

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

**JOMO KENYATTA UNIVERSITY**

**OF**

**AGRICULTURE AND TECHNOLOGY**

**UNIVERSITY EXAMINATIONS 2015/2016**

**FOURTH YEAR SECOND SEMESTER EXAMINATION FOR THE**

**DEGREE OF BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY**

**SCH 2455: APPLICATION IN ANALYTICAL CHEMISTRY**

**DATE: DECEMBER 2015 TIME: 2 HOURS**

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS**

**QUESTION ONE**

1. During experimental design, there are five general principles that

must be considered. Describe the FIVE general principles. [5 marks]

1. Define the following terms

i) ANOVA [1 mark]

ii) Factor Spare [1 mark]

iii) Factor [1 mark]

iv) Interraction effect [1 mark]

v) Measurand [1 mark]

1. i) Distinguish between full factorial design and fractional

factorial design experiments. [2 marks]

ii) Draw clearly and show the possible number of combination of

experiments expected for two of the above mentioned designs. [2 marks]

iii) A full factorial design for three factor (Cu2+, Cd2+ and Pb2+)

gave the following results:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Standard run | Level of Cu2+ | Level of  Cd2+ | Level of Pb2+ | EC |
| 1 | - | - | - | 0.52 |
| 2 | - | - | + | 0.73 |
| 3 | - | + | - | 0.55 |
| 4 | - | + | + | 0.62 |
| 5 | + | - | - | 0.46 |
| 6 | + | - | + | 0.48 |
| 7 | + | + | - | 0.60 |
| 8 | + | + | + | 0.68 |
|  | | | Mean | 0.58 |

a) Calculate the main effect for each factor. [3 marks]

b) Calculate the interaction effect for: [3 marks]

1. (Cu2+) (Pb2+)
2. (Cd2+ ) (Pb2+)
3. (Cu2+) (Cd2+)
4. i) Define the term Derivatisation? [2 marks]

ii) List FOUR objectives that are accomplished by derivatization

procedures. [2 marks]

iii) State FOUR conditions important in choosing a derivatizing

agent. [2 marks]

1. Distinguish between supercritical fluid chromatography and capillary electrophoresis. [3 marks]

**QUESTION TWO**

1. List and briefly discuss FIVE main separation modes of capillary

Electrophoresis. [10 marks]

1. i) List FOUR types of derivatisation methods used in gas

chromatography. [2 marks]

ii) From the above named derivatisation methods used in b(i),

choose two techniques and give TWO advantages and TWO

drawbacks of each technique. [4 marks]

iii) Hydrogen is listed as one of the carrier gas in GC

chromatography. State ONE advantage and ONE disadvantage

of the carrier gas. [1 mark]

1. List SIX requirements of a carrier gas. [3 marks]

**QUESTION THREE**

An analytical laboratory analyses the glucose levels in soft drinks using a spectroscopic enzyme assay method and an enzyme electrode methods.

The analytical laboratory therefore decided to check each method relative to an AOAC (Association of Official Analytical Chemists) method that employed HPLC. The analytical results for six replicate measurements (units nM) using each method are.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Spectroscopic assay | 1.90 | 1.82 | 1.70 | 1.94 | 1.85 | 1.90 |
| Enzyme electrode | 1.35 | 1.65 | 1.76 | 1.41 | 1.80 | 1.33 |
| AOAC method | 1.92 | 1.82 | 1.85 | 1.79 | 1.89 | 1.95 |

1. Calculate the grand mean, SST, SSC, SSR,  and , mean of each

method and standard deviation of each method. [7 marks]

1. Fill in an ANOVA table with your values. [5 marks]
2. Describe the Central composite design. Indicate the number of

experiments required. [5 marks]

1. Define the terms SST, SSC, SSR  [3 marks]

**QUESTION FOUR**

1. Draw a schematic diagram of a high performance liquid

chromatography. [2 marks]

1. Distinguish between the following:
2. Isocratic and programmed elution as used in high

performance liquid chromatography [3 marks]

1. Normal phase chromatography and reversed phase

chromatography as used in HPLC [3 marks]

1. List FOUR types of liquid chromatography. [4 marks]
2. i) List THREE functions of experimental design [3 marks]

ii) Given a full factorial 3 level design and a central composite

design, calculate the efficiency for the number of factors

shown in the table below. [5 marks]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of  Factors (K) | ½ (K+1)(K+2) | 3K | Efficiency | 3K+(2K+1) | Efficiency |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |
| 5 |  |  |  |  |  |