Chapter 12 14, 38, 84

14. $v = 265\ m/s$

$$V_{rms} = \sqrt{\frac{3k_BT}{m}}$$

$$\frac{V_{rms}^2 \cdot m}{3k_B} = T$$

Nitrogen is diatomic, N_2
its mass is $2 \cdot 14U = 14U$
$U = 1.66 \times 10^{-27}\ kg$
$m_{N_2} = 28 \cdot 1.66 \times 10^{-27}\ kg$
$= 4.65 \times 10^{-26}\ kg$

$$\frac{(265\ m/s)^2 \cdot 4.65 \times 10^{-26}\ kg}{3 \cdot 1.38 \times 10^{-23}\ J/k} = 78.8\ k$$

$$39.4\ k - 273\ k = \boxed{-194\ °C}$$

38. $m = 70\ kg$ $P = 1000\ W$
$\Delta t = 30\ min$

Power is energy per second so I can find the energy the body converts to thermal energy in 30 minutes then use $Q = mc\Delta T$ to determine the temperature change of a 70 kg body when that amount of heat is added.

$$1000\ J/s \left(\frac{30 \cdot 60\ s}{min}\right) = 1{,}800{,}000\ J$$

from Table 12.4

$$1800{,}000\ J = 70\ kg\ 3400\ \frac{J}{kg\ k}\ \Delta T$$

$\boxed{7.6°C} = \Delta T$

ΔT in K & °C is equal since degree size is equal.

84. $m = 5000\,kg$

$P = 2500\,W$

Similar to #38 I'll use the energy per second to find the energy metabolised in 1 hour. Then I'll find out how much water this amount of heat can evaporate. One trick is that this water is not at 100°C, it's cooler than that so the amount of energy carried away is a bit higher. Example 12.16 in the book uses the value $2.4 \times 10^6 \frac{J}{kg}$ for the latent heat of vaporization.

$E_{th} = P \Delta t = 2500\ J/s\ (3600\,s/hr) = 9{,}000{,}000\,J/hr$

$Q = m L_f$

$9{,}000{,}000\,J/hr = m\ 2.4 \times 10^6 \frac{J}{kg}$

$\boxed{3.75\,kg/hr = m}$