Q- A diver releases an air bubble of volume 2.0 cm^3 from a depth of 15 m below the surface of a lake where the temperature is 7.0^{0}C. What is the volume of the bubble when it reaches just below the surface of the lake where the temperature is 20^{0}C?

With depth the pressure of water and hence that of the air, in the bubble changes

The pressure at the surface of the water is equal to the atmospheric pressure

$P_0 = 1.013*10^5$ Pa.

At depth h the pressure is equal to the sum of the atmospheric pressure and the pressure of the water column of height h and hence the initial pressure of the air in the bubble is

$P_1 = P_0 + h\ r\ g = 1.013*10^5 + 15*10^3*9.8 = 2.483*10^5$ Pa

Where r is the density of water = 10^3 kg/m^3

Hence initial pressure $P_1 = 1.013*10^5 + 15*10^3*9.8 = 2.483*10^5$ Pa

The initial volume $V_1 = 2.0\ cm^3 = 2.0*10^{-6}\ m^3$

Initial temperature $T_1 = 273 + 7 = 280$ K

And

Final pressure $P_2 = 1.013*10^5$ Pa

Final volume V_2 =?

Final $T_2 = 273 + 20 = 293$ K

As the air can be considered as ideal gas, we can write using ideal gas equation

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Or $$V_2 = \frac{P_1V_1\,T_2}{P_2\,T_1}$$

Substituting the values, we get

$$V_2 = \frac{2.483*10^5*2.0*10^{-6}*293}{1.013*10^5*280} = 5.13*10^{-6}\ m^3$$

Hence the volume of the bubble near the surface will be $\mathbf{5.13*10^{-6}\ m^3 = 5.13\ cm^3}$