

COURSE CODE: GEL 325 2017/2018 SESSION
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.

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF PHYSICAL SCIENCES
DEPARTMENT OF GEOLOGY

SECOND SEMESTER 2015/2016 ACADEMIC SESSION C.A. TEST

GEL 325 INTRODUCTION TO GEOCHEMISTRY 3 UNITS

INSTRUCTIONS: Answer all questions. Time Allowed: 20 Minutes

- a) What is geochemistry? (b) Using a block diagram, outline the different branches of geochemistry.
- c) Aluminium goes into feldspars at all stages and in the minerals at the late stages of differentiation.
- d) Write an equation to show the partitioning of an element i between a mineral and a melt.
- e) The applications of radiogenic isotopes include?

Radioactive isotopes decay while stable isotopes -----?

$$K_{\text{mineral-melt}} = C_i^{\text{mineral}} / C_i^{\text{melt}}$$

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF PHYSICAL SCIENCES
DEPARTMENT OF GEOLOGY

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BTech GEOLOGY
2017/2018 SESSION

UNIT: 2

COURSE CODE: GEL 325

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 $1.41 \times 10^{-4}/\text{yr}$. 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.
(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.

QUESTION PAPER

QUESTION PAPER ON THE SUBJECT OF GEOTHERMISTRY

CLASSES VIII - XII

QUESTION PAPER - INTRODUCTION TO GEOTHERMISTRY

QUESTION PAPER - ANSWER TWO QUESTIONS FROM EACH SECTION

DATE: 10/10/2016

TIME: 3 HRS

SECTION A

1. Write notes brief on the following:

- (i) Geochemical dispersing and Dispersum 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) Major and trace elements show some marked preference for fine-grained minerals.
- (ii) Trace elements geochemistry is a tool in *mineral* and *mineral exploration*.
- (iii) The abundance of atoms comprising 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 surface 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:
(i) $^{18}\text{O}/^{16}\text{O}$ between water and vapour.
(ii) $^{13}\text{C}/^{12}\text{C}$ between calcite and carbon dioxide.
(iii) $^{32}\text{S}/^{34}\text{S}$ between sulphate and sulphide.
5. a) What 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 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, 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) Geochemical 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 with respect to oxygen.

(d) The primordial atmosphere is a reducing one, CO_2 was present due to photo-synthesis.

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

the atmosphere was formed when the crust was formed and volcanic activity transferred materials from deep Earth's surface due to gravity and radioactive decay.

6. CO_2 , N_2 , Sulfur

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)

UNIT: 3

DATE: 5TH AUGUST, 2016

TIME ALLOWED: 2 Hours

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

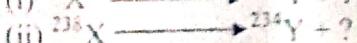
SECTION A

1. (a) What do you understand by element partitioning in partial melting and magma 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	2.75	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:



- (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?

SECTION B

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 $10^{-10.2}$. Calculate the solubility of siderite in g/L in the following media: (i) water, (ii) a solution of

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COURSE CODE: GEL 325

COURSE TITLE: INTRODUCTION TO GEOCHEMISTRY

INSTRUCTIONS: ANSWER TWO QUESTIONS FROM EACH SECTIONDATE: 23rd October, 2014

TIME ALLOWED: 2½ HOURS

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:
 - (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 (i) partial melting of rocks and (ii) fractional crystallization of magma.
 b) In a tabular form, give three examples each of (i) network forming elements (ii) high field strength elements and (iii) large-ion-lithophile elements.

Three more

Two (2) Hours

Instructions: Answer any four (4) Questions. Great importance is attached to clarity of expressions and neatness of diagrams.

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

- i. Major Elements.
- ii. Minor Elements.
- iii. Trace Elements.

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

2. Explain the following statements:

- (a) 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.
- (b) Why elements show marked preference for fine-grained sediments.
- (c) Gold is distinctly siderophile but appears in chalcophile group.
- (d) The primitive atmosphere is a reducing one.
- (e) The assembly of atoms composing the Earth system obeys the conservation principle, so that the Earth has remained approximately a closed system.

3. Define the following terms:

- i. Geochemical Dispersion
- ii. Geochemical Mobility
- iii. Dispersion Shift
- iv. Partition Elements
- v. Geochemical Prospecting

(b) Based on mineral 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?

- (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 magma differentiation.

(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.

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF PHYSICAL SCIENCES
DEPARTMENT OF GEOLOGY

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BTech GEOLOGY
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 $1.41 \times 10^{-4}/\text{yr}$. 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.
(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.

MATRICULATION NO.

207211426908L

NAME: Solaoluwa Oluwadare 0

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

SCHOOL OF PHYSICAL SCIENCES

DEPARTMENT OF GEOLOGY

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 ~~Bio geochemistry, Hydro geochemistry, Lith geochemistry and Climate geochemistry~~

2. Goldschmidt's geochemical classes of elements include ~~Silversph~~ ~~Atmosph~~ ~~Hydrosph~~ ~~Lithosph~~ and ~~Chalcoph~~

3. Three examples of High-field-strength elements are ~~Uranium(4)~~ ~~Zr~~ ~~Ta~~ and ~~Va~~

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

5. Aluminium goes into ~~Feldspar~~ at all stages of crystallization and it ends at the late stage

6. Some elements do not form rock-forming silicates; instead, they rather ~~substituted them~~ ~~form~~ ~~silicate~~

16. The major elements of the ~~lunar~~ ~~planets~~ ~~planets~~

7. Complete this equation: $K_{\text{H}_2\text{O}} = \frac{\text{mineral}}{\text{melt}}$ ~~Alpha (α)~~ ~~Beta (β)~~

8. The kinds of reaction caused by radioactive elements include ~~Gamma decay (γ)~~

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

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 ~~mechanism & physical properties such as evaporation and diffusion~~, ~~ion exchange reaction between two equilibrium of stable isotopes~~, ~~Unidirectional reaction such as bacterial reduction of sulfate to sulfide species~~. $(\text{CH}_4/\text{CO}_2) = 1.2$

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 ~~oxidant~~ ~~reducing agent (ace)~~ while the acceptor is an ~~reducent~~ ~~oxidizing agent (ace)~~.

14. In aqueous geochemistry, speciation simply means the abundance of different chemical species in a solution $\text{e.g., H}_2\text{O}$

15. Silicate weathering and erosion creates fresh alkalinity in water, unlike carbonate dissolution which ~~removes~~ ~~removal~~



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FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

SECOND SEMESTER CONTINUOUS ASSESSMENT TEST
2011/2012 ACADEMIC SESSION

10/1

COURSE CODE: GEL 303

COURSE TITLE: Introduction to Geochemistry

1. Two types of Geochemical Environment are terrestrial and aqueous.
2. The physico-chemical factors that control the distribution of chemical elements in geochemical environment include (i) Pressure, (ii) Temperature, (iii) Biological Activity and (iv) pH.
3. Pathfinder Elements are not the main elements sought for during mineral exploration but they serve as Indirect elements. The Pathfinder element for gold mineralization is Argentum while that for the uranium deposit is Thorium & Uranium.
4. 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 100 ppm, and this is equivalent to 0.01 wt wt%, while a ppm concentration of copper is the same as 10^-3 wt%.
5. The sampling media that can be used for geochemical studies include (i) Soil, (ii) Groundwater, (iii) Leaching fluid and (iv) Rock. The analytical techniques that can be utilized to determine for trace elements in geochemical samples include (i) GFAAS, (ii) ICP-MS and (iii) XRD.

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High side

$\chi_R = 10,000 \text{ g/L}$

$\frac{\chi_R + \chi_B}{2} = 10,000$

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF NATURAL AND APPLIED SCIENCES

DEPARTMENT OF GEOLOGY

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF B.TECH GEOLOGY
2013/2014 SESSION

COURSE CODE: GEL 325

UNIT: 3

COURSE TITLE: INTRODUCTION TO GEOCHEMISTRY

INSTRUCTIONS: ANSWER TWO QUESTIONS FROM EACH SECTION

TIME ALLOWED: 2½ HOURS

DATE: 23rd October, 2014

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 surface geochemical environment.
b) Explain the term "Geochemical Threshold" and state its significance.
c) Discuss techniques by which thresholds can be determined from a typical geological 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:
 - (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.
c) What are the ways through water becomes acidified?
6. 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.
c) In a tabular form, give three examples each of (i) network forming elements (ii) high field strength elements and (iii) large-ion-lithophile elements.



SECOND SEMESTER EXAMINATION FOR THE DEGREE OF B.TECH GEOLOGY

2014/2015 SESSION

UNIT: 3

COURSE CODE: GEL 325

COURSE TITLE: INTRODUCTION TO GEOCHEMISTRY

TIME ALLOWED: 2½ HOURS

DATE: Wednesday 7th October, 2015

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

SECTION A

(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) In silicate weathering and erosion, impact primary alkalinity on water, what does alkalinity do? (Briefly provide)

(e) Write equations for the following reactions in aqueous geochemistry.

(i) Alkali dissolution.

(ii) Carbonic acid dissociation.

(f) List positive or a compatible elements and incompatible elements and explain the behavior of each element during crustal differentiation.

(g) Explain why oxygen, fluorine and chlorine are called strong oxidants and hydrogen, iodine and sulfur are called strong reductants.

(h) Sulfur dioxide, chlorine, iron(II) chloride, iron(III) chloride, aluminum chloride and calcium chloride are dissolved in water. Calculate the pH of each case.

(i) A sample of meteorite (Gibeon) was collected from the surface of the planet Earth. It was found to have a very complex mineralogy. What is enstatite? Calculate the isotopes of the following elements during mineralization, Mg^{+2} , Mn^{+2} , Cr^{+3} and Al^{+3} . Explain how replacing a lighter isotope with a heavier one lowers the energy of mineralization.

(j) Explain at least four chemical factors that govern geochemical mobility of elements in marine sediment.

(k) The solubility product, K_{sp} , for siderite (FeCO_3) in water at 25°C and one bar is $1.1 \times 10^{-8.7}$. Calculate the solubility of siderite in mol dm^{-3} in the following media: (i) water, (ii) a solution of $6.00 \times 10^{-3} \text{ mol dm}^{-3}$ CaCl_2 , (iii) a solution of $3.2 \times 10^{-3} \text{ mol dm}^{-3} \text{ FeCl}_2$. What principle is demonstrated by these results? [Atomic radius of $\text{O} = 16.00$, $\text{Fe} = 55.85$].

(l) 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, Cr and W) are depleted in the present-day ocean (seawater) such that their concentrations are less than the amounts that have been added to the seawater over Earth's 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 rock and oil characterization.

(c) How would you distinguish colloids from true solutions and suspensions?

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF B.TECH GEOLOGY
2014/2015 SESSION

COURSE CODE: GEL 325

UNIT: 3

COURSE TITLE: INTRODUCTION TO GEOCHEMISTRY

TIME ALLOWED: 2½ HOURS

DATE: Wednesday 7th October, 2015

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 (i) partial melting and (ii) 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 $1.41 \times 10^{-14}/\text{yr}$. 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.
(d) Explain how replacing a lighter isotope with a heavier one lowers the energy of and stabilizes a molecule.

SECTION B → 10 (3) *Topic Related* Dr. *W. P. D. Jayasinghe*

- Q4. (a) Explain at least four chemical factors that govern geochemical mobility of elements in surface 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, Mn 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's 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 oils characterization.
(c) How would you distinguish colloids from true solutions and suspensions?