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General Physics I, Quiz 5
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SN:_______________, Name:________________

Chapter 18-20, Serway; ABSOLUTELY NO CHEATING!

P18.49 If the train is moving away from station, its frequency is depressed:

$$f' = 180 - 2.00 = 178 \text{ Hz}: \qquad 178 = 180\frac{343}{343-(-v)}$$

Solving for v gives $\quad v = \dfrac{(2.00)(343)}{178}$

Therefore, $\quad v = \boxed{3.85 \text{ m/s away from station}}$

If it is moving toward the station, the frequency is enhanced:

$$f' = 180 + 2.00 = 182 \text{ Hz}: \qquad 182 = 180\frac{343}{343-v}$$

Solving for v gives $\quad 4 = \dfrac{(2.00)(343)}{182}$

Therefore, $\quad v = \boxed{3.77 \text{ m/s toward the station}}$

P20.53 The loss of mechanical energy is

$$\frac{1}{2}mv_i^2 + \frac{GM_Em}{R_E} = \frac{1}{2}670 \text{ kg}\left(1.4\times10^4 \text{ m/s}\right)^2 + \frac{6.67\times10^{-11}\text{ Nm}^2\ 5.98\times10^{24}\text{ kg}\ 670\text{ kg}}{\text{kg}^2\ 6.37\times10^6 \text{ m}}$$

$$= 6.57\times10^{10}\text{ J} + 4.20\times10^{10}\text{ J} = 1.08\times10^{11}\text{ J}$$

One half becomes extra internal energy in the aluminum: $\Delta E_{\text{int}} = 5.38\times10^{10}$ J. To raise its temperature to the melting point requires energy

$$mc\Delta T = 670 \text{ kg } 900\frac{\text{J}}{\text{kg}^\circ\text{C}}\left(660-(-15^\circ\text{C})\right) = 4.07\times10^8 \text{ J}$$

To melt it, $\quad mL = 670 \text{ kg } 3.97\times10^5 \text{ J/kg} = 2.66\times10^8 \text{ J}$

To raise it to the boiling point, $\quad mc\Delta T = 670(1\,170)(2\,450-660)\text{ J} = 1.40\times10^9 \text{ J}$

To boil it, $\quad mL = 670 \text{ kg } 1.14\times10^7 \text{ J/kg} = 7.64\times10^9 \text{ J}$

Then

$$5.38\times10^{10}\text{ J} = 9.71\times10^9 \text{ J} + 670(1\,170)\left(T_f - 2\,450^\circ\text{C}\right)\text{J/}^\circ\text{C}$$

$$T_f = \boxed{5.87\times10^{4}{}^\circ\text{C}}$$