**Assignment 3 – Heating and Cooling Name: ……………………………………**

Energy Supplied = Mass × Specific Heat Capacity × Change in Temperature

$$Q = mcΔT$$

Energy Supplied = Mass changed × Latent Heat

$$Q = mL$$

(Specific heat capacity of water = 4.2 × 103 J kg-1 K-1).

1. Define Specific Heat Capacity (1)
2. The specific heat capacity of water is 4200 J/kg°C. Calculate the energy needed to raise a kettle full of water, volume 1.4 litres, from tap temperature, 10 °C, to boiling point. (2)
3. An electrical heater supplies 500 J of heat energy to a copper cylinder of mass 32.4 g. Find the increase in temperature of the cylinder. (Specific heat capacity of copper = 385 J/kg°C). (2)
4. A metal block of mass 0.5 kg and specific heat capacity 385 J/kg°C is at a temperature of 70 °C before it is plunged into an insulated beaker containing 200 g of water at 18 °C. The block and the water eventually reach a common temperature of *T* °C.
5. Write down an expression in terms of *T* for the decrease in temperature of the block. (1)
6. Write down the increase in terms of *T* for the increase in temperature of the water. (1)
7. Find in terms of *T* the heat lost by the block. (1)
8. Find in terms of *T* the heat gained by the water. (1)
9. Assuming that no heat is used to heat the beaker and that no heat is lost to the surroundings, find the value of *T*. (2)
10. Aluminium has a mass number, A, of 27 hence 1 mole (27 g) of aluminium contains 6.02 × 1023 particles. Find the amount of energy required to heat 27 g of aluminium by 1°C. The specific heat capacity of aluminium is 880 J/kg°C. (2)
11. Iron has a mass number, A, of 56 hence 56 g of iron contains 6.02 × 1023 particles. Find the amount of energy required to heat 56 g of iron by 1°C. The specific heat capacity of iron is 450 J/kg°C. (2)
12. Copper has a mass number, A, of 64 hence 64 g of copper contains 6.02 × 1023 particles. Find the amount of energy required to heat 64 g of copper by 1°C. The specific heat capacity of copper is J/kg°C. (2)
13. Lead has a mass number, A, of 207 hence 207 g of lead contains 6.02 × 1023 particles. Find the amount of energy required to heat 207 g of lead by 1°C. The specific heat capacity of lead is 130 J/kg°C. (2)
14. Considering your answers to questions 8 to 11 what is the connection between the number of particles in a material and the heat required to raise the temperature of the materials? (2)

**Armageddon!**

This question combines mechanical energy, heating and phase changes.

A spherical comet of radius 500 m made of ice at 0 °C, hits the Earth at a speed of 4.0 x 104 m/s. Assume that all of the kinetic energy is transferred as heat energy upon impact. Ice has a density of 917 kg/m3. The comet crashes into Lake Ontario.

1. Calculate the mass of the comet. (2)
2. Calculate the kinetic energy of the comet. (2)
3. Assuming this kinetic energy is transferred into heat upon impact. Given that Lake Ontario has a temperature of 10 °C, a volume of 1,640 km3 and is pure water, what is the final temperture of the lake after impact?

(1 km3 = 1 x 109m3). If the lake (and comet) rise above boiling point, how much of the lake is converted to steam? (4)

(bonus: what would be the effect of a huge comet smashing into lake (or an ocean for that matter)?)