N-35
Specific Heat

Target: I can perform "Specific Heat" calculations involving the amount of heat a substance can absorb.

Link to YouTube Presentation: https://youtu.be/h81y8n4ge-0

N-35
Specific Heat

How much heat can something absorb?

Specific Heat

The amount of energy it takes to raise the temperature of **1 gram** of something by **1 °C**

Units:

$$\frac{J}{g\ °C}$$

J = Joules

Specific Heat

Large specific heat

Substance can absorb a lot of energy BEFORE the temperature starts to go up.

Small specific heat

Substance cannot absorb much energy, the temperature will start to go up sooner.

Specific Heat

$$Q = mC\Delta T$$

Q = energy lost or gained
m = mass
C = specific heat
ΔT = "delta" T or change in temp

$$Q = m \times C \times (T_{final} - T_{starting})$$

Little trick!

$\Delta T = 50°C – 30°C =$ *A CHANGE* of 20 degrees

$\Delta T = 323\ K – 303\ K =$ *A CHANGE* of 20 degrees

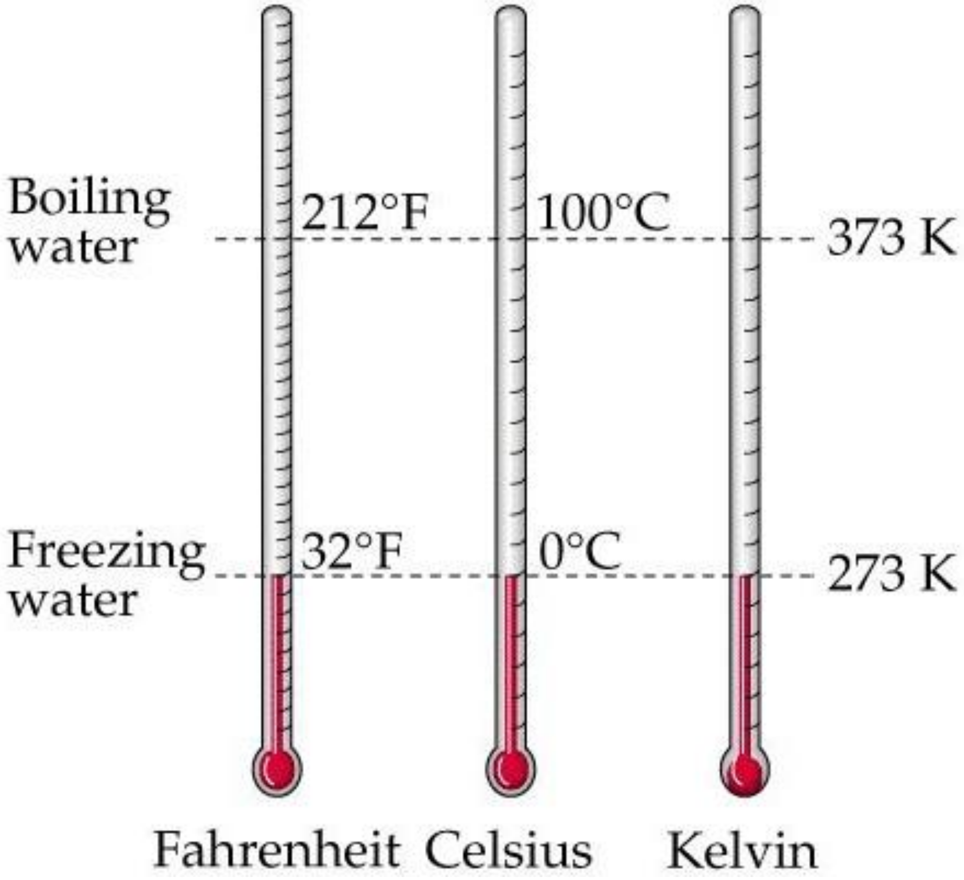
It doesn’t mean that you are
at a *TEMPERATURE* of 20 degrees.
Big difference!
Can save you conversion time!

Little trick!

ΔT in Kelvins will be the same as ΔT in Celsius!

Because the size of “one degree” is the same for K & C.

(Wouldn’t work for Fahrenheit because a Fahrenheit degree is smaller than a K or a C)



Positive or Negative?

Gaining Heat			
Losing Heat			
m and C are always positive			

Positive or Negative?

Gaining Heat	Endothermic	Q = +	ΔT = +
Losing Heat	Exothermic	Q = -	ΔT = -
m and C are always positive			

Showing your work…

Couple of choices…

- UNITS:
  - Put units IN the math equation
  - Make a list of variables and put the units there instead of in the math equation *(what Mrs. Farmer likes to do)*
- ALGEBRA
  - Show rearranging your problem once the numbers are in *(what Mrs. Farmer likes to do)*
  - Or show rearranging your equation before you put the numbers in

$5\ J = (10g)(0.5\ J/g°C)(\Delta T)$

$Q = 5\ J$
$m = 10g$
$C = 0.5\ J/g°C$
$\Delta T = ?$
$5=(10)(0.5)(\Delta T)$

$$\Delta T = \frac{Q}{mc}$$

Specific Heat

$Q = mC\Delta T$

How much heat is needed to raise the temperature of 10 grams of a substance from 40 °C to 60 °C if the specific heat is 3.8 J/ g °C ?

$Q =$

$$Q = (10\,g)\left(3.8\,\frac{J}{g\,°C}\right)(60°C - 40°C)$$

$$Q = 760\,J$$

Specific Heat

$$Q = mC\Delta T$$

A 2 gram sample of a metal was heated from 260 K to 300 K. It absorbed 52 J of energy. What's the specific heat?

$$52\,J = (2g)(C)(300K - 260K)$$

$$C = 0.65\ \frac{J}{g°\mathrm{C}}$$

Specific Heat

$$Q = mC\Delta T$$

A 2 gram sample of a metal was heated from -13°C to 27°C. It absorbed 52 J of energy. What's the specific heat?

$$52\ J = (2g)(C)(27°C - -13°C)$$

Careful about double negatives this chapter!

$$52\ J = (2g)(C)(27°C + 13°C)$$

$$C = 0.65\ \frac{J}{g°C}$$

Specific Heat

$Q = mC\Delta T$

A 50 gram piece of hot metal is put into cold water. The metal transfers 5000 J of energy to the cold water. The specific heat of the metal is 6 J/g °C. What is the change in temperature of the metal?

$$-5000J = (50g)(6\frac{J}{g°C})(\Delta T)$$

Releasing heat makes Q negative!!!

$$\Delta T = -16.67°\text{C}$$

Temperature DECREASED by 16.67°C

Specific Heat

$Q = mC\Delta T$

A 25 gram piece of cold metal is put into hot water. The metal absorbs 154 J of energy from the hot water. The specific heat of the metal is 0.35 J/g °C. What is the initial temperature of the metal if the metal ended at 25°?

$$154J = (25g)(0.35\frac{J}{g°C})(25°C - T_i)$$

$$\frac{154\,J}{(25g)(0.35\frac{J}{g°C})} = (25°C - T_i)$$

Remember!

$\Delta T = T_f - T_i$

$$T_i = 25°C - \left(\frac{154\,J}{(25g)(0.35\frac{J}{g°C})}\right)$$

Ti = 7.4 °C

Careful with algebra! Don't be too lazy to actually show steps so you don't make silly mistakes! MOST commonly missed type of question for silly algebra mistakes!

Options for your Algebra!

I don't care what you do…just do it right!

#1

$154 = (25)(0.35)(25 - T_i)$

$154 = 8.75(25 - T_i)$

$154 = 218.75 - 8.75T_i$

$+8.75T_i \quad -154 \qquad -154 \quad +8.75T_i$

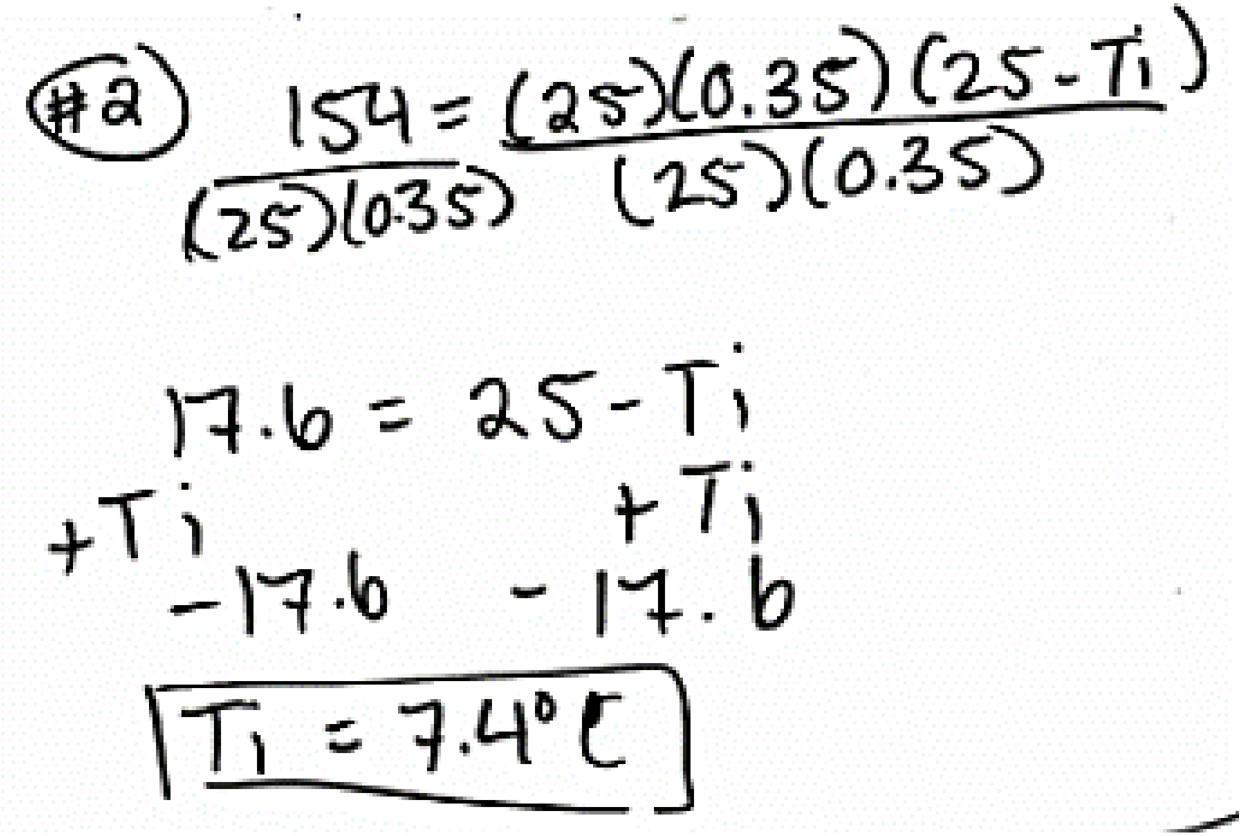
$$\frac{8.75T_i}{8.75} = \frac{64.75}{8.75}$$

$T_i = 7.4°C$

Could distribute first if you want!

Options for your Algebra!

I don’t care what you do…just do it right!



Could simplify as you go if you want!

Options for your Algebra!

I don’t care what you do…just do it right!

#3

$$\frac{154}{(25)(0.35)} = \frac{(25)(0.35)(\Delta T)}{(25)(0.35)}$$

$$17.6 = \Delta T$$

$$17.6 = 25 - T_i$$

$$+T_i \qquad +T_i$$

$$-17.6 \qquad -17.6$$

$$T_i = 7.4°C$$

Could solve for ΔT first and then figure out Ti at the end if you want.

***CAREFUL* - This way wont work for more complex “calorimetry” problems. Ok for simple problems.**

Preview of Our Next Topic

If one substance loses heat, it has to go somewhere! Has to go to another substance!

If one substance gains heat, it had to come from somewhere! Had to come from another substance!

Energy gained = -Energy lost

5 joules absorbed = -(-5 joules lost)

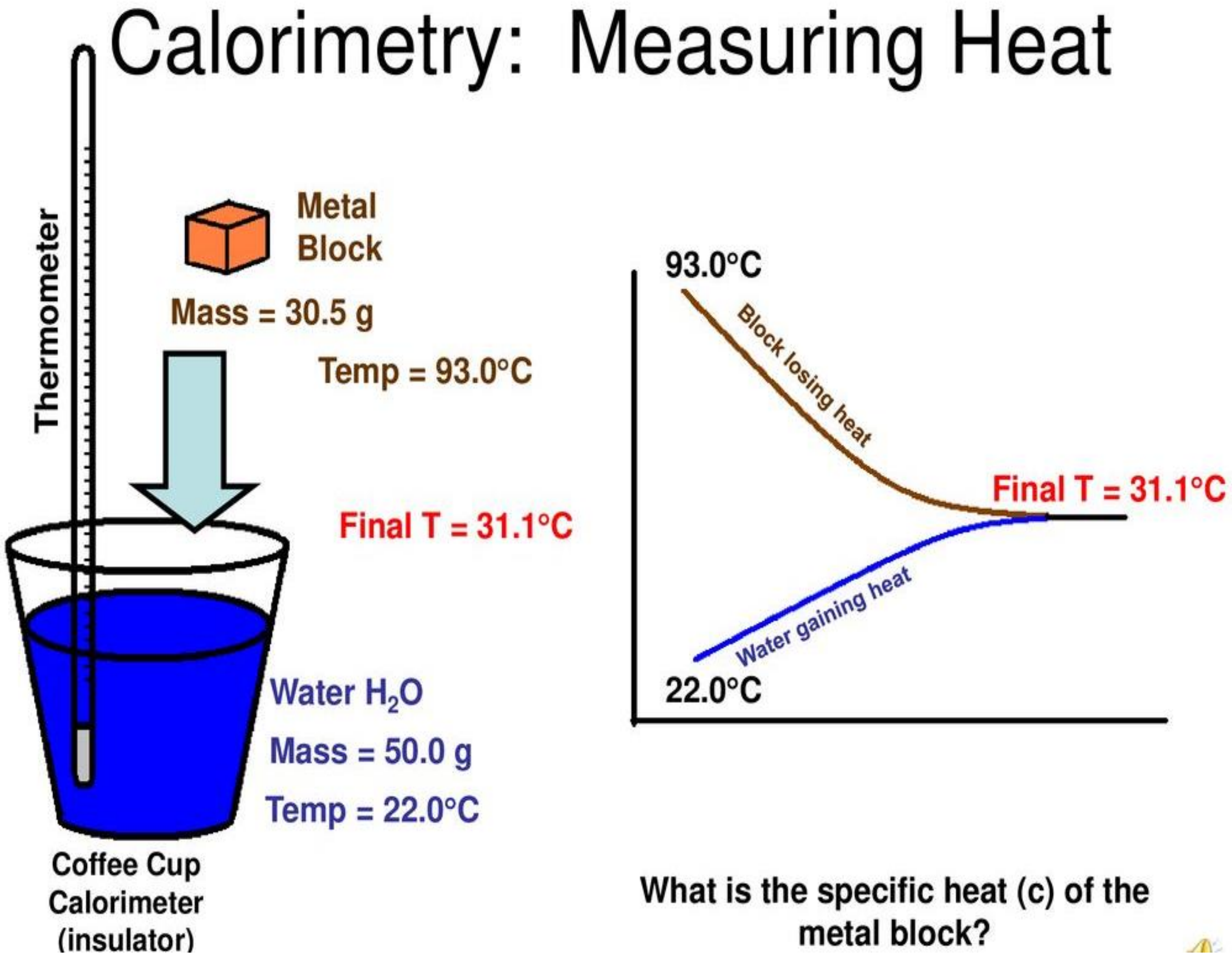
$$Q_{in} = -Q_{out}$$

$$Q_{system} = -Q_{surroundings}$$

Preview of Our Next Topic

Understanding that $Q_{system} = -Q_{surroundings}$ Can be a very helpful trick in the lab!

If you can't measure the thing you are actually interested in, you can measure the system instead!



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