Do Now ...

Date: May 8, 2017

Obj: Collect data and develop a mathematical equation.

Copy:

Thermochemistry is the study of heat and chemical reactions.

Monday, May 8, 2017

Today:

Warm-Up

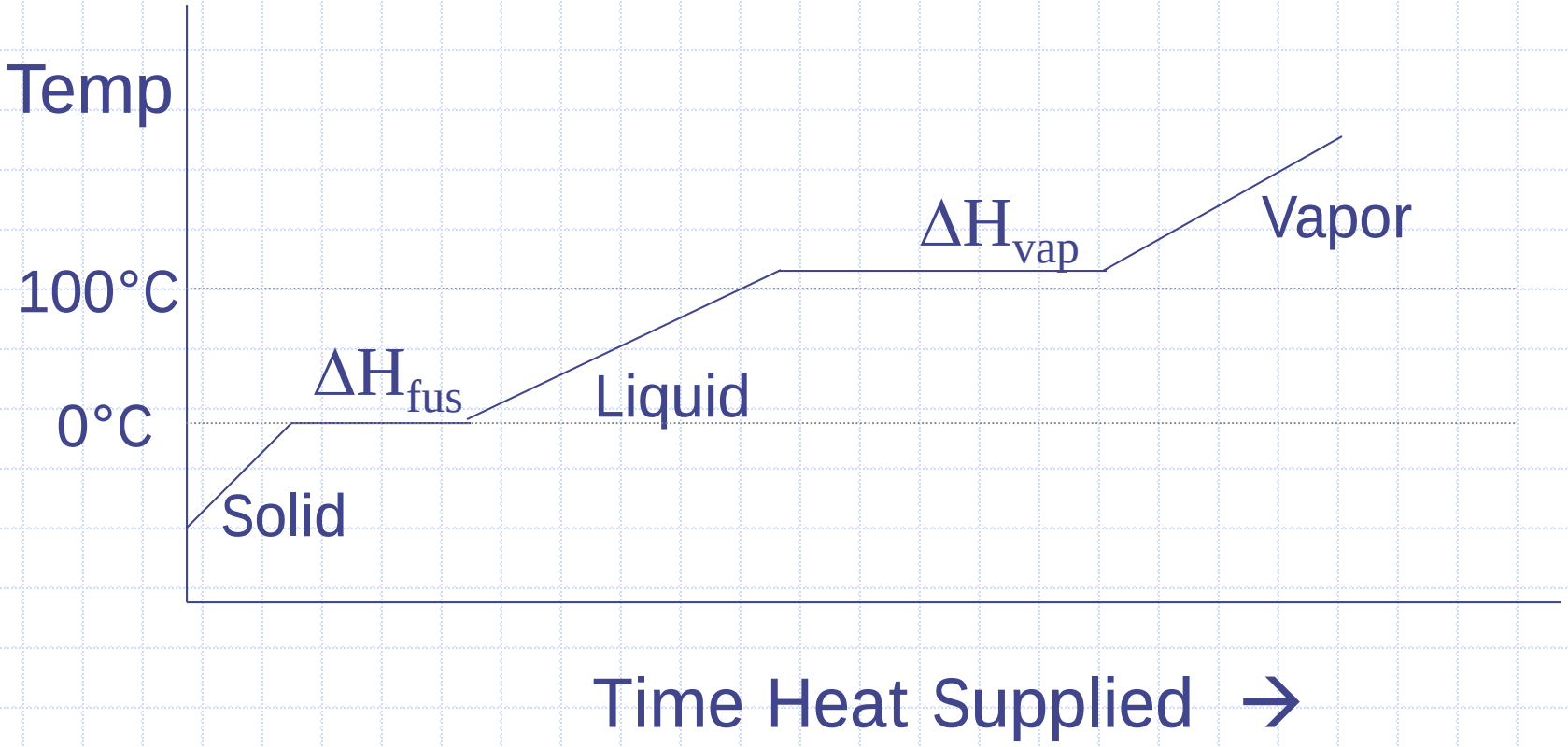
Content: Introduction to Thermochemistry

Mathematical Equations Lab

Homework: Finish Lab

Warm Up

Complete the graph showing water changing from (s) → (l) → (g)



Heat and Changes of State

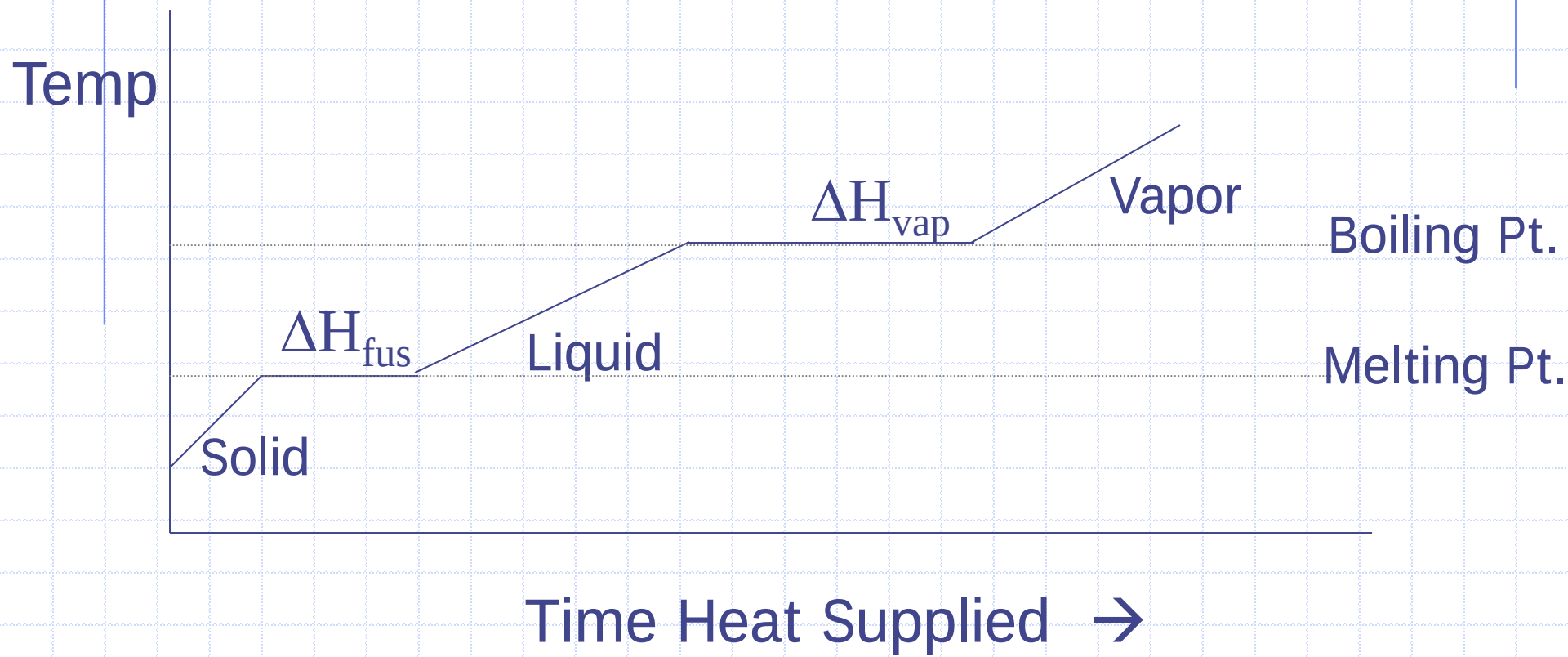
-- Energy is required to change from solid → liquid.

The energy is used to *separate the particles.*
Temperature stays constant.

-- Energy is given off in a phase change from a *liquid to a solid*.

Temperature stays constant.

Heating Curve for Water



Changes of State

The heat absorbed by one mole of substance in melting a *solid to a liquid* is called the

molar heat of fusion (ΔH_{fus}).

Changes of State

The heat lost by one mole of substance in changing from a liquid to a solid is called the *molar heat of solidification*.

We also have data for the molar heat of vaporization, molar heat of condensation, and molar heat of solution.

We can look up these values.

Practice

Looking at the heating curve for water, what do you notice about ΔH_{fus} compared to ΔH_{vap} ?

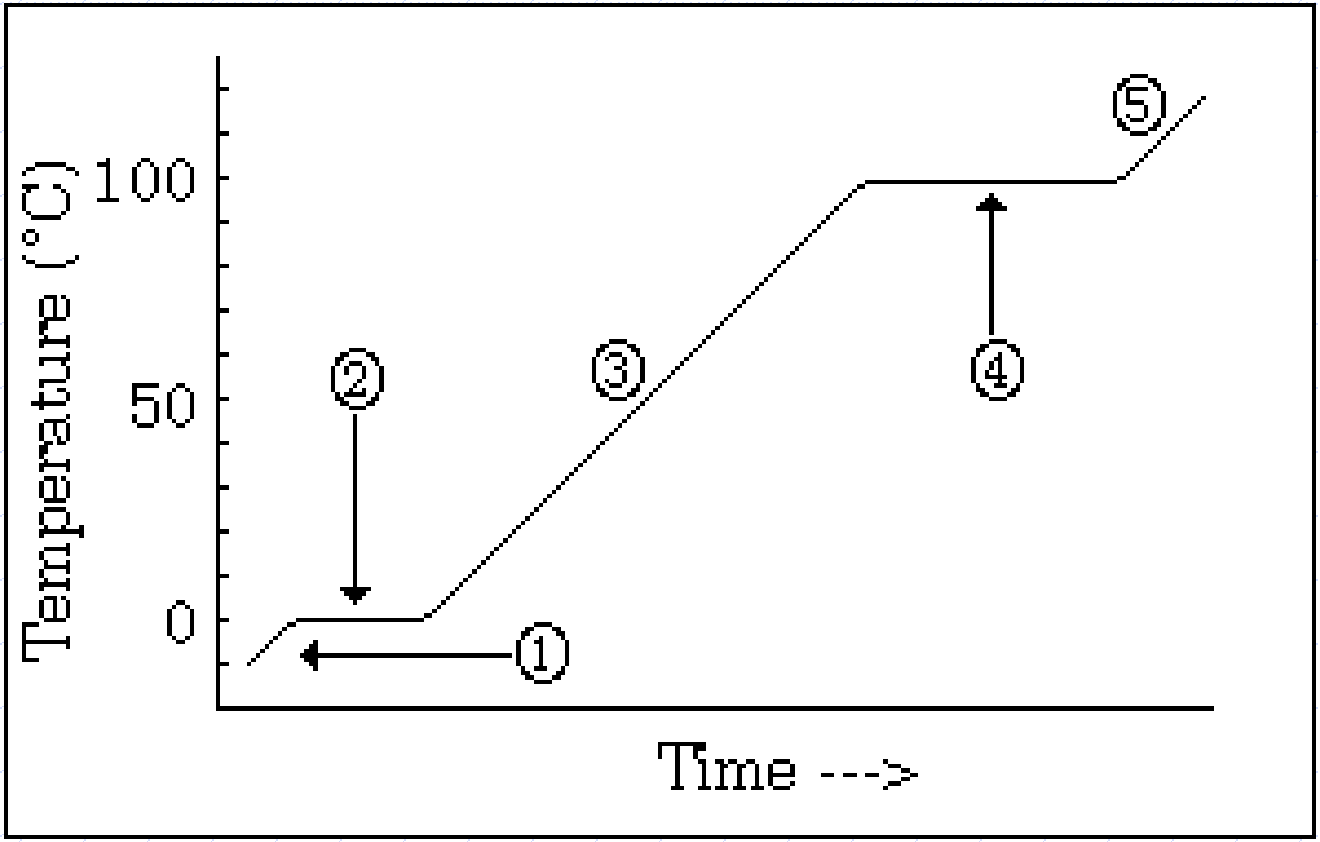
Why is this?

Heating Curve for Water

From the heating curve for water:

It takes more heat to vaporize water then to melt water.

Why is this the case?



Heating Curve for Water

What is happening at each number in the graph below?

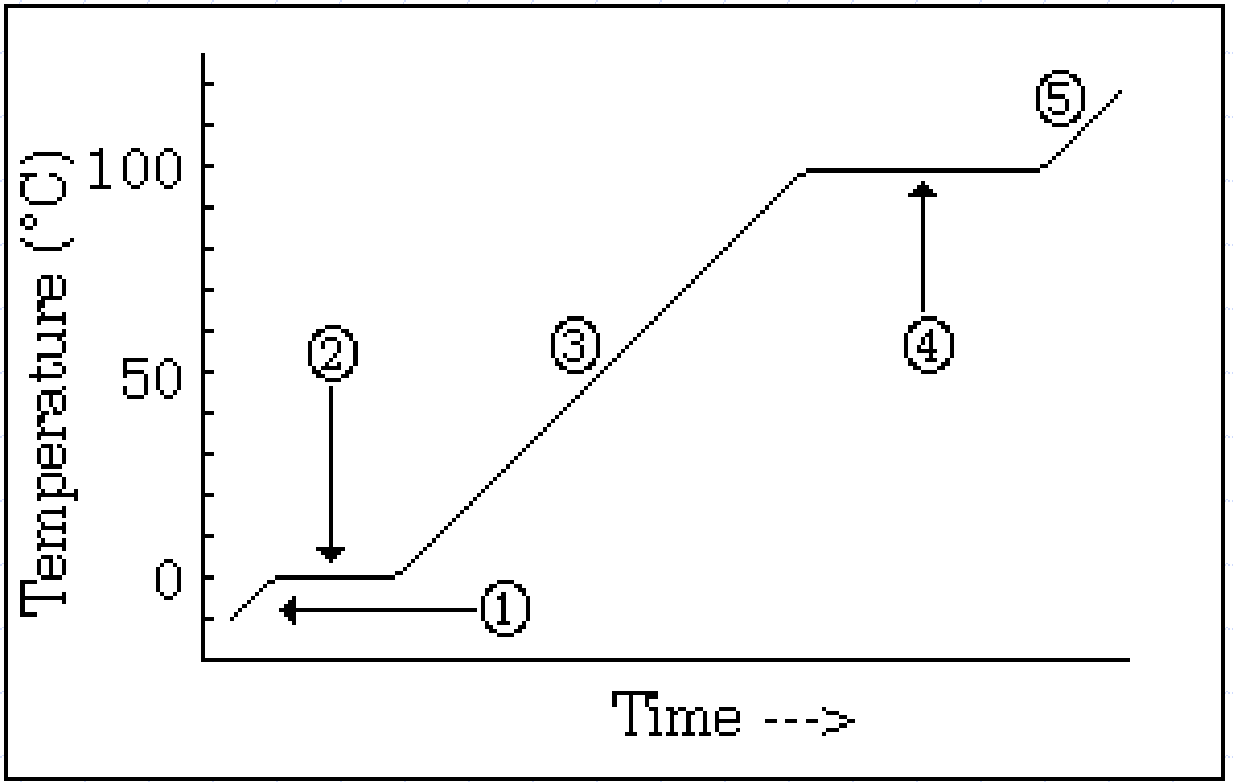


Image from http://dbhs.wvusd.k12.ca.us/webdocs/Thermochem/Time-Temperature-Graph.html

Liquid Nitrogen & Soap Suds

These people have too much time on their hands.

Images from: http://van.hep.uiuc.edu/van/demos/Soap%20Explosion/SoapExplosion.htm

Do Now ...

Date: May 9, 2017

Obj: Collect data and develop a mathematical equation.

Set-up and solve: $C = q / m \Delta T$

If **q** (the amount of heat) is 347 J and you have 3.5 g (the mass), what is the specific heat (**C**) if the temperature changes 7.0 °C ?

Tuesday, May 9, 2017

Today:

Finish Lab (Math Equations)

Notes and Practice: Thermochem

Homework: Google Form

Heat versus Temperature

Describe the difference between heat and temperature. Provide an example.

Hint: Which has a higher temperature, a drop of water at 100°C or a bucket of water at 100°C ? Which has more heat?

Heat

Heat (abbreviated *Q*) is a measurement of the total energy in a substance.

The SI unit for heat is the **joule**.

Heat will tend to move from the ***higher*** temperature system to the ***lower*** temperature system.

From wikipedia.org.

Temperature

Temperature is a number that is related to the **average kinetic** energy of the molecules of a substance.

The SI basic unit for temperature is the **Kelvin**.

Other temperature scales: Celsius, Fahrenheit, Rankine, Delisle, Réaumur, Rømer

Thermometers & Calorimeters

We use thermometers to measure temperature.

We use calorimeters to (indirectly) measure heat.

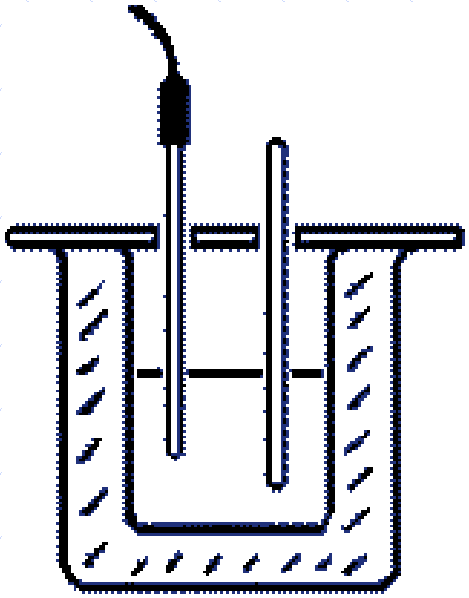
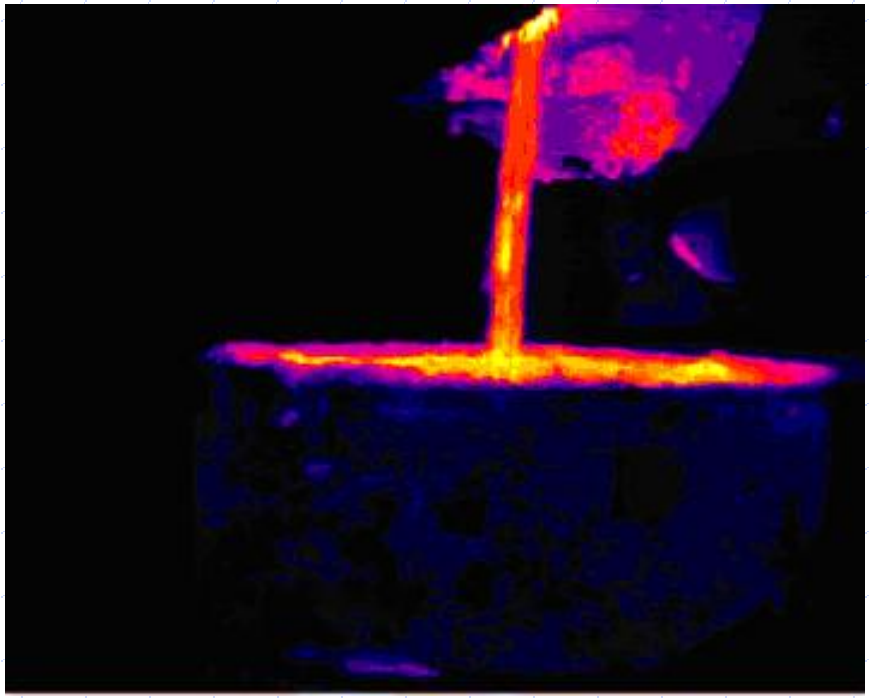


Fig. 2 Experimental Calorimeter

Thermochemistry

Thermochemistry is the study of heat changes that occur during chemical reactions and physical changes of state.



An Example

Which direction is the heat flowing in the plastic bag and flame demo?

Practice

Other ways to measure temperature.

Can these instruments measure the amount of heat in a substance?

Practice

$$C = q / m \Delta T$$

Calculate the specific heat of a metallic element if 756 joules of energy are needed to raise the temperature of a 100.0 gram sample 25.0 °C to 50.0 °C.

Do Now ...

Date: May 10, 2017

Obj: Calculate specific heat.

Copy and do: $C = q / m \Delta T$

When 200 J of heat is added to 5.0 g of olive oil at 30°C, the temperature increases to 85 °C. What is the specific heat of olive oil?

Be sure to show units in your answer.

_____ J/(g x °C)

Wednesday, May 10, 2017

Today:

Warm-Up

Notes & Practice: Specific Heat

Homework: Complete Practice

Practice

$$C = q / m \Delta T$$

The temperature of a piece of copper with a mass of 94.4 g changes from 25°C to 48 °C when the metal absorbs 849J of heat. What is the specific heat of copper?

0.387 J / (g x °C)

More Practice

$$C = q / m \Delta T$$

When 435 J of heat is added to 3.4 g of olive oil at 21°C, the temperature increases to 85 °C. What is the specific heat of olive oil?

2.0 J/(g x °C)

More Practice

$$C = q / m \Delta T$$

A copper penny is heated until it is red hot in a bunsen burner. It is then placed in 50 grams of water (initially at 22°C) and cools down. The final temperature of the water is 37 °C. What is the temperature of the bunsen burner flame?

Some Experimental Values

Substance	**J / (g x °C)**
Water	4.18
Iron	0.46
Copper	0.39
Aluminum	0.90
Lead	0.13

What would be the best for a frying pan?

Complete the Specific Heat Worksheet

Show all work ...

Specific Heat - PreLab

Different substances will respond differently to an input of heat.

Metals usually heat up quickly and cool down quickly.

Water heats up slowly but cools down slowly.

Specific Heat - PreLab

We use Specific Heat Capacity values to tell how well a substance absorbs and stores heat.

Specific Heat Capacity (C) is the amount of heat needed to raise the temp of 1g by 1°C .

Specific Heat = J / (g x °C)

C = heat (J) / (mass (g) x change in temp (°C))

C = q / m ΔT

Practice

$$C = q / m \Delta T$$

Calculate the specific heat of a metallic element if 250 joules of energy are needed to raise the temperature of a 100.0 gram sample 25.0 °C to 100.0 °C.

Practice

$$C = q / m \Delta T$$

The temperature of a piece of copper with a mass of 4.4 g changes from 25°C to 48 °C when the metal absorbs 1000J of heat. What is the specific heat of copper?

? J / (g x °C)

More Practice

$$C = q / m \Delta T$$

A copper penny is heated until it is red hot in a Bunsen burner. It is then placed in 50 grams of water (initially at 22°C) and cools down releasing 1000J of heat energy. The final temperature of the water is 37 °C. What is the temperature of the Bunsen burner flame?

Some Experimental Values

Water has a high specific heat:

4.18 **J / (g x °C)**

Lead has a low specific heat:

0.13 **J / (g x °C)**

Which will heat up and cool down fastest?

What are some implications?

Do Now ...

Date: May 11, 20117

Obj: Collect data and calculate specific heat.

Copy and do:

Which of the following would take the longest to heat up: C=4.18, 0.46, 0.90?

To cool down? What type of substance might each be (liquid, metal, non-metal, ...)?

Some Experimental Values

Substance	**J / (g x °C)**
Water	4.18
Iron	0.46
Copper	0.39
Aluminum	0.90
Lead	0.13

What would be the best for a frying pan?

Thursday, May 11, 2017

Today:

Lab: Red Hot Penny

HW: Finish Lab, Google Form

Do Now ...

Date: May 12, 2017

Obj: Calculate specific heat based on data from the lab yesterday.

Copy:

One **joule** of energy will raise the temperature of one gram of water one degree Celsius.

Friday, May 12, 2017

Today:

W-Up, Work on Lab Calculations, Notes & Practice, Quiz – Specific Heat

Lab Question #1

What are three unexpected things you saw in the lab yesterday?

Lab Question #2

How did we measure the temperature of the water?

How did we measure the amount of heat in the water?

Practice

$$C = q / m \Delta T$$

Calculate the specific heat of a metallic element if 1000 joules of energy are needed to raise the temperature of a 10.0 gram sample 25.0 °C to 75.0 °C.

Practice

$$C = q / m \Delta T$$

The temperature of a piece of copper with a mass of 5.0 g changes from 50°C to 58 °C when the metal absorbs 1000J of heat. What is the specific heat of copper?

_____ J / (g x °C)

Some Experimental Values

Substance	J / (g x °C)
Water	4.18
Iron	0.46
Copper	0.39
Aluminum	0.90
Lead	0.13

Which metal would be feel the coldest to the touch?

Some Experimental Values

Water has a high specific heat:

4.18 **J / (g x °C)**

Lead has a low specific heat:

0.13 **J / (g x °C)**

Which will heat up and cool down fastest?

What are some implications?