JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES UNIVERSITY EXAMINATION FOR THEDEGREE OF BACHELOR OF SCIENCE (SOIL SCIENCE)

3RD YEAR 2ND SEMESTER 2016/17

MAIN REGULAR

COURSE CODE: SCH 3324

COURSE TITLE: SOIL CHEMICAL ANALYSIS

EXAM VENUE: **STREAM: (BSC. SOIL SCI.)**

DATE: **EXAM SESSION:**

TIME: 2:00 HRS

<u>Instructions:</u>

1. **Answer question 1 (Compulsory) in Section A and ANY other 2 questions in Section B.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room**

Section A

Answer All Questions in Section A

Question 1

a) Causes of many injuries and incidents in the laboratory is taking unnecessary risks; this is sometimes called practicing at-risk behavior. Unnecessary risks are actions that violate safety principles, safety rules, and safe practices. Briefly discuss some of the unnecessary risks undertaken by students in the laboratory under the following incidents

   i.   Fire hazard

   ii.   Alarm from students

   iii.   Chemical spills

   iv.   Brocken glass

                                                           (4 marks)

b) Briefly discuss the working mechanisms behind the following fire extinguishers:

   i.   Carbon (IV) oxide fire extinguisher

   ii.   Water fire extinguisher

   iii.   Foam fire extinguisher

   iv.   Use of sand as a fire extinguisher

c) Briefly explain the purpose of the following apparatus/clothing towards laboratory safety

   i.   The shower at the entrance of the laboratory

   ii.   Laboratory white coat

   iii.   Closed shoes

   iv.   Goggles for the eyes

<div align="right">(4 mark)</div>

d) What are some of the wet chemistry methods employed in sample identification and quantification? (3 marks)

e) Use the diagram below to differentiate between accuracy and precision in sample quantification. (4 marks)
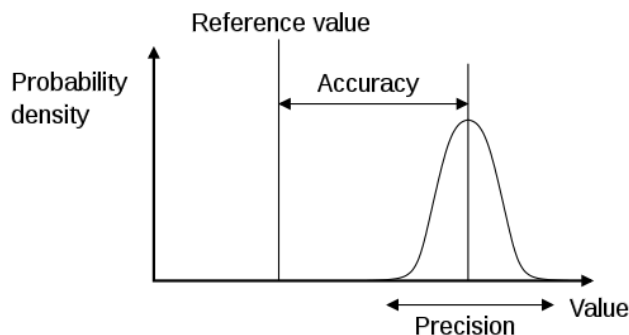
f) A measuring balance is precise to a gram. A student gave the following wrong readings. Please correct them.

   i.   12.300 g;

   ii.   0.004 g;

   iii. 120.0008 g;

   iv. 1100 g   (4 marks)

g) Titanium carbide (TiC) is the hardest of the known metal carbides. It can be made by heating titanium (IV) oxide (TiO_2), with carbon black to 2200 °C. $TiO_2 + 3C \rightarrow TiC + 2CO$

   i.   What is the maximum mass of titanium carbide (TiC) that can be formed from the reaction of 985 kg of titanium (IV) oxide (TiO_2) with 500 kg of carbon? (2 marks)

   ii.   Identify the reagent in excess? (2 marks)

h. Phosphorus tribromide (PBr_3) can be used to add bromine atoms to alcohol molecules such as 2-methyl-1-propanol. In an experiment,

5.393 g of 1-bromo-2-methylpropane was formed when an excess of PBr$_3$ reacted with 6.034 g of 2-methyl-1-propanol. Determine the percent yield using the given reaction stoichiometry equation.

$3CH_3CH(CH_3)CH_2OH + PBr_3 \rightarrow 3CH_3CH(CH_3)CH_2Br + H_3PO_3$

2-methyl-1-propanol   1-bromo-2-methylpropane
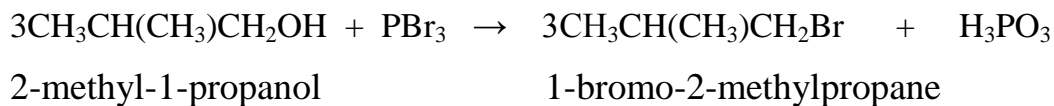
(5 marks)

Section B

Answer any Two Questions

Question 2

Briefly describe the qualitative and/or quantitative data obtained using the following analytical instruments. Discuss the physical quantity employed by the machines.

    a. Flame Emission Spectrophotometry

    b. Atomic Fluorescence Spectrophotometry

    c. Visible and Ultraviolet Spectrophotometry

    d. Nuclear Magnetic Resonance (NMR) Spectrometry

    e. Mass Spectrometry

(20 marks)

Question 3

    a. Briefly describe how you would prepare 16 ppm of Lead (II) ions in the laboratory using Lead (II) Chloride salt.   (4 marks)

b. Using examples, distinguish between the following chemical reactions

    i. *Direct combination or synthesis*

    ii. *Single displacement or substitution,*

    iii. *Metathesis or double displacement reaction*

    iv. *Acid-base reactions*

    v. *Redox reactions*

(10 marks)

c. Water is a universal solvent and there are several reactions that take place in aqueous medium. Discuss some of the useful chemical reactions that take place in water under the following processes.

    i. *Dissolving Insoluble Compounds*

    ii. *Synthesis of Inorganic Compounds*

    iii. *Extraction of Metals from Solution*

(6 marks)

Question 4

The diagram below shows different stages of soil analysis process to determine mineral soil composition. Briefly describe the stages labeled 1 to 5 under the following subtopics.

    i. Instruments

    ii. Methods

    iii. Standards

(20 marks)

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                    ┌──────────────┐
                    │  Population  │◄──────────┐
                    └──────────────┘           │
                       1 │ Sampling            │
                         ▼                      │
                    ┌──────────────┐            │
                    │    Sample    │            │
                    └──────────────┘            │
                       2 │ Separation           │
          ┌──────────────┼──────────────┐       │
          ▼              ▼              ▼        │
   ┌───────────┐  ┌───────────┐  ┌───────────┐  │
   │ Analyte A │  │ Analyte B │  │ Analyte C │  │ Discussion
   └───────────┘  └───────────┘  └───────────┘  │  5
                     3 │ Analysis                │
                       ▼                         │
                 ┌──────────┐ Statistics ┌──────────────┐
                 │   Data   │────────────│     Data     │
                 └──────────┘     4      │ Interpretation│
                                         └──────────────┘
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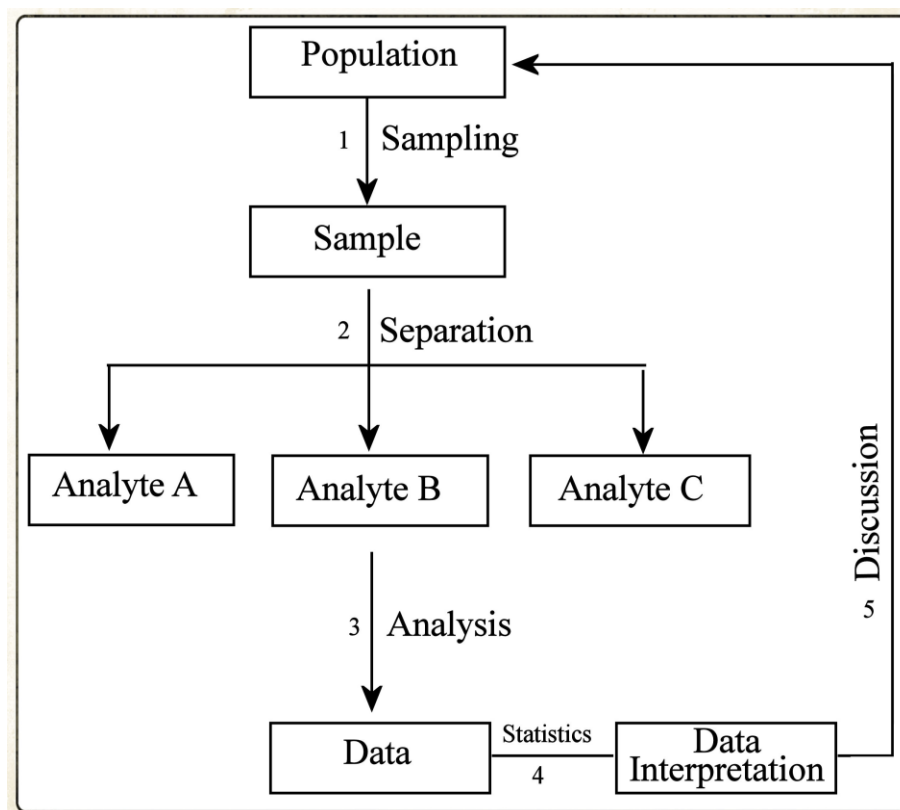
Question 5

Separation of a sample into different analytes and subsequent data acquisition from the analyte can be done using classical methods or instrumental methods. Briefly explain the working mechanisms of the following classical and instrumental methods.

   i.   Precipitation

  ii.   Solvent extraction

 iii.   Titration

 iv.   Column Chromatography

  v.   Ultra-violet spectrophotometer

 vi.   High Performance Liquid Chromatography

vii.   Gas Chromatography-Mass spectrometer

Periodic table

Key:
- Atomic number, Z
- Element symbol
- Relative atomic mass, A_r

1																		18
1 **H** 1.008	2												13	14	15	16	17	**2** **He** 4.00
3 **Li** 6.94	**4** **Be** 9.01												**5** **B** 10.81	**6** **C** 12.01	**7** **N** 14.01	**8** **O** 16.00	**9** **F** 19.00	**10** **Ne** 20.18
11 **Na** 22.99	**12** **Mg** 24.31	3	4	5	6	7	8	9	10	11	12		**13** **Al** 26.98	**14** **Si** 28.09	**15** **P** 30.97	**16** **S** 32.06	**17** **Cl** 35.45	**18** **Ar** 39.95
19 **K** 39.10	**20** **Ca** 40.08	**21** **Sc** 44.96	**22** **Ti** 47.90	**23** **V** 50.94	**24** **Cr** 52.01	**25** **Mn** 54.94	**26** **Fe** 55.85	**27** **Co** 58.93	**28** **Ni** 58.69	**29** **Cu** 63.54	**30** **Zn** 65.41		**31** **Ga** 69.72	**32** **Ge** 72.59	**33** **As** 74.92	**34** **Se** 78.96	**35** **Br** 79.91	**36** **Kr** 83.80
37 **Rb** 85.47	**38** **Sr** 87.62	**39** **Y** 88.91	**40** **Zr** 91.22	**41** **Nb** 92.91	**42** **Mo** 95.94	**43** **Tc** 98.91	**44** **Ru** 101.07	**45** **Rh** 102.91	**46** **Pd** 106.42	**47** **Ag** 107.87	**48** **Cd** 112.40		**49** **In** 114.82	**50** **Sn** 118.71	**51** **Sb** 121.75	**52** **Te** 127.60	**53** **I** 126.90	**54** **Xe** 131.30
55 **Cs** 132.91	**56** **Ba** 137.34	La–Lu	**72** **Hf** 178.49	**73** **Ta** 180.95	**74** **W** 183.85	**75** **Re** 186.21	**76** **Os** 190.23	**77** **Ir** 192.22	**78** **Pt** 195.08	**79** **Au** 196.97	**80** **Hg** 200.59		**81** **Tl** 204.37	**82** **Pb** 207.19	**83** **Bi** 208.98	**84** **Po** 210	**85** **At** 210	**86** **Rn** 222
87 **Fr** 223	**88** **Ra** 226.03	Ac–Lr	**104** **Rf** [261]	**105** **Db** [262]	**106** **Sg** [266]	**107** **Bh** [264]	**108** **Hs** [277]	**109** **Mt** [268]	**110** **Ds** [271]	**111** **Rg** [272]	**112** **Uub** [285]							

Lanthanoids	**57** **La** 138.91	**58** **Ce** 140.12	**59** **Pr** 140.91	**60** **Nd** 144.24	**61** **Pm** 146.92	**62** **Sm** 150.35	**63** **Eu** 151.96	**64** **Gd** 157.25	**65** **Tb** 158.92	**66** **Dy** 162.50	**67** **Ho** 164.93	**68** **Er** 167.26	**69** **Tm** 168.93	**70** **Yb** 173.04	**71** **Lu** 174.97
Actinoids	**89** **Ac** 227.03	**90** **Th** 232.04	**91** **Pa** 231.04	**92** **U** 238.03	**93** **Np** 237.05	**94** **Pu** 239.05	**95** **Am** 241.06	**96** **Cm** 244.07	**97** **Bk** 249.08	**98** **Cf** 252.08	**99** **Es** 252.09	**100** **Fm** 257.10	**101** **Md** 258.10	**102** **No** 259	**103** **Lr** 262