Heat (thermal energy)

- the flow of energy due to a difference in temperature, from higher to lower temperature

- system - the part of the universe being observed
- surroundings - the rest of the universe

Endothermic or Exothermic?

ex) cup of coffee (system) - exo
hands (surroundings) - endo

pan on stove (system) - exo
popcorn (surroundings) - endo

glaciers (system) - endo
atmosphere (surroundings) - exo

- Calculating Heat (q)

$q = mC\Delta T$

- q: heat (J or cal.)
- m: mass (g)
- C: specific heat capacity (J/g°C or cal/g°C)
- ΔT: change in Temperature (°C) $= T_f - T_i$

$q = +\#$ endothermic

$q = -\#$ exothermic

- Specific Heat Capacity (C)
amount of energy needed to heat 1g of a substance by 1°C.

4.184 J = 1 cal 1000 cal = 1 Cal

Ex) 1 serving of strawberries has 669.440 J.
(A) Convert to cal. (B) Convert to Cal.

(A) $669.440\ \text{J} \left(\frac{1\ \text{cal}}{4.184\ \text{J}}\right) = 160.000\ \text{cal}.$

$1.6000 \times 10^5\ \text{cal}.$

(B) $1.6000 \times 10^5\ \text{cal} \left(\frac{1\ \text{Cal}}{1000\ \text{cal}}\right) = 160.000\ \text{Cal}.$

Solving Heat Problems $q = mC\Delta T$ $\Delta T = T_f - T_i$

Ex) 1500.g of polystrene is heated from 0.00°C to 8.70°C. Calculate the amount of heat absorbed. (T_i, T_f; heat = q; 4 sf; 3 sf)

$q = ?$
$m = 1500.\ \text{g}$
$C = 1.400\ \text{J/g°C}$
$\Delta T = 8.70°\text{C} - 0.00°\text{C} = 8.70°\text{C}$

$q = (1500.\ \text{g})(1.400\ \text{J/g°C})(8.70°\text{C})$

$q = 18270\ \text{J} = +18300\ \text{J}$

q is +, it's endothermic

Ex) Lake Allatoona contains 4.533×10^{14} g of water. How much heat is released as the water cools from 25.00°C to 19.56°C? (T_i, T_f)

$q = ?$
$m = 4.533 \times 10^{14}\ \text{g}$
$C = 4.184\ \text{J/g°C}$
$\Delta T = 19.56°\text{C} - 25.00°\text{C} = -5.44°\text{C}$

$q = (4.533 \times 10^{14}\ \text{g})(4.184\ \text{J/g°C})(-5.44°\text{C})$

$q = -1.03 \times 10^{16}\ \text{J}$

q is −, it's exothermic

Ex) What is the change in temperature when 50.00g of diamond cools down and releases 150.0 J of heat?

$q = -150.0\ \text{J}$
$m = 50.00\ \text{g}$
$C = .516\ \text{J/g°C}$
$\Delta T = ?$

$-150.0\ \text{J} = (50.00\ \text{g})(.516\ \text{J/g°C})\,\Delta T$

$\frac{-150.0\ \text{J}}{25.80\ \text{J/°C}} = \frac{(25.80\ \text{J/°C})\,\Delta T}{25.80\ \text{J/°C}}$

$-5.814°\text{C} = \Delta T$