Temperature and Phase Changes

Pre-Class Questions

Problem Set (due next time)
Ch 14 - 1, 20, 23, 39

Lecture Outline

1. Temperature Scales
2. The Definition of Temperature
3. Heat as Energy Flow

Temperature Scales

Each of the three thermometers below uses a different temperature scale. The temperature of boiling water, freezing water, and typical room temperature are marked. Answer the questions below:

1. Find the number of K's, °C's, and °F's between freezing and boiling.

$\Delta K =$ $\Delta °C =$ $\Delta °F =$

2. Find the ratios below. Leave them as fractions with the least common denominator.

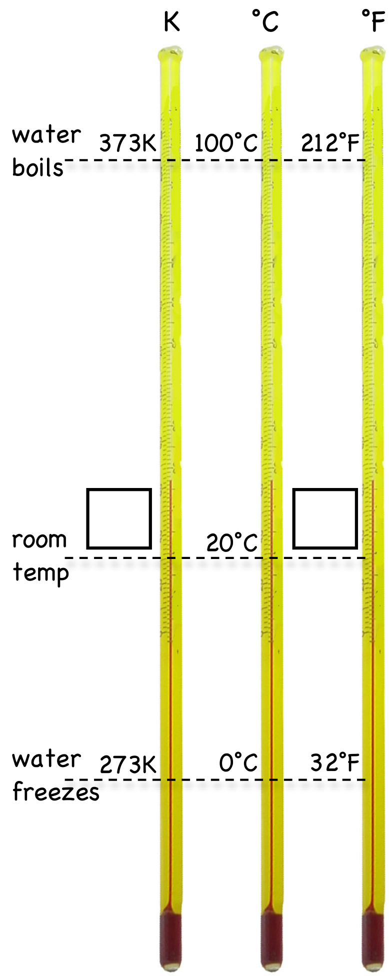
$$\frac{\Delta K}{\Delta °C} =$$

$$\frac{\Delta °F}{\Delta °C} =$$

3. The equation for a straight line is, $y = mx + b \Rightarrow T_K = \frac{\Delta K}{\Delta °C} T_C + b$. Use the ratio above and the value of T_K when $T_C = 0$ to find b. Write the equation to convert T_C to T_K.

4. The equation for a straight line is, $y = mx + b \Rightarrow T_F = \frac{\Delta °F}{\Delta °C} T_C + b$. Use the ratio above and the value of T_F when $T_C = 0$ to find b. Write the equation to convert T_C to T_F.

5. Find room temperature in °F and K. Put your answers in the boxes.



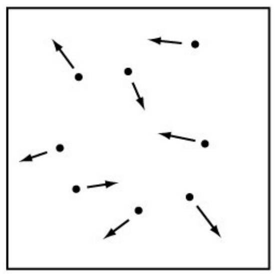
Discuss this question with your neighbors. See if you can agree upon an answer.

Temperature is:

A. The total heat energy stored in an object.
B. The average kinetic energy of the atoms and molecules in an object.
C. The thermal energy released by an object.

The Heat of the Moment

At the left is a molecule. It's velocity is indicated by the arrow. To increase the kinetic energy of the molecule, the (force) (velocity) (acceleration) must increase.



Now you have a box of molecules. You can increase the average kinetic energy by (speeding each one up) (slowing each one down).

If you increase the average kinetic energy, you can tell because the ____________________ increases.

same answer

So, the total energy in the box depends upon the ___________________.

It also depends upon the _______________________ of the molecules which can be found by using a balance to find the total _____________ of the molecules.

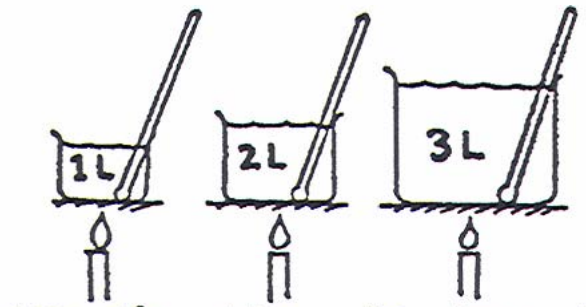
rhymes with lumber

rhymes with gas

Now perhaps you can explain where the equation $Q = mc\Delta T$ comes from. Give it a try.

Example 1: A soda fills a 500ml can initially at 5.0˚C. In fifteen minutes, it is at 20˚C. Assuming the soda is almost completely water. Find (a)the heat absorbed by the soda from the room and (b)the average power supplied by the surroundings.

Suppose you apply a flame and warm 1 liter of water, raising its temperature 10°C. If you transfer the same heat energy to 2 liters, how much will the temperature rise? For 3 liters? Record your answers on the blanks in the drawing at the right.



Example 2: To keep the soda cold, it is put into a glass with 300g of ice at 0°C. Let's assume that the surrounding supply heat at the same rate. Find the time for the ice to melt and everything to wind up at the same 20°C.

Lecture 36 - Summary

Temperature is the average kinetic energy of the molecules in an object.

Temperature scale conversions

$T_F = \frac{9}{5}T_C + 32$ $\qquad$ $T_K = T_C + 273$

Heat during temperature change $\quad Q = mc\Delta T$

Heat during phase change $\quad Q = mL$