CLASS NOTES FROM TUESDAY

Purpose:

Get better at solving story problems with Q=MCΔT

← in notebook

WARMUP:

tape the sheet into your notebook.
grab a textbook.

fill in the top two boxes.

D O N'T S O L V E , J U S T F I L L I N T H E BOXES.

Story problem	JUST calculate change in T $\Delta T = T_{final} - T_{initial}$	Use Page 296 to fill in the "C" (incl Units)
How much heat will raise a pot of 800 g of water from 20 °C to 90 °C?	ΔT=90−20 ΔT=70°c	c = 1.00 cal/g°c
Some chloroform is created in a laboratory. Experiments show that it climbs from 23.2 °C up to 56.8 °C when 3750 J of energy are added to the sample.	ΔT=56.8−23.2 ΔT = 33.6°c	c = 0.96 J/g°c
A blacksmith shapes a sword of iron while it is heated to 1000. °C. When finished, the hot sword is plunged into a barrel containing 500 kg of water at 30 °C and warms the water to 30.4°C. How much mass does the sword have?	ΔT=30.4−1000 ΔT=−969.6°c	c = 0.11 cal/g°c
Aluminum metal is used as a structural material in many aerospace applications. What is the specific heat of aluminum if it takes 89.7 J to raise the temperature of a 33.0g block by 5.20°C?	ΔT=5.20°c	c = 0.90 J/g°c

Today

1) warmup – finding the important info in a heat story problem
2) teacher demo, with a writing assistant
3) ~~practice heat problems~~ write a gallery walk of answe

rock explodes
https://www.youtube.com/watch?v=CfWHq-XDmIY

boiling water in my hat
https://www.youtube.com/watch?v=h83hM1JUwwk

#1 Data

aluminum mass (g)	79 g
C_p aluminum	0.21 $\frac{cal}{g \cdot °C}$
C_p water	1 $\frac{cal}{g °C}$
water volume (mL)	65.4 mL
water mass (g)	65.4 g
initial water (°C)	21.9 °C
final water (°C)	35.1 °C
ΔT water	13.2 °C
final aluminum (°C)	35.1°C

4th Period

https://www.youtube.com/watch?v=CfWHq-XDmIY

boiling water in my hat
https://www.youtube.com/watch?v=h83hM1JUwwk

#1 Data

aluminum mass (g)	80 g
C_p aluminum	.21 cal/g·°C
C_p water	1.00 cal/g·°C
water volume (mL)	60.19 mL
water mass (g)	60.19 g
initial water (°C)	23.2 °C
final water (°C)	46.1 °C
ΔT water	
final aluminum (°C)	46.1 °C

6th period

https://www.youtube.com/watch?v=CfWHq-XDmIY

boiling water in my hat
https://www.youtube.com/watch?v=h83hM1JUwwk

#1 Data

aluminum mass (g)	92.0 grams
C_p aluminum	.90 J/g·°C
C_p water	4.18 J/g·°C
water volume (mL)	69.4 mL
water mass (g)	69.4 grams
initial water (°C)	22.4 °C
final water (°C)	37.3 °C
ΔT water	
final aluminum (°C)	37.3 °C

7th Period by Siti

HOMEWORK ANSWERS TO THE WASHBOARD

Name NAME

Date

Tutors! Adults! Help this young chemist by visiting **http:genest.weebly.com** with any smart phone

1. Using your algebra skills rearrang Q = (m) (C) (ΔT) to isolate the indicated variable in each case (isolate means 'get it on one side of the equals sign by itself).

Isolate C	Isolate ΔT
$Q = mC\Delta T$ rearranges to $C_p = \frac{Q}{m\Delta T}$	$Q = m C_p \Delta T$ rearranges to $\frac{Q}{m C_p} = \Delta T$

2. How much heat is absorbed by 20g granite boulder as energy from the sun causes its temperature to change from 10°C to 29°C? (Specific heat capacity of granite is 0.1 cal/g°C)

$Q = (m)(C_p)(\Delta T)$

$\Delta T = 29°C - 10°C = 19°C$

$Q = (20g)(0.1\frac{cal}{g°C})(19°C)$

$Q = 38$ cal

3. How much heat is released when 30 g of water at 96°C cools to 25°C? The specific heat of water is 1 cal/g°C.

$Q = m C_p \Delta T$

$Q = (30g)(1\frac{cal}{g°C})(71°C)$

$Q = 2130$ calories

4. Decide whether heating (we called it Q) is entering or leaving the object in bold..

   a) An *ice cube* is placed in a cup of hot **coffee** Q LEAVES

   An ***ice cube*** is placed in a cup of hot coffee Q ENTERS

   b) A pot of ***hot tea*** is sealed into a well-insulated thermos Q LEAVES

   c) Some cold cream is poured into a cup of hot coffee Q ENTERS

   d) You blow *air* across a bowl of hot soup Q ENTERS

   e) *You* jump into an ice cold pond Q LEAVES

5. ~~How much heat will raise a pot of~~ 800 g of water from 20 °C to 90 °C?

   C_p of water is $1 \frac{\text{calorie}}{\text{gram °C}}$ $Q = m C_p \Delta T$ $Q = (800g)(1 \frac{cal}{g°C})(70°C)$

   ANSWER: 60000 calorie

6. What happens when you place two objects at different temperatures in contact with each other?

   HEAT FLOWS FROM THE HOT OBJECT TO THE COOLER UNTIL THEY REACH THE SAME TEMPERATURE

7. The temperature of a sample of metal with a mass of 10.0 g changed from 50.4°C to 25.0°C with the release of 95.1 joules of heat. What is the specific heat of this metal ?

   ① BE CAREFUL, IT'S ASKING YOU TO FIND C_p!! (DON'T SOLVE FOR Q)

   ② NOTICE THAT 95.1 J of "HEAT" is the "Q"

   $Q = m C_p \Delta T$

   $C_p = \frac{Q}{m \Delta T}$ $C_p = \frac{95.1 J}{(10.0g)(25.4°C)}$

   answer: $C_p = 0.374 \frac{J}{g°C}$

8. A 4.50 g coin of copper absorbed 54 calories of heat. What was the final temperature of the copper if the initial temperature was 25°C? The specific heat of copper is 0.092 cal/g°C. BE CAREFUL,

   SOLVE THIS ONE FOR ΔT.

   $\Delta T = \frac{Q}{m C_p}$ $\Delta T = \frac{54 \text{ calories}}{(4.50g)(0.092 \frac{cal}{g°C})}$

   $\Delta T = 130$

   $\Delta T = T_f - T_i$

   so

   answer: T_{final} is 155 °C

9. How much heat will raise a ...

first find T

remember $C_p = 1.\frac{cal}{g°c}$ for water

Same as #5!

10. What is the specific heat of silicon if it takes 192J to raise the temperature of 45.0g of Si by 6.0°C?

$Q = m C_p \Delta T$

$C_p = \frac{Q}{m \Delta T}$

$C_p = \frac{192J}{(45.0g)(6.0°c)}$

$C_p = 0.71 \frac{J}{g°c}$

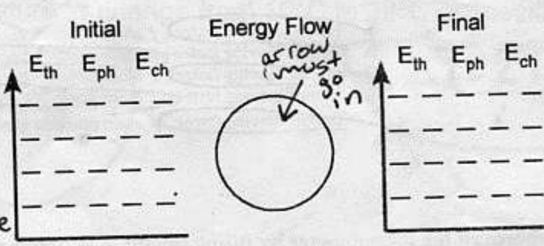
11. Make an energy diagram: Some water you spilled on your shirt evaporates.

Your diagram is correct if

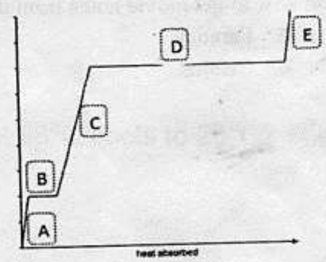
① Q enters water

② E_{ph} increases

③ E_{ch}, E_{th} stay Same



12. Find the melting and boiling point of **Bromine** in the CRC Book in class or on Wikipedia at home. Write those two numbers in appropriate places on the Y-Axis.



13. In each line below, mark a letter to describe what phase is present.

C pure liquid

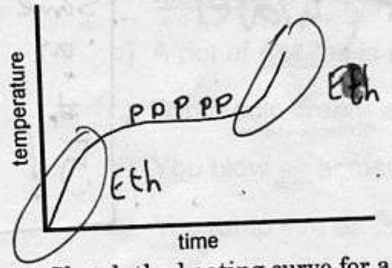
A pure solid

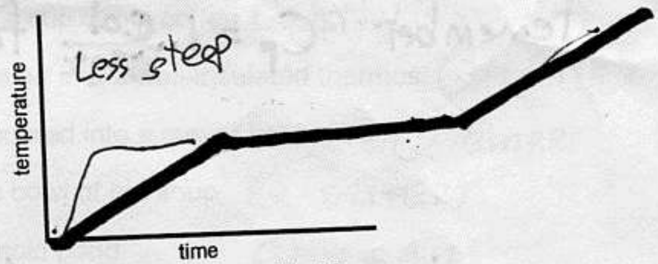
E pure gas

D mix of gas and liquid

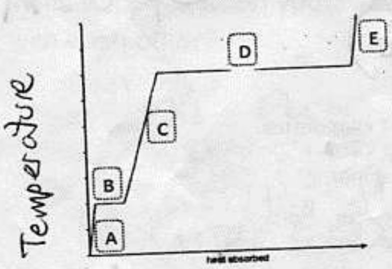
B mix of liquid and solid

14. The graph below left represents the heating curve for helium being heated from liquid state to a temperature above its boiling point.





a) Sketch the heating curve for a larger sample of the same liquid.
b) Put little P's all along the line of this graph if it is a time when the helium is gaining mostly potential energy
c) Draw a circle around the part of the graph where you think E_{th} is increasing. Label it E_{th}



15. Find the melting and boiling point of **Aluminum** in Table S and label the Y-axis of the graph at right with those two numbers.

In each line below, circle the correct choice to describe how the motion of the atoms is changing.

A. {atoms moving faster / atom position becomes farther apart}
B. {atoms moving faster / atom position becomes farther apart}
C. {atoms moving faster / atom position becomes farther apart}
D. {atoms moving faster / atom position becomes farther apart}
E. {atoms moving faster / atom position becomes farther apart}

16. Which scientist improved the thermometer by filling it with mercury to make it smaller and portable so doctors could use it to take the temperature of a patient? (See the website for advice on how to get movie notes from the movie we watched. . .)

a. Faraday
b. Celsius
c. Fahrenheit
d. Rumford

HOMEWORK ANSWERS TO THE IRONING BOARD

Name

Period

1) ... 45,000 joules into Calories (spelled with a capital). [useful numbe... ...ur notebook or the top of the next page of this handout]]

$45000\ J \times \left(\frac{1000\ cal}{4184\ J}\right) = 10755.2\ cal$

2) In today's lecture we dropped metal into water. The water went temperature went from 22.4 °C to 37.3 °C. The mass of the water was 69.4 grams. We know that the Cp of water (using joules) is 4.18 (including units).

Calculate the amount of heat that entered the water.

$Q = mc\Delta T$

$Q = (69.4g)(4.18)(14.9)$

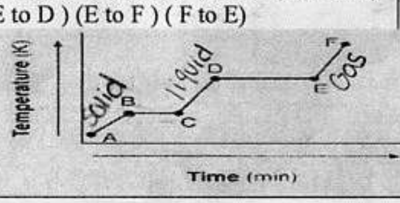
$Q = 4322 \approx 4320\ J$

The following situations all were shown during lecture in class today. In each case, the system has been underlined in the description.

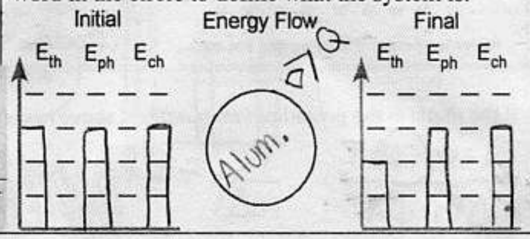
3) Dropping hot aluminum into cold water

Choose the **ONE** part of the heating curve best fits the situation described at left?

(A to B) ((B to A)) (B to C) (C to B) (C to D) (D to C) (D to E) (E to D) (E to F) (F to E)



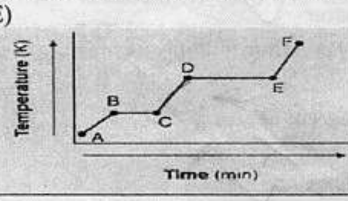
Fill in the energy diagram. Don't forget to write a word in the circle to define what the system is.



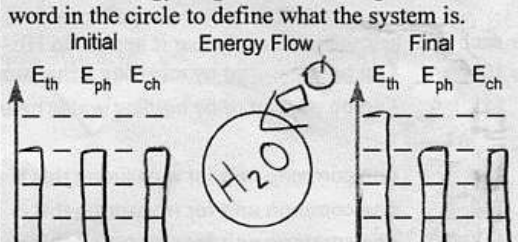
4) Dropping hot aluminum into cold water

Choose the **ONE** part of the heating curve best fits the situation described at left?

(A to B) (B to A) (B to C) (C to B) ((C to D)) (D to C) (D to E) (E to D) (E to F) (F to E)



Fill in the energy diagram. Don't forget to write a word in the circle to define what the system is.



15) Convert 123 calories into Calories.

$123\ cals \times \left(\frac{1\ calorie}{1000\ cals}\right) = 0.123\ Cal.$

1 Calorie = 1000 calorie

trick question

16) Which contains more energy? (1 Calorie / 1 calorie)

17) Which contains more energy? (1 joule / 1 calorie)

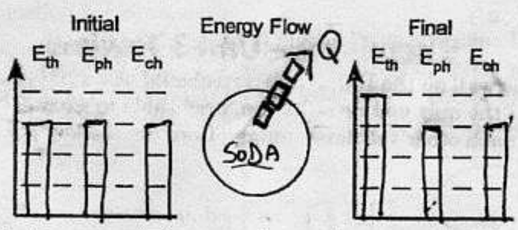
18) If a 3.1g ring made of unknown metal is heated using 10.0 calories, its temperature rises 17.9°C. Calculate the specific heat of the ring.

$Q = mC\Delta T$

$\frac{10\ cal}{3.1g\ 17.9°c} = C$

$C = 0.1802 \frac{cal}{g°C}$

19) A can of cold soda warms as it is left on the counter.



List two **mistakes** in the energy diagram shown above

a) Take Eth down 3

b) Arrow should go in

20) A gas filled weather balloon with a volume of 30.0 L is released at sea level at 100.1 kPa and 18.0°C. Find the volume the balloon will be at maximum altitude where the temperature is 241.0 kelvins and the pressure is 0.604 atm.

You will always be given these numbers on tests and quizzes.

4184 joules = 4.184 kilojoules = 1000 calories = 1 Calorie

5) In today's lecture we dropped metal into water. The heat that entered the water was calculated in Question #1, above, to be 4320 J. The heat that left the aluminum must therefore* be 4184 J. The mass of the aluminum was 92.0 grams. From looking up the specific heat, we know that Cp for aluminum is always .90 J/g°C (don't forget units).

Calculate the ΔT for the Aluminum.

$Q = m\,C_P\,\Delta T$ $\quad \Delta T = \frac{136\,J}{92g \cdot .90\,J/g°C}$ $\quad \Delta T = 1.64$

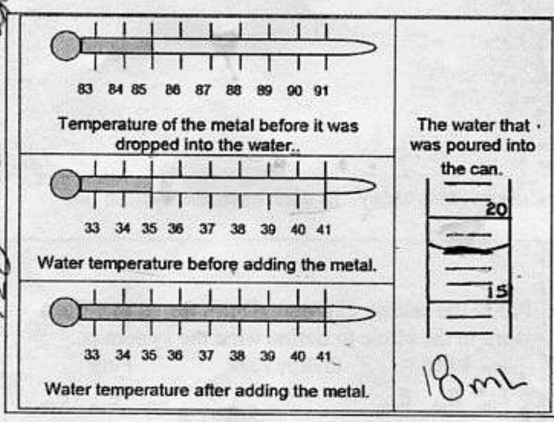
$\frac{Q}{m\,C_P} = \Delta T$

* It is safe to assume that all of the joules gained by the water were lost by the hot aluminum, according to the Law of Conservation of Energy

Hot metal

Cold H_2O

Hot H_2O



6) Stop. Read the four images at the left. They describe data for dropping hot metal into water. Use $Q = m\,C_p\,\Delta T$ to calculate how much heat entered the water.

$Q = mc\Delta T$

$Q = (18g)(4.18\,J/g°C)(6°C)$

$Q = 451.44\,J$

7) How much heat left the metal?

451.44 J

8) If the metal in the preceding two questions above had a mass of 24 grams, calculate **the Cp of the metal**.

$\frac{Q = m\,C_P\,\Delta T}{m\Delta T \quad m\Delta T}$ $\quad \frac{Q}{m\Delta T} = C_P$ $\quad \frac{451.44}{24g\ 44}$

$C_P = 0.4275$

9) Convert 123 cal into J.

$123\,cals \times \left(\frac{4184\,J}{1000\,cals}\right) = 514.6\,J$

For each item below indicate whether it applies to HEAT or TEMPERATURE

10) T Can be measured by inserting a thermometer ✓

11) H Can be measured by holding water nearby and then multiplying $mass_{water} \times Cp_{water} \times \Delta T_{water}$ ✓

12) T one common unit for measuring this is degrees celsius ✓

13) T one common unit for measuring this is kelvins ✗

14) H one common unit for measuring this is joules ✓

15)Convert 123 calories into Calories.

$123 \text{ cals} \times \left(\frac{1 \text{ calorie}}{1000 \text{ cals}}\right) = 0.123 \text{ Cal.}$

16)Which contains more energy? (1 Calorie / 1 calorie)

17)Which contains more energy? (1 joule / 1 calorie)

trick questi

1 Calorie = 1000 calories

18) If a 3.1g ring made of unknown metal is heated using 10.0 calories, its temperature rises 17.9°C. Calculate the specific heat of the ring.

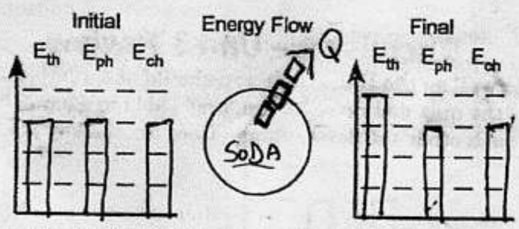
$Q = m C \Delta T_K$

$m\Delta T \quad m\Delta T$

$\frac{10 \text{ cal}}{3.1\text{g } 17.9°\text{C}} = C$

$C = 0.1802 \frac{\text{cal}}{\text{g°C}}$

19)A can of cold soda warms as it is left on the counter.



List two **mistakes** in the energy diagram shown above

a) Take Eth down 3

b) Arrow should go in

List two **mistakes** in the energy diagram shown above

a) ______

b) ______

FIXING THE PRESSURE UNITS TO MATCH

100.1 kPa is $100.1 \text{ kPa} \times \left(\frac{1.00 \text{ atm}}{101.3 \text{ kPa}}\right) = 0.988 \text{ atm}$

20) A gas filled weather balloon with a volume of 30.0 L is released at sea level at 100.1 kPa and 18.0°C. Find the volume the balloon will be at maximum altitude where the temperature is 241.0 kelvins and the pressure is 0.604 atm.

Lonely number is 30.0L because its by itself.
Circle the pairs of related measurements.
You must fix the units first: Make both temperatures kelvins (Always use kelvins for gas)
Fix the pressures. Make both pressures the same units.

Flip the ratios to make volume shrink and volume grow

$30.0\text{L} \times \left(\frac{241 \text{ K}}{291 \text{ K}}\right) \times \left(\frac{.988 \text{ ATM}}{.604 \text{ ATM}}\right) = 40.6 \text{ liters}$

★ notice the temperature was small number on top to shrink volume

★ notice pressure was big number on top to grow volume