|  |  |  |
| --- | --- | --- |
| University of Salahaddin | *Academic year* *Question Bank* | *Geochemistry: practical* |
| College of Science | 4th Class |
| Dep. of Earth Science and Petroleum |  |

Q1) The following data was obtained on 3 minerals from a Granite sample. Calculate the initial 87Sr/86Sr ratio and the age of the Biotite grain using the isochron method (both methods)? If you know that decay constant for 87Rb is 1.42 x10-11.

|  |  |  |
| --- | --- | --- |
| Sample | Sr87/Sr86 | Rb87 / Sr87 |
| Muscovite | 0.746 | 3.311 |
| Biotite | 0.78 | 6.211 |
| K-feldspar | 0.875 | 15.271 |

Q2) There are some data for zircons extracted from granite. What is the age of the zircon at time formed and lost of pb (by T0 and T1) in this diagram? Decay constant 235 U = 9.8485\*10-10 /yr ,238U = 1.55125\*10-10 /yr.

Q3) Three laser spot analyses were made on grain of biotite from a granite rock. All the 40Ar is radiogenic, J = 0.0140 and that the total decay constant is 5.543 x 10-10. What do these data tell you about this Biotite grain?

|  |  |
| --- | --- |
| Sample | 40Ar/39Ar |
| A | 69.156 |
| B | 63.211 |
| C | 64.350 |

Q4) what the δ18O of Jurassic Limestone according to the VSMOW stander (18O/16O= 2005.2\*10-6) if you know the ratio of Oxygen isotope (18O/16O) in calcite is 211.67\*10-5? What can stable isotopes be used for?

Q5) Draw the curve for the reaction below, the reaction at equilibrium state?

 Graphite (C) + CO2 Diamond (C)+ CO2

 ∆S298 = 3.36, ∆H 298 = 1897, ∆V = 0.1881

1. Which one (Graphite or Diamond) is stable at high pressure but relatively low temperature?
2. Write the first law of thermodynamic?
3. If we have this reaction CaCO3 (calcite) ⇔ CaCO3 (aragonite) and the ∆G < 0, the reaction proceeds to which direction?
4. Calculate the distribution coefficient (K or KD) for this reaction when the two phases pure and ideal mixing.

Q6) The table below shows the physicochemical parameters of ground water (the cations and anions in epm).

 Calculate:

1. Hypothetical salt, and which salt precipitate at the first?
2. Hydrochemical formula and type of water?
3. In which climate is rich with these ions, depends on the type of water?

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Well | T 0C | PH | TH | EC | TDS | Ca+2 | Na+ | Mg+2 | K+ | Cl- | SO4⁻2 | NOˉ3 | HCO-3 |
| Birayaty |  4.1 |  7.4 |  291 |  458 |  298 |  3.59 |  0.52 | 2.22 | 0.04 |  0.31 | 1.54 | 0.26 |  3.77 |

Q7) Find electronic configuration of the Cd48 representing the electron core by the symbol of the preceding inert gas (Kr36).

Q8) Find electronic configurations, valence electrons and valency of Sr38.

Q9) Write the Chemical Index formula of Alteration (CIA) and Weathering (CIW).

Q10) Find the ratio for (Ca & Mg) ions in carbonate rocks, if 50ml of the sample and 50ml of distill water was titrated with EDTA (volume of EDTA 19.40ml) by using indicator Murixide. And the total hardness was 85%, and the molarity of EDTA is 0.025 and atomic weight of Ca is 40.08.?

Q11) River has the following chemical parameters, if pH is 8.5 and the EC is 380 µS/cm, find the following?

1. Calculate hypothetical salt, and which salt precipitate at the first?
2. Hydrochemical formula and type of water?
3. In which climate the river is rich with these ions, depends on the type of water?
4. The value of HCO3 return of the whole HCO3, or CO3 or both of them and why?
5. Why are the cations in the river have high mobility, depend on solubility?

|  |  |  |  |
| --- | --- | --- | --- |
| Ions | ppm | Ions | ppm |
| Ca | 22.3 | HCO3 | 100.1 |
| K | 25.5 | Cl | 78.3 |
| Na | 40.6 | NO3 | 3.1 |
| Mg | 10.78 | SO4 | 22.4 |

Note: Atomic weight for Ca= 40.08, Mg=24.32, Cl= 35.457, Na= 22.99, K= 39.1.

 Molecular weight for HCO3= 61, NO3= 62, SO4= 96.

Q12) 1- Draw the curve for the reaction below, the reaction at equilibrium state?

 Kyanite ↔ Sillimanite

 ∆H =+1770, ∆S= +2.95, ∆V =+0.1389

1. Which one is stable at high pressure but relatively low temperature?
2. Write the first law of thermodynamic?
3. If we have this reaction ( Quartz ↔ Glass ) and the ∆G > 0, the reaction proceeds to which direction?
4. Find K (equilibrium constant) when the phases pure and ideal mixing?

Q13)Write the mode occurrence of Pb in feldspar.

Q14)Write the second law of thermodynamic?

Q15)Correlation coefficient when (r = -1 r = 0 r = +1), What do they imply.

Q16)Arrange these salts according to their solubility (starting with the salt that dissolved first).

Mg(HCO3)2, NaCl, Ca(HCO3)2, MgSO4, NaNO3, Na2SO4

Q17)Mention which ion Ca+2 or SO4-2 have high solubility? why?

Q18) Calculate gain and loss of chemical elements (% L) during weathering of Biotite Gneiss.

 Note: These calculations are performing in a medium that pH=7.

|  |  |  |
| --- | --- | --- |
| Oxides | % (fresh) | % (weathered) |
| SiO2 | 71.48 | 74.51 |
| Al2O3 | 16.61 | 16.4 |
| Fe2O3 | 2.19 | 2.55 |
| FeO | 1.64 | 0.22 |
| MgO | 0.77 | 0.21 |
| CaO | 1.08 | 0.1 |
| Na2O | 1.84 | 0.09 |
| K2O | 3.92 | 2.48 |
| H2O | 2.83 | 2.9 |
| Others | 0.7 | 0.54 |

Q19)This figure is a single grain of biotite from a granite. The numbers indicate where laser spot analyses were made. The table gives the data for the spots. You may assume that all the 40Ar is radiogenic, J = 0.0140 and that the total decay constant is 5.543 x 10-10. What do these data tell you about this biotite grain?

|  |
| --- |
| m5f9 |
| Ar laser spots  |

|  |  |
| --- | --- |
| spot number | 39Ar/40Ar (x 10-2) |
| 3 | 1.446 |
| 5 | 1.406 |
| 6 | 1.472 |
| 15 | 1.582 |
| 25 | 1.554 |
| 28 | 1.476 |
| 29 | 1.527 |

Q20) Draw and explain (Anomaly, Background, Threshold) for exploration to analysis samples of Haj-umran sediment about Cr element.

Note: X-= 1.75 , S.D.= 0.43

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Class interval | Frequency |  | 2.31-2.50 | 7 |
| 0.71-0.90 | 5 |  | 2.51-2.70 | 6 |
| 0.91-1.10 | 13 |  | 2.71-2.90 | 7 |
| 1.11-1.30 | 39 |  | 2.91-3.10 | 8 |
| 1.31-1.50 | 55 |  | 3.11-3.30 | 2 |
| 1.51-1.70 | 45 |  | 3.31-3.50 | 4 |
| 1.71-1.90 | 35 |  | 3.51-3.70 | 5 |
| 1.91-2.10 | 11 |  | 3.71-3.90 | 3 |
| 2.11-2.30 | 9 |  | 3.91-4.10 | 1 |

Q21) Fill in the open spaces of the following sentences by the appropriate words.

1. Exploration Geochemistry is divided to ................................. and …………………survey.
2. ……………………………is an instrument used in soil sampling.
3. The occurrence of trace elements in solids, as a trace element …………………..…….on the surface of a colloidal particle of Fe-Mn Oxides, Clay mineral or Organic material.
4. The decomposition by fusion, require high temperature to (1000C°) or more for that used special ovens called (furnace) by using ………………….and …….……...……….. bowl.
5. Analytic matrix separation and pre-concentration should be avoided whenever possible, because these techniques are severe sources of ………………………..and f…………………………….
6. Planning of exploration:………………………….....and ………..…………..………..

22) There are many ways for obtain background, threshold and anomaly, depended on.

23) Preparation soil sample in the Laboratory.

24) Mention 5 of the equipment that used for analyzing and separating of elements.

Q22) The following table is data of geochemical analysis of Pb element from stream sediment sample in Dokan Lake?

1. Find the Median.
2. Calculate Stander division (S.D), and explain to what the result indicates?
3. Find threshold.
4. Draw the relationships between Pb and S, when correlation coefficient (r=+0.99) and between Pb and Ni when (r=0.001).
5. Calculate Cumulative frequency percent.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of sample | Pb (ppm) | Log |  |  |  |  |
| 1 | 19.32 | 1.05 |  |  |  |  |
| 2 | 17.32 | 1.09 |  |  |  |  |
| 3 | 18.33 | 1.13 |  |  |  |  |
| 4 | 17.53 | 1.19 |  |  |  |  |
| 5 | 18.25 | 1.19 |  |  |  |  |
| 6 | 11.25 | 1.24 |  |  |  |  |
| 7 | 19.36 | 1.24 |  |  |  |  |
| 8 | 15.32 | 1.26 |  |  |  |  |
| 9 | 18.92 | 1.26 |  |  |  |  |
| 10 | 20.00 | 1.26 |  |  |  |  |
| 11 | 18.96 | 1.28 |  |  |  |  |
| 12 | 13.36 | 1.28 |  |  |  |  |
| 13 | 18.25 | 1.29 |  |  |  |  |
| 14 | 15.63 | 1.29 |  |  |  |  |
| 15 | 12.35 | 1.30 |  |  |  |  |

Q23) The table below represent data of geochemical analysis of Mn element from soil sample of Bastora area, determine the *Anomaly*, Background and Threshold, by using semi log paper.

Note: Standard deviation ( S )= 0.43 ,Mean (X )=1.75.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Log ppnr | Frequency | Cumulative frequency  | Cumulative percent% |   |   |   |
| 0.71-0.90 | 5 | 255 | 100.0 | 0.71 | 192 | 100 |
| 0.91-1.10 | 13 | 250 | 98.0 | 0.91 | 187 | 97.39583 |
| 1.11-1.30 | 39 | 237 | 92.9 | 1.11 | 174 | 90.625 |
| 1.31-1.50 | 55 | 198 | 77.6 | 1.31 | 135 | 70.3125 |
| 1.51-1.70 | 45 | 143 | 56.1 | 1.51 | 80 | 41.66667 |
| 1.71-1.90 | 35 | 98 | 38.4 | 1.71 | 35 | 18.22917 |
| 1.91-2.10 | 11 | 63 | 24.7 |   |   |   |
| 2.11-2.30 | 9 | 52 | 20.4 | 2.11 | 58.26331 |   |
| 2.31-2.50 | 7 | 43 | 16.9 | 2.31 | 48.17927 |   |
| 2.51-2.70 | 6 | 36 | 14.1 | 2.51 | 40.33613 |   |
| 2.71-2.90 | 7 | 30 | 11.8 | 2.71 | 33.61345 |   |
| 2.91-3.10 | 8 | 23 | 9.0 | 2.91 | 25.77031 |   |
| 3.11-3.30 | 2 | 15 | 5.9 | 3.11 | 16.80672 |   |
| 3.31-3.50 | 4 | 13 | 5.1 | 3.31 | 14.56583 |   |
| 3.51-3.70 | 5 | 9 | 3.5 | 3.51 | 10.08403 |   |
| 3.71-3.90 | 3 | 4 | 1.6 | 3.71 | 4.481793 |   |
| 3.91-4.10 | 1 | 1 | 0.4 | 3.91 | 1.120448 |   |
|   | 255 |   |   |   |   |   |
|   |   |   |   |   |   |   |
|   |   |   |   |   |   |   |
|   |   |   |  |   |   |   |
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|   |   |   |  |   |   |   |
|   |   |   |  |   |   |   |

Q24) The following table is data of geochemical analysis of Pb element from stream sediment sample of Dokan area using semi log paper to determine the Anomaly ,Background & Thresold ?

Note: Standard deviation, S=0.24, X=1.01

|  |  |
| --- | --- |
| Class Interval | Frequency |
| 1.1-1.2 | 1 |
| 1.2-1.3 | 16 |
| 1.3-1.4 | 33 |
| 1.4-1.5 | 50 |
| 1.5-1.6 | 49 |
| 1.6-1.7 | 36 |
| 1.7-1.8 | 9 |
| 1.8-1.9 | 6 |
| 1.9-2.0 | 5 |
| 2.0-2.1 | 4 |
| 2.1-2.2 | 10 |
| 2.2-2.3 | 8 |
| 2.3-2.4 | 5 |
| 2.4-2.5 | 4 |
| 2.5-2.6 | 2 |
| 2.6-2.7 | 0 |
| 2.7-2.8 | 1 |

Q25) Choose correct word for the following:

( colorless) , (Anomaly%100) ,( -1 ) ,(Ca) ,( zero ),( Pb ), (Gain) , (+1) , (Anomaly population) ,( Loss),( blue) ,(Background population),(Na),(10),(Insoluble Residual).

 1- The points witch located under inflection point in the table are

 used to determine ---------------- .

 2-ΔG at equilibrium state is equal to --------------.

 3- Transport of elements from rocks to water called ----------.

 4- Point located above the line of population Anomaly represented

 ------------- .

 5- When material is ideal mixing and impure then γ =---------------.

 6- First ion precipitate is ----------.

 7- ------------is very important for studying correlation between rock

 bed.

 8- When EBT is added to a sample and then titrated with EDTA

 ,the color changes to-------.

 9- When Phenolphthalein alkalinity is added to a sample and then

 titrated with Sulfuric acid the color change from purple to ------------.

10- Mode occurrence of ---------- element in K-Feldspar as a trace

 element.

Q26) The table below represent data of geochemical analysis of Cd element from soil sample of Bastora area ,determine the Anomaly , Background and Threshold ,by using semi log paper.

Note: Standard deviation, S = 0.12 ,X =1.22.

Log x Log x

1.21 1.36

1.23 1.39

1.23 1.40

1.24 1.47

1.25 1.51

1.25 1.66

1.26 1.73

1.28 1.77

1.30 1.79

1.30 1.90

Q27) Correct the underline words

1. Reconnaissance survey is an exploration geochemistry, the distance between two samples is (l-100m).
2. Sieving the samples by using sieve (60mesh) for getting Clay sizes.
3. The reduction agent like H2O2 is using for Ferromanganese Oxide.
4. To calculate precision depend on mean(X) and variance (S).
5. Anomaly is the boundary between background variation and extreme values.

Q28) River has the following physiochemical parameters, calculate:

1. Hypothetical salt.
2. Hydrochemical formula and type of water
3. Accuracy ( uncertainty (U ) and certainty (C) )

|  |  |  |  |
| --- | --- | --- | --- |
| Ions | ppm | Ions | Atomic weight |
| Ca | 36.20 | Cl | 35.457 |
| Mg | 11.00 | S | 32 |
| Na | 9.00 | O | 16 |
| K | 2.00 | C | 12 |
| HCO3 | 106.00 | N | 14 |
| Cl | 46.50 | Ca | 40.08 |
| NO3 | 8.80 | Mg | 24.32 |
| SO4 | 3.04 | Na | 22.99 |
|  TDS |  206.7mg/l | K | 39.1 |
|  pH |  8.6 | H | 1 |

Q29) Find the ratio for (Ca & Mg) ions in carbonate rocks, if 50ml of the sample was titrated with EDTA (volume of EDTA 33.21ml) by using indicator Murixide. Another 50ml from the same sample titrated with EDTA (volume of EDTA 67.3l) by using Erichrom black T, and the normality of EDTA is 0.025?

Q30) Draw the curve for the reaction below, the reaction at equilibrium state?

 Albite ↔ jadeite +Quartz

 ∆S = -8.42 and ∆V = -0.4058 , ∆H = -375

 34) Three Samples of granite rock with 87Sr/86Sr ratios and 87Rb and 86Sr concentrations are given in the table below. If it’s known that the decay constant for 87Rb is 1.42 x 10-11. What is the age of this rock?

|  |  |  |  |
| --- | --- | --- | --- |
| Sample no. | 87Sr/86Sr  | 87Rb ppm  | 86Sr ppm |
| 1 | 0.7316 | 43.1 | 17.7 |
| 2 | 0.8841 |  74.8 | 3.32 |
| 3 | 0.8309 | 70.4 | 4.48 |

Q31) The table below represent data of geochemical analysis of Sr element from soil sample of Bastora area, determine the.

1. Anomaly
2. Background
3. Threshold
4. 100% anomaly and 100% Background if exist.

 Note: Standard deviation, S.D. = 0.7, Mean ( X ) =1.02

|  |  |
| --- | --- |
| Class interval | Frequency |
| 1.1-1.2 | 1 |
| 1.2-1.3 | 16 |
| 1.3-1.4 | 33 |
| 1.4-1.5 | 50 |
| 1.5-1.6 | 50 |
| 1.6-1.7 | 36 |
| 1.7-1.8 | 9 |
| 1.8-1.9 | 6 |
| 1.9-2.0 | 5 |
| 2.0-2.1 | 4 |
| 2.1-2.2 | 10 |
| 2.2-2.3 | 8 |
| 2.3-2.4 | 5 |
| 2.4-2.5 | 4 |
| 2.5-2.6 | 2 |
| 2.6-2.7 | 0 |
| 2.7-2.8 | 1 |

Q32) Write hypothetical salt for these ions, and write the hydrochemical formula of water then find the type of water, PH =7.8 and EC=360.

|  |  |
| --- | --- |
| Ions | ppm |
|  Na | 943 |
| Ca | 392 |
| Mg | 200 |
| Cl | 1864 |
| SO4 | 1035 |
| NO3 | 41 |
| HCO3 | 131 |

Q33) Draw the curve for this reaction:

 Albite ↔ jadeite +Quartz (Equilibrium state )

 ∆S = -8.42 and ∆V = -0.4058 , ∆H = -375

Q34) What would you expect to be the general relationship among the hardness values and entropies of minerals?

Q35) The relative mobility of elements depends on?

Q36) Write the First law of thermodynamic?

Q37) Insoluble residues in the carbonate rocks are the materials that remain after treatment these rocks with weak acid, why we use weak acid?

Note: Atomic weight of Ca=40.08, Mg = 24.32, Cl=35.457, S=32, Na=22.99, C=12, N=14, O=16, H=1.0

Q38)Write the mode occurrence of Zn in Magnetite.

Q39)Why we use Platinum and Nickel bowl in fusion method?

Q40)Oxalate is used for what?

Q41)Why separation and pre-concentration should be avoided?

Q42)Draw the relationship between Mn and Cu when the correlation coefficient ( r ) is (-0.98).

Q43)List the requirements that are needed in samples collecting?

Q44) Find precision for these cations of some water samples taken from the river, if it is acceptable or not accepted.

If Standard deviation (SD or σ ) Arithmetic mean(X)

|  |  |  |
| --- | --- | --- |
| Elements | SD (σ) | X |
| Ca ppm | 2.15 | 68.03 |
| Mg ppm | 0.51 | 9.03 |
| Na ppm | 0.5 | 6.5 |
| K ppm | 0.02 | 0.94 |

Q45) The data of geochemical analysis for Pb element from stream sediment is given below, using semi-log paper to determine the Anomaly, Background and Threshold?

Note: Standard deviation (SD or σ) = 0.24, and Arithmetic mean(X)=1.01

|  |  |
| --- | --- |
| Class Interval | Frequency |
| 1.1-1.2 | 1 |
| 1.2-1.3 | 16 |
| 1.3-1.4 | 33 |
| 1.4-1.5 | 50 |
| 1.5-1.6 | 49 |
| 1.6-1.7 | 36 |
| 1.7-1.8 | 9 |
| 1.8-1.9 | 6 |
| 1.9-2.0 | 5 |
| 2.0-2.1 | 4 |
| 2.1-2.2 | 10 |
| 2.2-2.3 | 8 |
| 2.3-2.4 | 5 |
| 2.4-2.5 | 4 |
| 2.5-2.6 | 2 |
| 2.6-2.7 | 0 |
| 2.7-2.8 | 1 |

Q46) Find the ratio for (Ca & Mg) ions in carbonate rocks, if 25ml of the sample was titrated with EDTA (volume of EDTA 25.83ml) by using indicator Murixide. Another 25ml from the same sample titrated with EDTA (volume of EDTA 51.00ml ) by using Erichrom black T, and the normality of EDTA is 0.02?

Note/ Atomic weights for Ca=40.08 and Mg =24.32.

**Q47) What is  ΔG for the melting of ice at 200C?**

 H2​O(s)→H2​O(l)

 If we know: ΔH=6.01, ΔS =0.022

1. Also predict the direction of the reaction.
2. Write the mixed law of thermodynamics?

Q48)

1. What are the valence electron and electronic configuration of the Ag47 representing the electron core by the symbol of the preceding inert gas (Kr36).
2. How does the Ionization energy change as moves up the Periodic table?
3. Classify the following set of elements as either noble gases, halogens, alkali metals, alkaline earth metals, or transition metals. Li, Mn, He.

Q49) The table below shows the physicochemical parameters of groundwater (the cations and anions in epm).

 Calculate:

1. Hypothetical salt, and Total haedness if Ca is 45ppm and Mg 44ppm.

Hydrochemical formula and type of water?

Q50) Under what conditions the heat evolved or absorbed is equal to the internal energy change?

Good Luck