 Name:________________________________

Material	Specific Heat Capacity (J/(kg·C))
Water	4200
Ice	2040
Alcohol	2380
Concrete	880
Aluminum	900
Copper	430
Iron	450
Steel	480
Lead	130

1. Explain in terms of atomic and molecular interactions why the mercury rises in a thermometer when it is placed in a beaker of hot water. Remember that the mercury is enclosed in a glass tube.

As the mercury heats up it's molecules moves around more, so it needs more space, the only place for it to expand is upwards.

2. What will the change in temperature be if a 3.5 kg ball of lead has 2500 J of heat energy added to it?

$$E_h = mc\Delta T$$

$$\frac{E_h}{mc} = \Delta T$$

$$\frac{2500}{3.5 \times 130} = 5.5°C$$

3. How much energy does it take to raise the temperature of 10.0 Liters of water from 5.0° C to 95° C? Assume density of H_2O is 1.0 g/mL

Since density is 1.0 g/mL
1 L = 1 kg water

$$\Delta T = 95 - 5 = 90°$$

$$E_h = mc\Delta T$$

$$= 10 \times 4200 \times 90$$

$$= 3.8 \times 10^6 \text{ J}$$

 Name:___________________

4. If $2.5x10^4$ J of energy are absorbed by 5.0 kg of a substance to raise its temperature by 20.0° C, what is the specific heat of the substance?

$$E_h = mc\Delta T$$

$$\frac{E_h}{m\Delta T} = c$$

$$\frac{2.5\times10^4}{5.0\times20} = \boxed{\frac{250\ J}{kg\times{}^\circ C}}$$

5. If $1.5x10^4$ J of heat are absorbed by a 2.0 kg block of copper initially at a temperature of 20.0°C, what is the final temperature reached?

$$E_h = cm\Delta T$$

$$\frac{E_h}{cm} = \Delta T$$

$$\frac{1.5\times10^4}{2\times430} = 17.4^\circ$$

$$\Delta T = \text{Final} - \text{Initial}$$

$$\text{Final temp} = 20+17 = \boxed{37^\circ}$$

6. An 0.032 kg bullet ~~is~~ travelling at 452 m/s is stopped by a 3.0 L pool of water. How much will the water heat up as it stops the bullet?

$$E_h = E_K = \frac{1}{2}\,0.032\times452^2 = 3268.86\ J$$

$$\Delta T = \frac{E_h}{cm} = \frac{3268.86\ J}{4200\times3} = \boxed{0.30^\circ C}$$

7. Through a complex set of machinery, thermal energy is used to lift a ~~25.0~~ ~~2500~~ .25 kg block. Through the process a [redacted]5[redacted]L container of water, initially at 95°C cools to 45°C. How high is the block lifted?

$E_h = \sout{250}\ 5.0 \times 4200 \times -50 = \sout{-52500000\,J}\ 1050000$

Energy lost to heat = Energy gained by block

$E_p = \sout{82500000}\ 1050000 = mgh$

$\frac{\sout{82500000}\ 1050000}{25 \times 9.8} = 42857 \approx$ **4300 m**

8. A turkey is considered "cooked" when it has an internal temperature of 82°C, assuming wildly that a turkey has the same specific heat capacity as water, you, a brilliant physics student suggest an alternative to cooking the Thanksgiving turkey in the oven. Instead, if you dropped the turkey from a high enough place, the potential energy would convert into kinetic energy which would then convert into thermal energy when the bird hit the ground, instantly raising the temperature to the required 82°C. How high must you drop a 10.0 kg turkey, initially at 22°C from to cook it in this manner?

E_h required $= 10 \times 4200 \times 60 = 2520000\,J$

$E_p = E_h = 2520000 = mgh$

$\frac{2520000}{10 \times 9.8} = h$

$25714\,m = h$

$\approx$ **26 km**