Heat and Temperature

1. Define the following terms and include units:
    a. Specific Heat
    b. Latent Heat

2. Calculate the amount of energy that must be added to 100 g of water to raise the temperature from 10.0°C to 20.0°C.

3. Calculate how much energy must be added to 750 g of asphalt ($c = 920\ J\ kg^{-1}\ K^{-1}$) to raise the temperature from 10.0°C to 20.0°C.

4. Calculate the change in temperature of 500 g of gold ($c = 130\ J\ kg^{-1}\ K^{-1}$) when 5000 J of heat is added to the system.

5. When 10,000 joules of heat is added to 5 kg of a gas, its temperature increases by 10 C. Calculate the specific heat of the gas.

6. A 5 kg piece of steel ($c = 440\ J\ kg^{-1}\ K^{-1}$) is heated by a 500.0 Watt heater for 5.0 minutes. The steel has an initial temperature of 15.0°C. Assume the heater is 100% efficient.
    a. Calculate the amount of energy given to the steel in that time.
    b. Calculate the final temperature of the steel.

7. Calculate how much energy it takes to melt 250 g of ice that was originally 273 K.

8. A 1500 kg car is stopped after initially traveling at 20 m/s. Assume that 75% of the energy lost is converted to heat in the car brakes.
    a. Calculate the amount of heat gained by the brakes.
    b. Assume each of the brakes on the front of the car have a mass of 9.5 kg and $c = 460\ J\ kg^{-1}\ K^{-1}$. Calculate the temperature change in the brakes as a result of the braking.
    c. Explain how cars keep their brakes from melting.

9. 200 g of water vapor at 373 K is condensing into water. Assuming the temperature does not change, calculate the amount of heat removed from the system.

10. Mercury was used in old thermometers. The typical mass was about 5 grams. The specific heat is 140 J kg^{-1} K^{-1}.
    a. Calculate the amount of heat needed to increase the temperature of the thermometer from 20 ^oC to 38 ^oC.
    b. The alcohol that has often replaced mercury for use in thermometers has a specific heat of 2460 J kg^{-1} K^{-1}. Assuming the properties of the glass container remain the same, describe one reason a mercury thermometer would be preferred over the alcohol thermometer.

11. A 10.0 g ice cube is initially -5.0 ^oC. Calculate the amount of energy required to completely melt the cube.

12. A Cast iron factory uses a 250,000 Watt heater to melt their raw cast iron. The latent heat of fusion for cast iron is 126,000 JK^{-1} and the specific heat of cast iron is 460 J kg^{-1} K^{-1}. Assume 1000 kg of cast iron is heated at a time.
    a. The cast iron starts at room temperature (25^oC). The heater initially heats the metal to its melting point (1200^oC). Calculate the amount of heat required for this temperature change.
    b. Upon reaching 1200^oC, the heater begins to melt the cast iron. Calculate the amount of heat required to completely melt the cast iron.
    c. Calculate the time required for the heater to completely melt the cast iron starting from room temperature.

13. In the morning, a lake is typically colder than the surrounding air. In the evening, the water is typically warmer than the surrounding air. Describe a reason why this would be true.