FLINN SCIENTIFIC

Name____

Activity A. Phase Change—Cooling Curve

Data Table A

Cooling Curve Time	Temperature (°C)	Time	Temperature (°C)
0 sec	_________	4 min 30 sec	_________
0 min 30 sec	_________	5 min	_________
1 min	_________	5 min 30 sec	_________
1 min 30 sec	_________	6 min	_________
2 min	_________	6 min 30 sec	_________
2 min 30 sec	_________	7 min	_________
3 min	_________	7 min 30 sec	_________
3 min 30 sec	_________	8 min	_________
4 min	_________		

Observations and Analysis *(Answer questions on a separate sheet of paper.)*

1. Prepare a graph of temperature on the *y*-axis versus time on the *x*-axis. Draw a smooth (continuous) curve through the plotted points for the series of data.
2. Label the following regions (A–C) on the *cooling curve:* A, only liquid is present; B, liquid and solid are present together; C, only solid is present.
3. What happens to the temperature of a substance while it is freezing? Estimate the freezing point of lauric acid from the cooling curve.
4. *Circle the correct choices:* Freezing is an (exothermic/endothermic) process—the liquid (absorbs/releases) heat from or to its surroundings. At the freezing point, the average (kinetic energy/potential energy) of the molecules (increases/decreases) and the liquid solidifies.
5. *(Optional)* Lauric acid is a fatty acid (a component of fats and oils). What factor might explain the regular increase in the melting point of the following fatty acids as the number of carbon atoms increases?

Lauric acid, $CH_3(CH_2)_{10}CO_2H$, mp 43.2 °C

Myristic acid, $CH_3(CH_2)_{12}CO_2H$, mp 54.0 °C

Palmitic acid, $CH_3(CH_2)_{14}CO_2H$, mp 61.8 °C

Stearic acid, $CH_3(CH_2)_{16}CO_2H$, mp 68.8 °C

Activity B. Intermolecular Forces

Data Table B

Microscope Slide	Water: Glass	Water: Polyethylene	Ethyl Alcohol: Glass	Ethyl Alcohol: Polyethylene
Steps 3 and 4				
Drop width (mm)	____	____	____	____
Drop height (mm)	____	____	____	____
Step 8				
Force to separate slides	more / less	more / less		
Capillary Tube Steps 11 and 12				
Capillary rise (mm)	____ mm		____ mm	
Dry Erase Board Steps 15 and 16				

Pattern of water on dry erase board ____________________

Pattern of ethyl alcohol on dry erase board ____________________

Evaporation time (sec) Water ____________ Ethyl Alcohol ____________

Observations and Analysis *(Answer questions on a separate sheet of paper.)*

1. Which liquid was least attracted to each of the surfaces? Give evidence to support your answer.
2. In steps 3 and 4, which of the drops was the flattest and widest? What does this mean about the attraction of the molecules to the surface?
3. Can you determine whether the polyethylene is made of polar or nonpolar molecules? Explain.
4. When you compressed the slides in step 8, which slide seemed the most difficult to separate?
5. The glass capillary tube contains encapsulated ions at the surface; based on this fact, which molecules shows the greatest ion-dipole attraction?
6. In step 15 when the drops run down the dry erase board, which liquid seemed to spread out on the surface?
7. Which liquid took longer to evaporate? What does this imply about the attraction of the molecules to each other?
8. Which liquid has weaker intermolecular attractions and which has stronger intermolecular attractions?

Activity C. Evaporation

Data and Results Table C

Evaporation of Liquids		Trial A	Trial B
CH1	**Liquid**	**Hexane**	**Acetone**
	Initial temperature		
	Minimum temperature		
	Temperature change due to evaporation		
CH2	**Liquid**	**Heptane**	**Isopropyl Alcohol**
	Initial temperature		
	Minimum temperature		
	Temperature change due to evaporation		

Observations and Analysis *(Answer questions on a separate sheet of paper.)*

1. Describe in words a typical temperature versus time graph for the evaporation of a liquid—be as specific as possible. Explain the graph in terms of the cooling effect of evaporation.
2. Summarize the results of this experiment in Data and Results Table C. Subtract the initial temperature from the minimum temperature to determine the temperature change due to evaporation. What is the relationship between the temperature change due to evaporation and the rate of evaporation of a liquid? Explain.
3. Compare the results obtained for hexane and heptane in Trial A. Which compound evaporated more quickly? How are these compounds similar? How are they different? Which compound has stronger attractive forces? Explain.
4. Compare the results obtained for acetone and isopropyl alcohol in Trial B. Which compound evaporated more quickly? How are these compounds similar? How are they different? Which compound has stronger attractive forces? Explain.
5. (a) Is there a pattern between the molar mass of a compound and the temperature change observed due to evaporation? (b) Why would it not be fair to conclude that "dispersion forces are stronger than hydrogen bonding" by comparing the results for hexane and isopropyl alcohol in this experiment?
6. Rank the four liquids tested from most volatile to least volatile based on their observed temperature changes due to evaporation.
7. *(Optional)* Look up the boiling points of the four compounds tested in this experiment. Is there a relationship between the rate of evaporation of a liquid and its boiling point?

Activity D. Properties of Metals—Crystal Structure and Heat Treatment

Data and Results Table

	Number of Bends to Breaking			
	Sample #1	Sample #2	Sample #3	Sample #4
Untreated				
Annealed				
Hardened				
Tempered				

Post-Lab Questions *(Answer questions on a separate sheet of paper.)*

1. Examine the BCC model: Why is this arrangement of atoms called a body-centered cubic structure? How many "nearest neighbors" surround the central atom of the structure?
2. Examine the FCC model: Why is this arrangement of atoms called a face-centered cubic structure?
3. Repeat step 17 to construct another "middle" layer of four balls and add this to the top of the structure as a fourth layer. Count the number of balls that surround the center atom in the third layer. How many "nearest neighbors" surround this atom?