6. 1 BTU = 1055 J. $P = \dfrac{Q}{\Delta t} = \dfrac{20\,000\text{ Btu}}{1\text{ h}} = \dfrac{(20\,000\text{ Btu})(1055\text{ J/Btu})}{3600\text{ s}} = \boxed{5.86 \times 10^3\text{ W}}$.

7. In one day, the energy required is $(4 \times 10^5\text{ J/h})(24\text{ h}) = 9.6 \times 10^5\text{ J}$.

The number of Big Macs is $\dfrac{9.6 \times 10^5\text{ J}}{(600\text{ Cal})(4186\text{ J.Cal})} = 3.8 = \boxed{4}$.

$\boxed{8}$. (a) Work done in each lift: $W = Fd = (20\text{ kg})(9.80\text{ m/s}^2)(1.0\text{ m}) = 196\text{ J}$.

Energy input: $E = 2800\text{ Cal} = (2800\text{ J})(4186\text{ J/Cal}) = 1.17 \times 10^7\text{ J}$.

So the number of lifts is $\dfrac{1.17 \times 10^7\text{ J}}{196\text{ J}} = \boxed{60\,000\text{ times}}$.

(b) $t = 60\,000(5.0\text{ s}) = 3.0 \times 10^5\text{ s} = \boxed{83\text{ h}}$.

$\boxed{16}$. $Q = mc\Delta T$, ☞ $\Delta T = \dfrac{Q}{cm} = \dfrac{(200\text{ J})}{[920\text{ J/(kg}\cdot\text{C°)}](5.0 \times 10^{-3}\text{ kg})} = 43\text{ C°}$.

So the final temperature is $T_f = T_i + \Delta T = 20°\text{C} + 43\text{ C°} = \boxed{63°\text{C}}$.

17. $Q = cm\Delta T = [4186\text{ J/(kg}\cdot\text{C°)}](5.0\text{ kg})(100°\text{C} - 20°\text{C}) = \boxed{1.7 \times 10^6\text{ J}}$.

18. Heat is lost, so Q is negative.

$Q = mc\Delta T$, ☞ $\Delta T = \dfrac{Q}{cm} = \dfrac{(-1500\text{ J})}{[4186\text{ J/(kg}\cdot\text{C°)}](0.250\text{ kg})} = -1.43\text{ C°}$.

So the final temperature is $37.0°\text{C} - 1.43\text{ C°} = \boxed{35.6°\text{C}}$.

21. Let the final temperature be T. The heat lost by water is
$Q_{lost} = cm\Delta T = [4186\text{ J/(kg}\cdot\text{C°)}](0.40\text{ kg})(T - 90°\text{C}) = (1674\text{ J/C°})(T - 90°\text{C})$.

The heat gained by the cup is $Q_{gained} = [840\text{ J/(kg}\cdot\text{C°)}](0.200\text{ kg})(T - 20°\text{C}) = (168\text{ J/C°})(T - 20°\text{C})$.

From calorimetry: $\Sigma Q_i = Q_{gained} + Q_{lost} = 0$, or $-Q_{lost} = Q_{gained}$.

So $-(1674\text{ J/C°})(T - 90°\text{C}) = (168\text{ J/C°})(T - 20°\text{C})$. Solving, $T = \boxed{84°\text{C}}$.

$\boxed{22}$. The heat gained by the cup is $Q_{gained} = c_c m_c \Delta T_c = c_c (0.250\text{ kg})(80°\text{C} - 20°\text{C}) = (15\text{ kg}\cdot\text{C°})c_c$.

The heat lost by the coffee is $Q_{lost} = [4186\text{ J/(kg}\cdot\text{C°)}](0.250\text{ kg})(80°\text{C} - 100°\text{C}) = -2.093 \times 10^4\text{ J}$.

From calorimetry: $\Sigma Q_i = Q_{gained} + Q_{lost} = 0$, or $-Q_{lost} = Q_{gained}$.

So $-(-2.093 \times 10^4\text{ J})\text{ J} = (15\text{ kg}\cdot\text{C°})c_c$, therefore $c_c = \boxed{1.4 \times 10^3\text{ J/(kg}\cdot\text{C°)}}$.

31. Assume the final temperature is T. We use $Q = cm\Delta T$.

The heat lost by lead is $Q_{lost} = [130\text{ J/(kg}\cdot\text{C°)}](0.60\text{ kg})(T - 100°\text{C}) = (78\text{ J/C°})(T - 100°\text{C})$.

The heat gained by water is

$_{Q\text{-water}} = [4186\text{ J/(kg}\cdot\text{C°)}](0.50\text{ kg})(T - 17.3°\text{C}) = (2093\text{ J/C°})(T - 17.3°\text{C})$.

The heat gained by the cup is

$Q_{gained\text{-}cup} = [920\text{ J/(kg}\cdot\text{C°)}](0.20\text{ kg})(T - 17.3°\text{C}) = (184\text{ J/C°})(T - 17.3°\text{C})$.

From calorimetry: $\Sigma Q_i = Q_{gained} + Q_{lost} = 0$, or $-Q_{lost} = Q_{gained}$.

So $-(78\text{ J/C°})(T - 100°\text{C}) = (2093\text{ J/C°})(T - 17.3°\text{C}) + (184\text{ J/C°})(T - 17.3°\text{C})$.

Solving, $T = \boxed{20.0°\text{C}}$.