

## QUESTION PAPER

1. If the concentration of  $^{18}\text{O}$  of a given water sample is 2010 ppm, calculate its  $\delta^{18}\text{O}$  value (in permil) against VSMOW (considering VSMOW  $^{18}\text{O}$  concentration is 2000 ppm)?
2. The altitude of a mountain is 1500m (foot of the mountain 500m and top 2000m), the rain water collected from different altitudes of the mountain showed following  $\delta^{18}\text{O}$  values, Calculate average depletion of  $^{18}\text{O}$  per 100 m rise in altitude.

altitude	$\delta^{18}\text{O}$ value (‰)
500	-12
600	-12.5
750	-14.2
1000	-15.8
1500	-17.6
1750	-19.4
2000	-20.8

3. If the spring at an altitude of 720m showed a  $^{18}\text{O}$  value of  $-20\text{‰}$  then what is the recharge altitude of this spring. Use the above table for calculation.
4. Mention True/False
  - a. Addition of NaCl changes the isotopic composition of a given water sample
  - b. Away from coast the heavy isotope values in rainfall increases (enriched isotopic values)
  - c. High amount of rain shows high amount of heavy isotopes (enriched isotopic values)
  - d. Rainfall at equator is enriched in heavy isotopes compared to north pole
  - e.  $\delta^{15}\text{N}$  can be used to identify the source of nitrate and sulphate contamination
  - f. Bacterial action can modify the  $\delta^{34}\text{S}$  composition of sulphates in water
  - g. Isotope values doesn't change when exposed to air
  - h.  $^2\text{H}$  and  $^{18}\text{O}$  can be used to find out the age of water
5. Is it possible to distinguish on the basis of  $^{18}\text{O}$  and  $^2\text{H}$  analyses the original isotopic composition of surface water has undergone evaporation? Explain.
6. Write the different species of water molecules that can be formed from three isotopes of hydrogen ( $^1\text{H}$ ,  $^2\text{H}$ ,  $^3\text{H}$ ) and three isotopes of oxygen ( $^{16}\text{O}$ ,  $^{17}\text{O}$ ,  $^{18}\text{O}$ ). Which of them is most abundant?
7. The relative contributions of precipitation, river and groundwater to a well are 10%, 25% and 65%. The  $\delta^{18}\text{O}$  values of precipitation, river and groundwater are  $-5\text{‰}$ ,  $-11\text{‰}$  and  $-15\text{‰}$  respectively. Calculate the  $\delta^{18}\text{O}$  value of the well water?
8. In Ilkal village of Karnataka, the well waters were found to be fluoride contaminated (4-7 ppm). There are two possible sources, fluoride rich rocks and rock polishing industries. Is it possible to establish the exact source using water isotopes? Explain.
9. What is the equation of Global Meteoric Water Line and how is that established?
10. Can isotopes be used for understanding paleotemperatures?