



# **SOUTH EASTERN KENYA UNIVERSITY**

## **UNIVERSITY EXAMINATIONS 2016/2017**

### **SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE(CHEMISTRY)**

#### **SCA 301: INSTRUMENTAL METHODS OF ANALYSIS**

**DATE: 18<sup>TH</sup> APRIL, 2017**

**TIME: 1.30-3.30 P.M**

#### **INSTRUCTIONS TO CANDIDATES**

- (a) Answer question One and any other Two questions
- (b) Question 1 carries 30 marks while the other questions carry 20 marks each
- (c) Illustrate your answers with well label diagrams where applicable
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#### **Question 1**

**(30 marks)**

- a) A solution of compound Cobalt chloride ( $\text{CoCl}_2$ ) with concentration 1622 ppm gave an absorbance of 0.624 at 595 nm in a 1.00-cm cuvette. A blank solution containing solvent only had an absorbance of 0.029 at the same wavelength. Find the molar absorptivity of compound A ( $\text{L mol}^{-1} \text{cm}^{-1}$ ). (RAM  $\text{CoCl}_2 = 129$ ) (6 marks)
- b) The absorbance of an unknown solution of Cobalt chloride in the same solvent using the same cuvette, was 0.375 at 238nm. Find the concentration of Cobalt chloride in the unknown solution in **ppm** (6 marks)
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- c) List **Two** detectors **each** for UV-Vis spectrophotometry and Infra-Red spectrometry  
(4 marks)
- d) The Dispersive Infrared spectrometer (DIR) resembles the UV-Vis double beam spectrophotometer BUT has one significant difference. State and explain the difference in the two instruments.  
(4 marks)
- e) During the analysis of Tertbutyl Tin chloride using graphite furnace atomic absorption spectrometer, the following furnace conditions were used:
- Step 1: 105 °C for 20 s  
Step 2: 1000 °C for 30 s  
Step 3: 2300 °C for 5 s  
Step 4: 2600 °C for 5 s
- Briefly explain what is happening at each heating step.  
(4 marks)
- f) State and explain **Three** factors that lead to line broadening in Atomic absorption spectroscopy  
(6 marks)

**Question 2** **(20 marks)**

Palladium and gold can be determined simultaneously by complexing the two ions with methiomeprazine (C<sub>19</sub>H<sub>24</sub>N<sub>2</sub>S<sub>2</sub>). The absorption maximum for palladium complex occurs at 480 nm and that of gold complex at 635 nm. Molar absorptivity data at these wavelengths are:

|            | Molar absorptivity (Lmol <sup>-1</sup> cm <sup>-1</sup> ) |                        |
|------------|---|------------------------|
|            | 480 nm  | 635 nm                 |
| Pd complex | 3.55 x 10 <sup>3</sup>                                    | 5.64 x 10 <sup>2</sup> |
| Au complex | 2.96 x 10 <sup>3</sup>                                    | 1.45 x 10 <sup>4</sup> |

25.00 mL sample was treated with an excess of methiopraine and subsequently diluted to 50.00 mL. Calculate the molar concentrations of Pd and Au if the diluted solution had an absorbance of 0.533 at 485 nm and 0.590 at 635 nm, when measured in a 1.00 cm cell.

(20 marks)

**Question 3****(20 marks)**

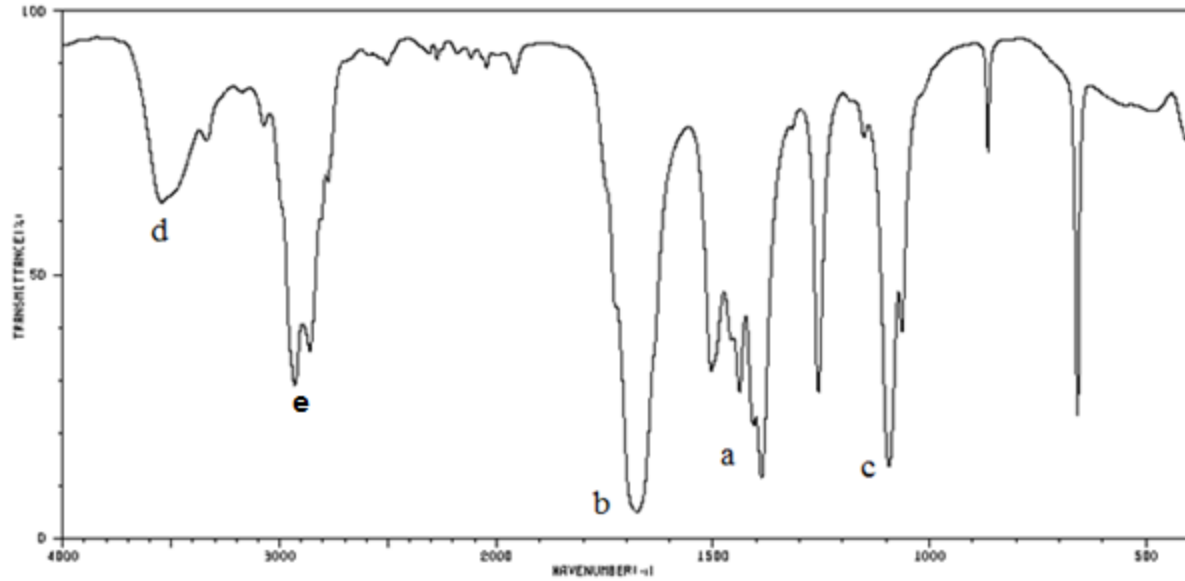
- a) There is increasing use of Inductively Coupled Plasma-atomic emission spectroscopy over Flame AAS/ AES. Explain SIX reasons for this attribute. (6 marks)
- b) List four atomizers used in atomic emission/ absorption spectrometry (4 marks)
- c) State and explain three non-spectral interferences that occur in Atomic absorption spectroscopy (6 marks)
- d) State how the interferences in (c) above can be eliminated (4 marks)

**Question 4****(20 marks)**

- a) List Four reasons why plasma atomization offers better quantitative data than Flame atomization (4 marks)
- b) Draw and label the essential parts of and inductively coupled plasma emission spectrometer (10 marks)
- c) Describe three disadvantages of sequential ICP (6 marks)

**Question 5****(20 marks)**

- a) List three instruments used in Infrared spectrometry. (3 marks)
- b) The infrared spectrum provided in the Figure below is of an organic compound with the formula  $C_3H_7NO$ . Study it and identify the functional groups responsible for the peaks labelled a – e (5 marks)



c). State FOUR advantages of Fourier Transform-Infrared spectroscopy (FT-IR) over Dispersive Infrared (DIR). (8 marks)

d) Briefly explain why in dispersive infrared (DIR) instruments, the sample cell is located between radiation source and monochromators (4 marks)