

**W1-2-60-1-6**

**JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY**

**UNIVERSITY EXAMINATIONS 2014/2015**

**YEAR III SEMESER I EXAMINATION FOR THE BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY**

**SCH 2354: STATISTICS FOR ANALYTICAL CHEMISTRY**

**DATE: APRIL, 2015**  **TIME: 2 HOURS**

**INSTRUCTIONS: Answer Question ONE and any TWO other questions.**

**Use the following information where appropriate**

Qtab (n=6)=0.621 at 95% confidence level

Ttab (dt=6)=2.4469 at 95% confidence level

Ttab (dt=5)=2.5706 at 95% confidence level

Ttab (df=10)=2.2281 at 95% confidence level

Ftab (f5,5)=7.146 at 95% confidence level

**Question One (20 Marks)**

a) Consider the following data.

|  |  |
| --- | --- |
| Class limit | Frequency |
| 60-70 | 2 |
| 49-59 | 3 |
| 38-45 | 4 |
| 27-37 | 5 |
| 16-26 | 2 |
| 5-15 | 4 |

Calculate:

1. Variance [3 marks]
2. Mode [2 marks]
3. Median [2 marks]

b) i. Explain the principle of the following:

1. Method of standard deviation. [2 marks]
2. Standard method. [2 marks]

ii. Discuss the merits and demerits of:

1. Standard method. [3 marks]
2. Methods of standard addition [3 marks]

c) The following data were obtained for measuring 0.5 kg of sodium chloride by three students, Liz, David and Anne.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Weight of NaCl (g) | | | |
| Liz | 480 | 490 | 475 | 485 |
| David | 474 | 480 | 476 | 482 |
| Anne | 480 | 500 | 490 | 495 |

Provide: i. Ascending order of precision [2 marks]

ii. Descending order of accuracy. [2 marks]

Give reasons for your answer.

d) Distinguish between the following statistical terms: [2 marks each]

1. Sample and population
2. Gross and random errors
3. Histogram and bar chart

e) Consider the following data; 4.2 5.8 10.2 3.2 3.4 2.4

convert the above data to their log values to the base 10 then determine whether the largest value after conversion to log values is an outlier at the 995% confidence level. [3 marks]

**Question Two (20 Marks)**

a) The % glucose in samples from various counties in Africa were deterred by two analytical techniques (A and B). The following results were obtained.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | % glucose in honey from | | | | | | |
|  | Kenya | Uganda | Tanzania | Congo | Sudan | Zaire | Mali |
| Method A | 37.5 | 38.2 | 39.9 | 45.5 | 42.5 | 40.5 | 41.1 |
| Method B | 36.8 | 39.5 | 40.8 | 43.1 | 41.5 | 39.7 | 39.1 |

Using suitable:

1. Parametric method. [6 marks]
2. Non-parametric method. [3 marks]

Determine whether there is significant difference in the results obtained by the two analytical methods (A and B) at 95% confidence level.

b) Describe the advantages and disadvantages of instrumental methods of analysis as compared to chemical methods of analysis of samples. [6 marks]

c) Explain the following performance parameters of instrument.

1. Sensitivity [1 mark]
2. Limit of detection [1 mark]

d) i. Explain the term systematic error as used in statistics for analytical chemistry. [1 mark]

ii. Explain how systematic errors are minimized in analytical chemistry. [2 marks]

**Question Three (20 Marks)**

a) Quinine drug was determined by HPLC using flourescence detection system. The following results were obtained using standard methods calibration strategy.

|  |  |
| --- | --- |
| concentration of quinine standard (ppb) | Flourescence intensity |
| 0 | 0 |
| 10 | 0.12 |
| 20 | 0.23 |
| 30 | 0.34 |
| 40 | 0.43 |
| 50 | 0.52 |
| 60 | 0.64 |

a) Using suitable standard method:

1. Determine whether the relationship between fluorescence intensity and concentration of quinine standard is linear. [3 marks]
2. Calculate:
3. The slope [3 marks]
4. The y intercept and provide the regression equation for the best line of fit. [3 marks]

b) Draw the best line of fit, after plotting the above data on a graph paper provided.

[3 marks]

c) State the three assumptions you must have made in getting the best line of fit and comment on their validity. [4 marks]

d) Calculate:

1. The concentration of quinine in a drug sample, giving fluorescence intensity of 0.435. [1 mark]
2. Detection limit of the instrument. [3 marks]

**Question Four (20 Marks)**

a) The level of lead in a water sample was determined by AAS and a new method developed in JKUAT. The following tabulated results were obtained:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Concentration of lead (ppm) | | | | | |
| AAS Method | 5.4 | 5.2 | 5.0 | 4.8 | 5.4 | 4.6 |
| New method | 4.0 | 4.5 | 6.3 | 4.5 | 5.5 | 6.5 |

1. Determine whether the precision for the AAS method and the new method developed in JKUAT are significantly different at the 95% confidence level.

[5 marks]

1. Using suitable statistical method, proceed to establish whether the results obtained by the two methods are significantly different at the 95% confidence level.

[9 marks]

b) Assuming that the mean concentration of lead obtained for AAS method is the true value (concentration) for the water sample, determine whether there is evidence of systematic error in the results for the new method at 95% confidence level. [3 marks]

c) State:

1. One advantage of mean over median. [1 mark]
2. One advantage of median over mean [1 mark]
3. One advantage of mode over other measures of central tendency. [1 mark]