Answer on Question #41556, Physics, Other

Calculate the change in internal energy of 2kg of water at 90 degree Celsius when it is changed to 3.30 m3 of steam at 100oC. The whole process occurs at atmospheric pressure. The latent heat of vaporization of water is 2.26×106J/kg.

a. 4.27 MJ b. 3.43 kJ c. 45.72 mJ d. 543.63 J

Solution

The amount of heat received water is equal to the sum of the change in internal energy of water and the work on the steam:

$$Q = \Delta U + W,$$

where $Q = Q_{heating} + Q_{vaporization}$.

The change in internal energy is

$$\Delta U = Q_{heating} + Q_{vaporization} - W = mc\Delta t + mr - p\Delta V = mc\Delta t + mr - p\left(v - \frac{m}{\rho}\right).$$

$$\Delta U = 2 \cdot 4200 \cdot (100 - 90) + 2 \cdot 2.26 \cdot 10^6 - 101325 \cdot \left(3.30 - \frac{2}{1000}\right) = 4.27 \cdot 10^6 J = 4.27\ MJ.$$

Answer: a. 4.27 MJ.