M. Sc. Applied Geology Examination, 2023

(1st Year, 1st Semester)

Geochemistry

Paper – CORE/TH/02

Time : Two hours   Full Marks : 40

(Use a separate Answer script for each Part)

PART – I (20 Marks)

Answer any **two** questions.

All questions carry equal marks.

1. "Thermodynamic activity of a component in a solution is always lower than its actual concentration in the solution" — accept or reject the statement with reason. Why it is dangerous for a scuba diver to move fast towards the surface of water after completing the diving?

2. Derive an equation to demonstrate the temperature dependence of solubility of a solute in a solution. What is hydrated radius of an ion? Are the hydrated ionic radii of all ions in solutions same? Justify.

3. "In all dilute solutions, thermodynamic activity of a solute always follows the Henry's law" — accept or reject the statement with reason. Why do Ni and Rb concentrate in ultramafic and granitic rocks respectively? What is the unit of thermodynamic activity of a component in a solution?

[Turn over

PART – II (20 Marks)

Answer any **four** questions.   4×5

1. "Magmatic hydrothermal fluid derived from a basaltic melt will carry the same sulphur isotopic signature as that of the melt whereas a magmatic hydrothermal fluid derived from a granitic melt may not carry the same sulphur isotopic signature as that of the melt" – accept or reject the statement with reasons.   5

2. What do you understand by $\in$Nd and $\in$Sr values of an igneous rock? "An igneous rock derived from the partial melting of the crust can be distinguished from an igneous rock derived from the partial melting of the depleted mantle based on their $\in$Nd and $\in$Sr values" – accept or reject the statement with explanations.   2+3

3. What is model age? Discuss how we determine the Sm-Nd model age of a rock using graphical methods.   1+4

4. Derive the fundamental equation of U-Th-Pb$_{Total}$ chemical dating. What are the advantages and disadvantages of such dating?   5

5. "Bacterial reduction of seawater sulphate will lead to lighter $\delta^{34}S$ value of the produced H_2S than thermochemical sulphate reduction" – accept or reject the statement with reason. Given that $10^3\ln \alpha_{ZnS-H2S} = (0.10$

$\times 10^6)/T^2$ and $10^3\ln \alpha_{PbS-H2S} = (-0.63 \times 10^6)/T^2$ derive the equation for $10^3\ln \alpha_{ZnS-PbS}$.   2+3

6. Write short notes : $2\times2^{1}/_{2}$

   a) Sulphur isotope thermometer

   b) Radiogenic Isotopic character of HIMU mantle and enriched mantle.