Enthalpy Practice

As always show all work and box your final answer for the following problems.

(Remember Kilo is the prefix meaning one thousand. Ex. – 5 $\boldsymbol{kilo}joules\ is\ equal\ to\ 5\ 000\ joules$)

1.) How much heat is needed to raise the temperature of $0.257\ kg$ of ethanol ($C_{ethanol} = 2400\frac{J}{kg}$°C) by 49.1°C?

Answer – $E_h = mc\Delta T$ $E_h = (0.257)(2400)(49.1)$ $E_h = 30\ 284.88\ J$

2.) How much heat is needed to raise the temperature of $0.125\ kg$ of lead ($C_{lead} = 130.\frac{J}{kg}$°C) from 17.5°C to 41.1°C?

Answer – $E_h = mc\Delta T$ $E_h = (0.125)(130)(23.6)$ $E_h = 383.5\ J$

3.) How many kilojoules of heat are required to heat $1.37\ kg$ of water from 21.3°C to 89.5°C?

Answer – $E_h = mc\Delta T$ $E_h = (1.37)(4180)(68.2)$ $E_h = 390.55\ kJ$

4.) What mass of iron ($C_{iron} = 450\frac{J}{kg}$°C) would need $305\ kJ$ or energy to raise the temperature by 87.0°C? (be careful!!!) $305\ kJ \times \frac{1000\ J}{1\ kJ} = 305\ 000\ J$

Answer – $E_h = mc\Delta T$ $305\ 000 = (m)(450)(87.0)$ $m = 7.79\ kg$

5.) What is the final temperature of a bar of nickel ($C_{nickel} = 0.54\frac{J}{g}$°C) if $3228\ J$ of energy is added to a $384\ g$ sample with an initial temperature of 24.4°C?

Answer – $E_h = mc(T_f - T_i)$ $3228 = (384)(0.54)(T_f - 24.4)$ $T = 39.97$°C

6.) What is the specific heat of an unknown metal sample if $10.3\ kJ$ of energy are required to raise the temperature of $254.3\ g$ sample of the metal by 38°C?

Answer – $E_h = mc\Delta T$ $10\ 300 = (254.3)(c)(38)$ $c = 1.07\frac{J}{g}$°C Or $c = 1065.88\frac{J}{kg}$°C

Practice: Thermal Energy Calculations

Answer the following questions. Make sure to show all work for the math problems to receive credit. You may need a separate sheet of paper.

1. Explain the relationship between temperature, energy, and motion of particles in an object.

   Thermal energy is the amount of movement (vibration) of atoms and temperature is a number value that measures that amount of thermal energy.

2. Referencing the reasoning you used from #1, explain the difference between objects that feel hot and those that feel "cold".

   Objects that feel cold have less energy than your hand and so thermal energy (heat) is moving from your hand to the object. Vice versa if the object feels warmer.

3. You've been waiting for the bus and your hands become cold. When you get onto the bus and sit down, you put your hands under your legs to warm up. After a while your hands feel warmer but your legs feel colder. Explain this with regards to what you know about thermal energy transfer.

   The energy of heat in your legs was transferred into your hands to warm them up. As such, the temperature (measure of energy) has decreased in your legs.

4. How much energy must be absorbed by water with a mass of 0.5 kg in order to raise the temperature from 30°C to 65°C? Note: Water has a specific heat of 4,190 J/kg °C.

   Answer - $E_h = mc\Delta T$ $E_h = (0.5)(4190)(35)$ $E_h = 73325\ J$

5. How much heat is needed to warm .052 kg of gold from 30°C to 120°C? Note: Gold has a specific heat of 136 J/kg °C.

   Answer - $E_h = mc\Delta T$ $E_h = (0.52)(136)(90)$ $E_h = 6364.8\ J$

6. A 9.5 kg outdoor copper sculpture heats up during the day from 24°C to 78°C. How much energy was absorbed? Note: Copper has a specific heat of 390 J/kg °C.

   Answer - $E_h = mc\Delta T$ $E_h = (9.5)(390)(54)$ $E_h = 200\ 070\ J$

7. **Challenge:** If it takes 820 Joules of heat to warm a sample of zinc from 0°C to 50°C, what would be the mass of the zinc? Note: Zinc has a specific heat of 380 J/kg °C.

   Answer - $E_h = mc\Delta T$ $820 = (m)(380)(50)$ $m = 0.0432\ kg$ or $43.2\ g$

5. What mass of iron (c_{iron}= 0.11 cal/g°C) would need 1450 cal of energy in order to raise its temperature by 19.7°C?

$$(c_{iron} = 450\,\frac{J}{kg}°C)$$

Answer - $E_h = mc\Delta T$ $\quad 1450 = (m)(0.11)(19.7)$ $\quad m = 669.13\ g\ or\ 0.669kg$

6. What is the final temperature of a samples of nickel (c_{nickel}= 0.54 J/g°C) if 328 J of energy is added to a 16.7g sample at an initial temperature of 24.4°C?

Answer - $E_h = mc\Delta T$ $\quad E_h = mc(T_f - T_i)$ $\quad 328 = (16.7)(0.54)(T_f - 24.4)$

$$\frac{328}{(16.7)(0.54)} = T_f - 24.4 \qquad 36.37 = T_f - 24.4$$

$$T_f = 60.77\ g\ or\ 0.06077\ kg$$

7. What is the specific heat of an unknown metal if 1.67 kcal of energy are required to raise the temperature of 79.2 g sample of the metal by 63.3°C?

Answer - $E_h = mc\Delta T$ $\quad 1670 = (79.2)(c)(63.3)$ $\quad c = 0.33\ \frac{kcal}{g}°C\ or\ 333.11\ \frac{kcal}{kg}°C$