1) A sample of drinking water was found to be severely contaminated with chloroform, $CHCl_3$, supposed to be carcinogenic in nature. The level of contamination was 15 ppm (by mass).

(i) Express this in percent by mass.

(ii) Determine the molality of chloroform in the water sample.

(i) 15 ppm means 15 parts in million (10^6) parts.

$$\therefore \% \text{ mass} = \frac{15}{10^6} \times 100 = 15 \times 10^{-4} = 1.5 \times 10^{-3}\%$$

(ii) Molar mass of chloroform (M_B) = 118.5 $gmol^{-1}$

100 g of the sample contain

$$= 1.5 \times 10^{-3}g \text{ chloroform}$$

$\therefore$ 1000 g of the sample contain

$$= 1.5 \times 10^{-2}g \text{ chloroform}$$

$$\text{Molarity} = \frac{W_B \times 1000}{M_B \times W_A} = \frac{1.5 \times 10^{-2} \times 1000}{118.5 \times 1000} = 1.266 \times 10^{-4}$$

2. Calculate the molarity of a solution of ethanol in water, in which the mole fraction of ethanol is 0.040 (assume the density of water to be one)

Moles of ethanol = 0.04 mol
Moles of water = 1 - 0.04 = 0.96 mol

Mass of water = 0.96 * 18 = 17.3g
Mass of ethanol = 0.04 * 46 = 1.84g

Mass of solution = 17.3 + 1.84 = 19.1g
Let density of solution be 1g/ml

Volume of solution = mass/density = 19.1/1 = 19.1ml = 0.0191L

Molarity = 0.04/0.0191 = 2.1M