Question #71873, Physics / Mechanics | Relativity |

A solid lead sphere of volume 0.5 m³ is lowered to a depth in the ocean where the water pressure is equal to 2*10^7 N/m² . The bulk modulus of lead is equal to 7.7*10^9 N/m² . What is the change in volume of the sphere??

Need to find: dV - ?

$V = 0.5\ m^3$

$p_0 = 2*10^7\ N/m^2$

The atmospheric pressure is $p = 1.013 \times 10^5$ Pa

The bulk modulus of lead is equal to $K = 7.7*10^9\ N/m^2$

Solution

The bulk modulus (K) of a substance measures the substance's resistance to uniform compression. It is defined as the pressure increase needed to cause a given relative decrease in volume.

$$K = -V\left(\frac{dp}{dV}\right)$$

Here, $dp = 2*10^7 - 1.013*10^5 = 1.39987*10^7\ N/m^2$

Hence, $dV = \left(-V\frac{dp}{K}\right) = -0.5 \cdot \left(\frac{1.98 \cdot 10^7}{7.7 \cdot 10^9}\right) = 1.3 \cdot 10^{-3}\ m^3$

Answer – $V = 1.3 \cdot 10^{-3}\ m^3$. The negative sign implies that there is a reduction in Volume