_p = 0.16$ at 25°C

State which way the equilibrium will shift (left, right, or no change) when each change given below is made and explain the reason for the shift. Assume constant-volume conditions for parts (i), (ii), and (iii)

(i) Add more $Br_2(g)$ (2 marks)
(ii) Remove some NOBr(g) (2 marks)
(iii) Decrease the temperature (2 marks)
(iv) Increase the container volume (2 marks)

c. Name four factors that affect reaction rates. (2 marks)

d. Briefly explain how an increase in temperature brings about an increase in reaction rate. (3 points)

15

e. Name two techniques that are used to monitor very fast reactions. (1 mark)

f. Write short notes on the following.

i. Continuous flow method (3 marks)

ii. Stopped flow method (3 marks)

iii. Flash photolysis (3 marks)

7. Give detailed information about principal application and data analysis on the following two thermal analysis methods.

i. Thermogravimetric analysis (TGA) (10 marks)

ii. Differential Scanning Calorimetry (DSC) (15 marks)