Temperature of Mixtures

Part IV: Reading

Directions: ***Read the information below, revise your explanation (if appropriate), and answer the questions at the end of the passage.***

Temperature

All matter is composed of continually jiggling atoms or molecules. Whether the atoms and molecules combine to form solids, liquids, gases, or plasmas depends on how fast the molecules are moving. By virtue of their motion, the molecules or atoms in matter possess kinetic energy. The average kinetic energy of the individual particles is directly related to a property you can sense: how hot something is. Whenever something becomes warmer, we know that the kinetic energy of its particles increases. Strike a solid penny with a hammer and it becomes warm because the hammer's blow causes the atoms in the metal to move faster. Put a flame to a liquid and it too becomes warmer. Rapidly compress air in a tire pump and the air becomes warmer. When a solid, liquid, or gas gets warmer, its atoms or molecules move faster. The atoms or molecules have more kinetic energy. Temperature is a measure of the average kinetic energy of the particles of a substance.

(Adapted from *Conceptual Physics*, Addison Wesley, 8th Ed. 1998 p. 256)

Conservation of Energy

When two masses of water at different temperatures are mixed, energy passes from the warmer to the colder water. This transfer of energy continues until the temperature of the mixture comes to equilibrium at a point intermediate between the original temperatures of the two masses of water. During this process, the warm water loses energy, which is transferred to the cold water. The energy absorbed by the cold water then results in a gain in its energy. In a closed system, the total amount of energy is conserved so that the sum of the energies of the two masses of water before they are mixed will equal the total energy of the water after it is mixed.

(Adapted from *Physics Its Methods and Meanings, Laboratory Manual*, Prentice Hall, 6th Ed. 1992, pp. 97-98)

Please respond to the following questions:

- How does the concept of Conservation of Energy help you explain what happened in your investigation of the Temperature of Mixtures?

- Did the information from the reading above encourage you to change the explanation you wrote in Part III? If so, in what way(s)?

Data Table: Temperatures of Mixtures

V_1	T_1	V_2	T_2	T_{final}
20 mL	20 C	80 mL	50 C	45 C
40 mL	18 C	60 mL	52 C	38 C
75 mL	22 C	25 mL	60 C	32 C

The amount of energy given off by the warmer water equals the amount of energy gained by the cooler water according the Law of Conservation of Energy. This is most often represented by a change in temperature. The final temperature of the mixture will depend on the masses of the two amounts of water and their initial temperatures according to the following mathematical relationship:

$$m_1c(T_1) + m_2c(T_2) = (m_1 + m_2)cT_{final}$$

$$T_{final} = \frac{m_1(T_1) + m_2(T_2)}{m_1 + m_2}$$

Where:
m = mass
c = specific heat capacity
T = temperature

Note: Since the density of water is 1 g/cm^3, the volume measurements in mL or cm^3 taken during the investigation are equivalent to the mass of water in grams.