

INSTRUCTIONS: Answer all questions.

1. In the periodic table, elements in the same group have the same _____.

2. The first daughter product of the ^{238}U decay series is Pb ~~True~~ ~~False~~3. What is the last product of the series in No. 2 above? Pb ~~True~~ ~~False~~4. Palynogeochimistry is an aspect of geochemistry. True or False? True5. The Mendeleev periodic table did not take into account the distribution of elements in geologic systems. True or False? False6. The chalcophile elements form all the following minerals, except: antimonates, arsenates, bismuthates and silicates. False7. The platinum group of elements are typically siderophilic. True or False? True8. The high field strength elements are so called because have (a) large ionic size (b) high charges (c) high solubilities (d) high electrode potentials. False9. One of the following is not a high field strength element: Ta, Rh, Zr and Nb. False10. The relative abundance of elements is the basis for the geochemical periodic table. True or False? False11. Low ionic potential is responsible for the relatively good solubility of the alkali and alkaline earth metals. True or False? True12. Which of the following is not an example of large-ion-lithophiles? Barium, Calcium, Rubidium and Zirconium False13. Geochemistry is not concerned with the synthesis of chemical compounds. True or False False14. At what stage of magma crystallization do the alkali metals leave the melt? After Leave15. Aluminium is incorporated in Felspar in all stages of magma crystallization.16. Two ions having the same charge and radius will enter a forming crystal with equal ease. True or False? False17. In stratified lakes, the lower level is comparatively richer in Fe^{2+} because of (a) high pressure (b) low temperature (c) reducing conditions (d) oxidizing conditions Reducing Condition True18. Isotopes are Atoms with the same Electron and Proton Number Contain different number of Neutrons. True19. The isotopes that are used in determination of absolute ages of geological materials are called Radioactive Isotope20. The decay constant is affected by conditions of temperature, pressure and chemical composition of the environment. True or False? True21. If P_0 has decreased to half $1/2P_0$ in time $t_{1/2}$, this is called Half-life Decay22. ^{12}C and ^{13}C are stable isotopes while ^{14}C is a radioactive isotope of carbon.23. Stable Radioactive isotopes undergo decay to daughter atoms, while stable isotopes undergo fractionation.24. Elements can be classified into Major elements, minor elements and trace elements.25. The two types of geochemical environments are Primary and Secondary.

✓ Q1 (a) Define the term geochemistry and outline the branches of the subject.

- (b) (i) What is geochemical environment?
- (ii) Outline the characteristics of the two major geochemical environments and state the processes associated with each of them.

✓ Q2 (a) Define the terms compatible elements and incompatible elements and explain their behaviour during partial melting and fractional crystallization.
(b) With the aid of a diagram, show the distribution of compatible and incompatible elements as a function of magma evolution.
(c) In a tabular form, outline the Goldschmidt geochemical classes of elements and give three examples of elements in each class.

✓ Q3 (a) What is aqueous geochemistry?

- (b) List and explain any three types of reactions that occur in the Earth's hydrosphere.
- (c) Define the terms oxidant and reductant and give one example of each in nature.
- (d) If silicate weathering and erosion impart primary alkalinity on water, what does carbonate dissolution provide?
- (e) Write equations for the following reactions in aqueous geochemistry.
 - (i) Orthoclase dissolution.
 - (ii) Carbonic acid dissociation.

✓ Q4 (a) What is an isotope? Outline the applications of radiogenic isotopes in geology.

- (b) An isotope has a half-life ($t_{1/2}$) of 5370 years. What is the decay constant of this isotope?
- (c) What are the assumptions upon which the calculation of ages using radioactive isotopes based?
- (d) Explain how replacing a lighter isotope with a heavier one lowers the energy of and stabilizes a molecule.

✓ Q5 Write short notes on the following:

- (i) Geochemical mobility.
- (ii) Geochemical anomaly.
- (iii) Geochemical background.

✓ Q6 (a) In a tabular form, classify the following into major, minor and trace elements: Mg, Mn, Ti, Ca, Na, Cr, Ni, Al, Si, Zn, K, Pb and P.

- (b) Explain the distribution of major elements during magma differentiation.
- (c) Outline Goldschmidt rules for substitution of trace elements in silicate minerals.

SECOND SEMESTER

2017/2018 SESSION

COURSE CODE: GEL 325

UNIT: 2

COURSE TITLE: INTRODUCTION TO GEOCHEMISTRY

INSTRUCTIONS: ANSWER ANY THREE QUESTIONS

TIME ALLOWED: 2 HOURS

DATE: 21ST SEPT., 2018

Q1

- (a) What is aqueous geochemistry?
- (b) List and explain any three types of reactions that occur in the Earth's hydrosphere.
- (c) Define the terms oxidant and reductant and give one example of each in nature.
- (d) If silicate weathering and erosion impart primary alkalinity on water, what does carbonate dissolution provide?
- (e) Write equations for the following reactions in aqueous geochemistry.
 - (i) Albite dissolution.
 - (ii) Carbonic acid dissociation.

Q2

- (a) Define the terms compatible elements and incompatible elements and explain their behaviour during partial melting and fractional crystallization.
- (b) With the aid of a diagram, show the distribution of compatible and incompatible elements as a function of magma evolution.
- (c) In a tabular form, outline the Goldschmidt geochemical classes of elements and give three examples of elements in each class.

Q3

- (a) What is an isotope? Outline the applications of radiogenic isotopes in geology.
- (b) An isotope was found to have a decay constant (λ) of 1.41×10^{-4} /yr. What is the half-life of this isotope?
- (c) List the isotopes of the following elements that you know: O, H, C, Cl and S.
- (d) Explain how replacing a lighter isotope with a heavier one lowers the energy of and stabilizes a molecule.

Q4

- (a) Define the term geochemistry and outline the branches of the subject.
- (b)
 - (i) What is geochemical environment?
 - (ii) Outline the characteristics of the two major geochemical environments and state the processes associated with each of them.

Q5

Write short notes on the following:

- (i) Geochemical mobility.
- (ii) Geochemical dispersion.
- (iii) Geochemical anomaly.
- (iv) Geochemical background.

(v a)

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

DEPARTMENT OF GEOLOGY
SECOND SEMESTER CONTINUOUS ASSESSMENT TEST
2013/2014 ACADEMIC SESSION

(S)

COURSE CODE: GEL 325

CREDIT UNIT: 3

COURSE TITLE: Introduction to Geochemistry

TIME ALLOWED: 1 Hour

INSTRUCTIONS: Answer all questions in both sections. Answer questions in Sections A and B on separate answer sheets.

SECTION A

1. Highlight four physical and/or chemical processes that take place in the geochemical cycle. State five physico-chemical factors that control the distributions of chemical elements in geochemical environments.
2. What are Pathfinder Elements (PE)? State two examples.
3. State the criterion upon which the classification of elements into major and trace and/or minor elements is based. The metal content (ferrous, Fe^{2+}) in an analysed soil sample is reported as 400 ppm while that of copper (Cu^{2+}) in the same sample is 8 ppb. Report these values, for Fe^{2+} & Cu^{2+} , in wt.% and ppm respectively.
4. State five applications of major and trace elements geochemistry.

SECTION B

1. What is geochemistry? With the aid of a diagram, show the different branches of geochemistry and its relationship with chemistry, cosmochemistry and geology.
2. A radioactive element has a half-life of 1.4×10^4 years. Calculate the decay constant of the element.
3. List the major elements commonly encountered in silicate rocks.
4. What is aqueous geochemistry? With the aid of relevant equations, explain the dissociation of carbonic acid.

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF PHYSICAL SCIENCES
DEPARTMENT OF GEOLOGY,
SECOND SEMESTER EXAMINATION FOR THE DEGREE OF B.TECH (GEOLOGY),
2015/2016 SESSION

COURSE: GEL 325 (INTRODUCTION TO GEOCHEMISTRY)

DATE: 5TH AUGUST, 2016.

TIME ALLOWED: 2 Hours

INSTRUCTIONS: This paper has two sections. Answer two questions from each section.

SECTION A

1. (a) What do you understand by element partitioning in partial melting and magmatic crystallization?
(b) The data in Table 1 shows the concentration (ppm) of three elements in crystals coexisting with a melt. Calculate the melt/mineral partition coefficient ($D_{min-melt}$) for each of the elements and comment on their compatibility.

Table 1 Concentration of elements in mineral and melt

Element	Concentration in melt	Concentration in crystals
X	2.35	2.32
Y	7.00	7.50
Z	4.65	3.07

2. (a) Complete the following radioactive decay equations and state the type of decay that has taken place:
(i) $^{14}X \longrightarrow ^{14}Y + ?$
(ii) $^{238}X \longrightarrow ^{234}Y + ?$
(b) Briefly discuss one assumption made while calculating radioactive ages that may be the source of variations in calculated ages.
(c) What are the applications of stable isotope geochemistry?
3. (a) Define the term geochemistry and use an appropriate diagram to outline the different branches of the science.
(b) What are the major types of reactions commonly encountered in aqueous geochemical systems?
(c) What are the processes through which groundwater can become acidified?
4. (a) (i) What is meant by pH? (ii) Calculate the pH of the aqueous solution of 0.10M acetic acid ($K_a = 1.74 \times 10^{-5}$). Explain any three chemical factors other than the pH and solubility that govern geochemical mobility of elements in surficial environment.
(b) The solubility product, K_{sp} , for siderite ($FeCO_3$) in water at 25°C and one bar is $10^{-10.7}$. Calculate the solubility of siderite in g/L in the following media: (i) water, (ii) a solution of

SECTION B

0.0020 molL⁻¹ Na₂CO₃, (iii) a solution of 3.2×10^{-4} molL⁻¹ FeCl₂. [Atomic masses: C = 12.00, O = 16.00, Fe = 55.85]. What principle is demonstrated by these results?

5. Briefly explain what you understand by the following:

- (a) The trace elements such as V, Ni, Co, N, Mo and W are depleted in the present-day ocean compared to their concentrations that have been added to the seawater over Earth's history.
- (b) Rarity of hydrogen (H) and helium (He) in the Earth and meteorites. (c) Evolution of the early atmosphere. (d) Chromium is dominantly lithophile but it appears in the chalcophile group.

6. (a) Explain the following terms: Geochemical Background, Threshold, and Anomaly.

(b) Discuss various ways by which geochemical threshold can be determined from a typical geochemical data set, and state its significance in mineral exploration.

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF B.TECH GEOLOGY

2014/2015 SESSION

COURSE CODE: GEL 325

COURSE TITLE: INTRODUCTION TO GEOCHEMISTRY

NOTE ALLOWED: 2½ HOURS

INSTRUCTIONS: This paper has two sections. Answer four questions from each of sections A & B.

QUESTION

(a) What is aqueous geochemistry? List and explain any three types of reactions that occur in the Earth's hydrosphere. Define the terms oxidant and reductant and give one example of each in nature.

(b) Define weathering and erosion. Explain primary and secondary weathering processes provided.

Write equations for the following reactions in aqueous geochemistry.

(i) Carbonic acid dissociation.

(ii) Carbonic acid dissociation.

(c) Define aqueous immobile elements and immobile elements and explain their behaviour during and after fractional crystallization. Explain the effect of immobile elements on the distribution of trace elements in the crust. Define immobile elements, volatile and fugitive elements and discuss their behaviour during and after fractional crystallization.

(d) Define solubility product, K_{sp}, for siderite (FeCO_3) in water at 25°C, and one less is 10^{-10} . The solubility of siderite in 2dm^{-3} in the following media: (i) water, (ii) a solution of 0.0020M CaCl_2 , (iii) 0.0016M MgCl_2 , (iv) 0.0016M Na_2CO_3 , (v) 0.0016M K_2CO_3 , (vi) 0.0016M Li_2CO_3 , (vii) 0.0016M Cs_2CO_3 , (viii) 0.0016M Rb_2CO_3 , (ix) 0.0016M NH_4CO_3 , (x) 0.0016M H_2O_2 , (xi) 0.0016M H_2S , (xii) 0.0016M H_3PO_4 , (xiii) 0.0016M H_2SO_4 , (xiv) 0.0016M HNO_3 , (xv) 0.0016M HCl , (xvi) 0.0016M H_2CO_3 , (xvii) 0.0016M H_2O_2 + 0.0016M H_2CO_3 , (xviii) 0.0016M H_2O_2 + 0.0016M H_2S , (xix) 0.0016M H_2O_2 + 0.0016M H_3PO_4 , (xx) 0.0016M H_2O_2 + 0.0016M H_2SO_4 , (xxi) 0.0016M H_2O_2 + 0.0016M HNO_3 , (xxii) 0.0016M H_2O_2 + 0.0016M HCl .

QUESTION 2

(a) Explain at least four chemical factors that govern geochemical mobility of elements in sedimentary environment.

(b) Calculate the solubility product, K_{sp} , for siderite (FeCO_3) in water at 25°C, and one less is 10^{-10} . The solubility of siderite in 2dm^{-3} in the following media: (i) water, (ii) a solution of 0.0020M CaCl_2 , (iii) 0.0016M MgCl_2 , (iv) 0.0016M Na_2CO_3 , (v) 0.0016M K_2CO_3 , (vi) 0.0016M Li_2CO_3 , (vii) 0.0016M Cs_2CO_3 , (viii) 0.0016M Rb_2CO_3 , (ix) 0.0016M NH_4CO_3 , (x) 0.0016M H_2O_2 , (xi) 0.0016M H_2S , (xii) 0.0016M H_3PO_4 , (xiii) 0.0016M H_2SO_4 , (xiv) 0.0016M HNO_3 , (xv) 0.0016M HCl , (xvi) 0.0016M H_2CO_3 , (xvii) 0.0016M H_2O_2 + 0.0016M H_2CO_3 , (xviii) 0.0016M H_2O_2 + 0.0016M H_2S , (xix) 0.0016M H_2O_2 + 0.0016M H_3PO_4 , (xx) 0.0016M H_2O_2 + 0.0016M H_2SO_4 , (xxi) 0.0016M H_2O_2 + 0.0016M HNO_3 , (xxii) 0.0016M H_2O_2 + 0.0016M HCl .

(c) Briefly explain what you understand by the following:

(i) The groups of elements (Cu, Zn, Mo, Ag, Cd, Hg, Pb and Bi) and (V, Ni, Co, Ni, and W) are depicted in the present-day ocean (seawater) such that their concentrations are less than the amounts that have been added in the seawater over Earth's history.

(ii) Rarity of hydrogen and helium (He) in the Earth and meteorites.

(iii) The present-day atmosphere has 21% of oxygen by volume although the primordial atmosphere is reducible.

(iv) Not all geochemical anomalies indicate mineralization. (v) The Earth is a dynamic system.

Q6: (a) Briefly discuss the term "Geochemical Environment".

(b) Write a concise essay on the applications of trace elements geochemistry in petroleum source rocks and oil's characterization.

(c) Distinguish elements from true solutions and suspensions.

SECOND SEMESTER 2014/2015 ACADEMIC SESSION C.A. TEST

GEL 325 INTRODUCTION TO GEOCHEMISTRY 3 UNITS

INSTRUCTIONS: Answer all questions by filling-in the blank spaces. Remember to write your name and matriculation number in the spaces provided. TIME ALLOWED: 45 Minutes

1. List four branches of geochemistry Biogeochemistry, Hydrogeochemistry, Lithochemistry, and Astrogeochemistry.

2. Goldschmidt's geochemical classes of elements include Silicophiles, Metals, Actinides, and Chalcophiles.

3. Three examples of High-field-strength elements are Uranium(U), Zirconium(Zr) and Titanium(Ti).

4. Most alkali metals separate out of a melt at late stage of magma crystallization.

5. Aluminium goes into Feldspars at all stages of crystallization and in mica at the late stage. Other elements do not form rock forming silicates of their own; they rather solid solution with minerals of Accessory phases.

6. Complete this equation: $K_2O = \text{Melt} + \text{Mineral}$

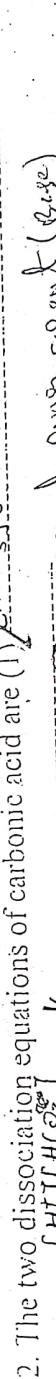
7. Complete this equation: $\text{K}_2\text{O} = \text{Alpha}(\alpha) + \text{Beta}(\beta)$

8. The kinds of fractionation emitted by radioactive elements include Alpha decay.

9. Complete this equation: $\frac{dP}{dt} = \frac{dD}{dt} = \Delta P$

10. Fractionation results in redistribution of the isotopes in order to lower the vibrational energy of the system.

11. The three mechanisms of isotope fractionation are 1. Mechanistic or physical properties such as evaporation and diffusion; 2. Ion exchange or exchange between ions, such as between equilibrium of soluble isotopes; 3. Unidirectional reaction such as between reaction of sulfate to sulfide species:



12. The two dissociation equations of carbonic acid are (1) $\text{H}_2\text{CO}_3 \rightleftharpoons \text{H}_2\text{O} + \text{CO}_2$ and (2) $\text{H}_2\text{CO}_3 \rightleftharpoons \text{H}_2\text{O} + \text{HCO}_3^{-}$

13. In a redox reaction, the electron donor is called a reductant and the acceptor is an oxidizing agent.

14. In aqueous geochemistry, speciation simply means the ability to exist in different chemical forms.

15. Silicate weathering and erosion creates fresh alkalinity in water, unlike carbonate dissolution which creates acidic conditions.

B

GLADON FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SECOND SEMESTER CONTINUOUS ASSESSMENT TEST
2012/2013 ACADEMIC SESSION
COURSE CODE: GEL 325

Two types of Geochemical Environment are Primary and Secondary.

The physico-chemical factors that control the distributions of chemical elements in geochemical environments include: (i) Pressure, (ii) Temperature, (iii) ~~Strategic effects~~, and (iv). ~~pH~~.

Pathfinder Elements are not the main elements sought for during mineral exploration but they serve as Indicators elements. The Pathfinder Element for gold mineralization is Arsenic while that for the uranium deposit is Antimony ~~& Lead~~.

The elements whose concentration is in excess of 1.0 wt.% are termed as Major, while those whose concentration is less than 0.1 wt.% are called Trace. The concentration of ferric ion (Fe^{3+}) in analysed stream sediment is reported as 660 ppm, and this is equivalent to $Q.OH \times 10^{-3}$ wt.%, while 4 ppm concentration of copper is the same as ~~4000~~ in ppm.

The sampling media that can be used for geochemical studies include (i) ~~Different~~, (ii) ~~Geochemical~~, (iii) ~~Hair~~, and (iv) ~~Pathfinder element~~. The analytical techniques that can be utilized to analyse for trace elements in geochemical samples include (i) ~~GFAAS~~, (ii) ~~ICP-MS~~.

$$\chi_{wt} = \frac{\rho_m}{\rho_s}$$
$$\chi_{wt} = \frac{1g \text{ of sample}}{1kg \text{ of solution}}$$

SECTION A

1. Write concise notes on the following:
(i) Geochemical dispersion and Dispersion halo (ii) Ionic potential (iii) Geochemical C.
(iv) Chalcophiles and Siderophiles (v) Deep-seated geochemical environment.

Explain any four of the following statements:

- Minor and trace elements show some marked preference for fine-grained sediments
- Trace elements geochemistry is a tool in source rock and crude oil characterisation.
- The assemblage of atoms composing the Earth system obeys the conservation principle and hence, the Earth remains approximately a closed system
- Oxygen is approximately 21% in the present day atmosphere even though the atmosphere is devoid of oxygen.
- Not all geochemical anomalies indicate mineralization.

2. Explain any four of the following statements:
(a) Using relevant examples, discuss chemical elements mobility and factors that may affect in surficial geochemical environment.
(b) Explain the term "Geochemical Threshold" and state its significance.
(c) Discuss techniques by which thresholds can be determined from a typical geochemical dataset.

SECTION E

X; P, V

3. a) What are the kinds of radiation emitted by radioactive elements?
b) List and briefly explain three geological applications of radioactive isotopes.
c) Explain how stable isotope fractionation lowers the energy of a system.
d) With the aid of equations, show the fractionation of:
(i) $^{16}\text{O}/^{18}\text{O}$ between water and vapour.
(ii) $^{12}\text{C}/^{13}\text{C}$ between calcite and carbon dioxide.
(iii) $^{32}\text{S}/^{34}\text{S}$ between sulphate and sulphide.
4. a) What aqueous geochemistry? Using relevant examples, write short notes on complete incomplete dissociation of acids.
b) With the aid of relevant examples and equations, explain how mineral dissolution contributes to the total dissolved solids load of groundwater.
b) What are the ways through water becomes acidified?
5. a) What is geochemistry?
b) Briefly explain the behaviour of compatible and incompatible elements during (i) partial melting of rocks and (ii) fractional crystallization of magma.
6. a) In a tabular form, give three examples each of (i) network forming elements (ii) high field strength elements and (iii) large-ion-lithophile elements.

INTRODUCTORY GEOCHEMISTRY (GLY 325) PRACTISING QUESTIONS

1. Explain the term "Geochemical Environment". Discuss the physico-chemical factors that control the distributions of chemical elements in geochemical environments.
2. A German scientist, Victor Goldschmidt (1937) proposed a geochemical classification of chemical elements based on the affinity of the elements for certain materials. Using these materials' affinity and other available sources of information, give with examples five classifications of chemical elements. Give reasons for the purpose of these classifications.
3. Define the following terms:

- (a) Geochemical Dispersion (b) Geochemical Mobility (c) Dispersion Halo (d) Ionic Potential (e) Pathfinder Elements (f) Geochemical Prospecting

4. (a) With examples, explain the following:

(i) Major elements (ii) Minor elements (iii) Trace elements

- (b) Give various analytical techniques that can be utilized to analyze for the group of elements in (a) above.

5. Explain the following statements:

(a) Geophysical character of an element is largely governed by the electronic configuration of its atom and hence is closely related to its systematic position in the periodic table.

(b) Why minor and trace elements show some marked preference for the fine-grained sediments in enrichment.

(c) Gold is dominantly siderophile but it appears in the chalcophile group form of native gold or sulfide minerals.

(d) The primordial atmosphere is a reducing one, cos there was no plant to convert CO_2 to O_2 by photosynthesis.

(e) The assemblage of atoms composing the Earth system obeys the conservation principle and hence, the Earth remains approximately a closed system.

escape of atoms from gravitational attraction of the Earth is extremely slow except for the lighter atoms (H, He) which may migrate continually between different reservoirs of Earth through the system.

INSTRUCTIONS: This paper has two sections. Answer two questions from each of sections A & B.

SECTION A

- Q1 (a) What is aqueous geochemistry?
(b) List and explain any three types of reactions that occur in the Earth's hydrosphere.
(c) Define the terms oxidant and reductant and give one example of each in nature.
(d) If silicate weathering and erosion impart primary alkalinity on water, what does carbonate dissolution provide?
(e) Write equations for the following reactions in aqueous geochemistry.
 (i) Albite dissolution
 (ii) Carbonic acid dissociation

- ✓ Q2 (a) Define the terms compatible elements and incompatible elements and explain their behaviour during partial melting and fractional crystallization.
(b) With the aid of a diagram, show the distribution of compatible and incompatible elements as a function of magma evolution.
(c) In a particular form, outline the Goldschmidt geochemical classification of elements in each class.

- ✓ Q3 (a) What is an isotope? Outline the applications of radioactive isotopes in geology.
(b) An isotope was found to have a decay constant (λ) of $1.4 \times 10^{-4}/\text{yr}$. What is the half-life of this isotope?
(c) List the isotopes of the following elements that you know: O, H, C, Cl and S.
SECTION B

- ✓ Q4: (a) Explain at least four chemical factors that govern geochemical mobility of elements in subsurface environment.
(b) The solubility product, K_{sp} , for siderite (FeCO_3) in water at 25°C and one bar is $10^{-10.7}$. Calculate the solubility of siderite in gdm⁻³ in the following media: (i) water, (ii) a solution of 0.0020 mol dm⁻³ Na_2CO_3 , (iii) a solution of 3.2×10^{-4} mol dm⁻³ FeCl_2 . What principle is demonstrated by these results? [Atomic masses: C = 12.00, O = 16.00, Fe = 55.85].

Q5. Briefly explain what you understand by the following:
(a) The groups of elements (Cu, Zn, Mo, Ag, Cd, Hg, Pb and Bi) and (V, Ni, Co, Ni and W) are denoted in the present-day ocean (seawater) such that their concentrations are less than the amounts that have been added to the seawater over Earth history.

- (b) Rarity of hydrogen and helium (He) in the Earth and meteorites.
(c) The present-day atmosphere has 21% of oxygen by volume although the primordial atmosphere is reducing.
(d) Not all geochemical anomalies indicate mineralization.
(e) The Earth is a dynamic system.

- Q6. (a) Briefly discuss the term "Geochemical Environment".
(b) Write a concise essay on the applications of trace elements geochemistry in petroleum source rocks and oil's characterization.
(c) How would you distinguish colloids from true solutions and suspensions?

Two (2) Hours

Diagram: Answer Any Four (4) Questions. Great importance is attached to clarity of expressions and neatness.

(a) With examples, explain the following:

- Major Elements,
- Minor Elements,
- Trace Elements.

(b) Give various analytical techniques that can be used to analyze for each group of elements in (a) above.

Explain the following statements:

- The geochemical character of an element is largely governed by the electronic configuration of its atoms and hence is closely related to its position in the periodic table.
- Why elements show marked preference for fine-grained sediments.
- Gold is dominantly siderophile but appears in chalcophile group.
- The primordial atmosphere is a reducing one.
- The assemblage of atoms composing the Earth system obeys the conservation principle, so that the Earth has remained approximately a closed system.

3. (a) Define the following terms:

- Geochemical Dispersion
- Geochemical Mobility
- Dispersion Halo
- Pathfinder Elements
- Geochemical Prospecting

(b) Based on material affinity, outline with examples five Goldschmidt's classes of elements.

4. (a) What is geochemistry? With the aid of well labelled diagram, outline the different branches of geochemistry and its relationship with geology, chemistry and cosmochemistry.
 (b) List four major categories of reactions commonly encountered in aqueous geochemistry.
 (c) Briefly explain the impact of rock-water interaction on water quality.

5. (a) What is an isotope? Briefly explain three major applications of radiogenic isotopes.
 (b) What are the assumptions upon which calculation of ages using radioactive decay is based?
 (c) i. List five areas of application of stable isotope geochemistry.
 ii. What are the three mechanisms of stable isotope fractionation?

6. (a) With the aid of an equation; briefly explain the melt/mineral partitioning of trace elements during magmatic crystallization.
 (b) What conditions affect the value of the partition coefficient (K_D)?
 (c) What is an incompatible element? Using appropriate examples, give a classification of incompatible elements on the basis of ionic potential.

SECTION A

1. Write concise notes on the following:

- (i) Geochemical dispersion and Dispersion halo
- (ii) Ionic potential
- (iii) Geochemical Cycle
- (iv) Chalcophiles and Siderophiles
- (v) Deep-seated geochemical environment.

2. Explain any four of the following statements:

- (i) Minor and trace elements show some marked preference for fine-grained sediments
- (ii) Trace elements geochemistry is a tool in source rock and crude oil characterisation.
- (iii) The assemblage of atoms composing the Earth system obeys the conservation principle and hence, the Earth remains approximately a closed system
- (iv) Oxygen is approximately 21% in the present day atmosphere even though the early atmosphere is devoid of oxygen.
- (v) Not all geochemical anomalies indicate mineralization.

3. (a) Using relevant examples, discuss chemical elements mobility and factors that may affect it in surficial geochemical environment.
(b) (i) Explain the term "Geochemical Threshold" and state its significance.
(ii) Discuss techniques by which thresholds can be determined from a typical geochemical dataset.

SECTION B

4. a) What are the kinds of radiation emitted by radioactive elements?

b) List and briefly explain three geological applications of radiogenic isotopes.

c) Explain how stable isotope fractionation lowers the energy of a system.

d) With the aid of equations, show the fractionation of: *using with your own question, show*

(i) $^{16}\text{O}/^{18}\text{O}$ between water and vapour.

(ii) $^{12}\text{C}/^{13}\text{C}$ between calcite and carbon dioxide.

(iii) $^{32}\text{S}/^{34}\text{S}$ between sulphate and sulphide.

5. a) What is aqueous geochemistry? Using relevant examples, write short notes on complete and incomplete dissociation of acids.

b) With the aid of relevant examples and equations, explain how mineral dissolution contributes to the total dissolved solids load of groundwater.

b) What are the ways through which water becomes acidified?

6. a) What is geochemistry?

a) Briefly explain the behaviour of compatible and incompatible elements during melting of rocks and (ii) fractional crystallization of magma.

b) In a tabular form, give three examples each of (i) network forming elements

DEPARTMENT OF GEOLOGY, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.
SECOND SEMESTER CONTINUOUS ASSESSMENT TEST 2015/2016 SESSION
COURSE CODE: GEL325 TIME ALLOWED: 30 MINUTES

Instruction: Answer all Questions.

- 1(a) Define the term pH. (b) List any four chemical factors that govern geochemical mobility in surficial environment other than the pH. (c) Calculate the pH of 0.125 mol/L $\text{Ca}(\text{OH})_2$ aqueous solution.
- 2(a) The average composition of the organic matter in phytoplankton is $\text{C}_{106}\text{H}_{175}\text{O}_{42}\text{N}_{16}\text{P}$. If the molecular weight of the phytoplankton ($\text{C}_{106}\text{H}_{175}\text{O}_{42}\text{N}_{16}\text{P}$) is 2375, determine the number of kilograms of carbon (C) contained in 2.5×10^{10} kg of the plankton. [C = 12.00].
- 3 Briefly explain the following: (a) Residence time (b) The Earth as a system (c) Siderophile (d) Meteorite (e) Major and Trace elements.

