heat capacities (Δ Cp) of the reaction can be ignored. If the minerals behave as non-ideal solutions, would the temperature estimate of the geothermometer at a constant pressure increase or decrease with respect to the aforesaid case ? Justify your answer. 6

8. Write short notes on : 6

(i) The relation between Nernst Partition coefficient and compatibility of an element during crystallization of a basaltic melt.

(ii) Activity – composition relation in a solid solution phase.

—— X ——

MASTER OF SCIENCE EXAMINATION, 2019

(1st Year, 1st Semester)

APPLIED GEOLOGY

Geochemistry

Paper : - II

Time : Two hours Full Marks : 50

Use a separate answer script for each group.

GROUP - A (25 marks)

Answer any ***two*** questions.

1. For a hydrothermal solution establish the following relation :
$\delta^{34}S_{fluid} = \delta^{34}S_{H2S} + \Delta_{SO2} \cdot (R/(R+1))$ where R is the mole ratio of SO_2/H_2S and $\Delta_{SO2} = \delta^{34}S_{SO2} - \delta^{34}S_{H2S}$.
"The volume of magmatic-hydrothermal fluid exsolved from an oxidized granitic magma has important control on the $\delta^{34}S$ values of the fluid" – accept or reject the statement with reason. Using necessary sketch discuss how the $\delta^{34}S_{H2S}$ of a fluid, initially in H_2S-dominant field, will change with decreasing temperature in the following cases : (a) H_2S/SO_2 ratio remains nearly constant, (b) H_2S/SO_2 ratio decreases gradually. $4+2^{1}/_{2}+6$

2. Using necessary sketch briefly discuss the evolution of $\delta^{34}S_{H2S}$ and $\delta^{34}S_{SO4}$ during bacterial reduction of seawater sulphate (SO_4^{2-}) to sulphide (H_2S) when the system is closed to both sulphate and sulphide. Given that $10^3 \ln \alpha_{ZnS\text{-}H2S} = (0.10 \times 10^6)/T^2$ and $10^3 \ln \alpha_{PbS\text{-}H2S} = (-0.63 \times 10^6)/T^2$ derive the equation for $10^3 \ln \alpha_{ZnS\text{-}PbS}$. Among pyrite, chalcopyrite, sphalerite and galena, which mineral pair is commonly used as sulphur isotope thermometer to know the temperature of metamorphosed hydrothermal deposit and why ?
$6+4^1/_2+2$

3. "The initial $^{87}Sr/^{86}Sr$ ratios of a set of co-genetic igneous rock samples are same where as their initial $^{87}Rb/^{86}Sr$ ratios are different" – accept or reject the statement with reason. How does the ϵNd and ϵSr value of the crust differ from that of the depleted mantle and why ? What is μ and how the high μ value of HIMU mantle is explained ? $3+6+3^1/_2$

4. Derive the fundamental equation of U-Th-Pb_{Total} chemical dating. What are the advantages and disadvantages of such dating ? Using necessary sketch briefly discuss the method of determining the Sm-Nd model age by graphical method. $6+2+4^1/_2$

GROUP - B (25 marks)
Ansqer ***Q.no. 5*** and any ***two*** from the rest.

5. What is Nernst Partition Coefficient for a chemical species (Di) ? Can the relation DNi < DRb holds good in common rocks ? Justify your answer. A basaltic magma has 300 ppm Ni and 30 ppm Sr. The magma is crystalizing in equilibrium in a closed system. For the first 30% crystallization of the magma olivine (DNi = 14) is the only phase. In the next 60% of the crystallization olivine and plagioclase (DNi = 0, DSr = 3) appear in 1:1 weight percent. Calculate Ni/Sr ratio of the melt after 90% of crystallization ? 13

6. Derive an equation that can be used to calculate volume strain of a mylonite from the compositions of the sheared and the un-sheared wall rocks. Also calculate the change of rock mass during shearing. 6

7. Using the following ion exchange reaction,
$^1/_2$ Fe2Si2O6 + $^1/_3$ Mg3Al2Si3O12 = $^1/_2$ Mg2Si2O6 + $^1/_3$ Mg3Al2Si3O12
How do you formulate a geothermometric equation where, $\Delta H_{1,T}$, ΔS_T and ΔV represent the change of enthalpy (at, 1 bar and T oK), entropy and volume change of the reaction. K_D represent distribution coefficient. Given that garnet and pyroxene behave like ideal solutions under all conditions. Change of