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Problem 3.28 (R)

A ton of water is heated from the freezing point to the boiling point. We have to calculate the increase in mass in kilograms and as a percentage of the original mass.

Solution:

Specific heat of water is $c = 4190 \text{ J/kg K}$.

1 ton $= 907.2$ kg.

Amount of energy acquired by 1 ton of water when it is heated from the freezing point to the boiling point will be

$\Delta E = 907.2 \times 4190 \times 100 \text{ J} = 3.80 \times 10^5 \text{ J}$.

Increase in mass of 1 ton of water on heating from the freezing point to the boiling point will be

$\dfrac{\Delta E}{c^2} = \dfrac{3.8 \times 10^5}{9 \times 10^{16}} \text{ kg} = 4.22 \times 10^{-12} \text{ kg}$.

Percentage increase in mass with respect to the original

mass will be $\dfrac{4.22 \times 10^{-12} \times 100}{907.2} = 4.65 \times 10^{-13}\%$.