CHEMISTRY MATTERS
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Unit 8D Practice Problems I
Calculating Specific Heat

Name:

Date:

Example #1: Solve this one together.

How much heat is required to raise the temperature of 53 g of water from 11 °C to 44 °C?

Substance	Specific Heat (J/g°C)
$H_2O(l)$	4.184
$H_2O(s)$	2.03
Al(s)	0.89
Fe(s)	0.45

- To solve for heat when the temperature changes, use the equation: *Q = m x C x Δt*
- In this problem, the mass is given, *m = 53 g*
- If the substance is known, the value of C can be found on a chart like the one above. *C = 4.184 J/g °C*
- The change in temperature is found by subtracting the initial temperature from the final temperature:
  $\Delta t = t_f - t_i$ = 44 °C-11 °C   *Δt = 33 °C*
- To calculate amount of heat (Q), plug these values into the equation Q = m x C x Δt
  Q = 53 g x 4.184 J/g °C x 33 °C = *7300 J*

Example #2: Try this one on your own.

How much heat is released when 21 g of Al cools from 31.0 °C to 27.0 °C?

Q = m x C x Δt = 21 g x 0.89 J/g °C x (27.0 °C – 31.0 °C) =

Did you get a negative number for Δt? If so, you did it right! Δt = 27 °C -31 °C = -4.0 °C.
This negative number just means that heat was released.

Example #3: Solve together.

What is the specific heat capacity of 32.3 g of a metal if 50. J of heat increases the temperature of the metal by 3.5 °C?

questions continued on next page

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Example #4: Do this one as a class.

How much heat is required to change 25.0 g of liquid water into steam (water vapor)?

Water
ΔH_{fus} = 334 J/g
ΔH_{vap} = 2260 J/g

- Changing from liquid to gas is a phase change. There is NO change in temperature during phase changes, so the equation we have been using cannot be used here. Recall, if you change from liquid to gas, the equation is $Q = m \times \Delta H_{vap}$. Changing from a solid to a liquid uses the equation, $Q = m \times \Delta H_{fus}$. Both ΔH_{vap} and ΔH_{fus} can be found on a chart. Be careful to choose the correct one!

$Q = m \times \Delta H_{vap}$ $\quad$ $Q = 25.0\ g \times 2260\ J/g =$

Example #5: Try this one on your own.

How much heat is required to change 25.0 g of ice into liquid water?

- Ice is solid, so the equation to use is $Q = m \times \Delta H_{fus}$

$Q = 25.0\ g \times 334\ J/g =$

Example #6: Do this one as a class.

How much heat is released when 155 g of water at 0 °C changes to ice at the same temperature?

ΔH_{fus} =	334 J/g
$\Delta H_{crystallization}$ =	334 J/g

- You already know that the quantity of heat needed to change a unit mass of solid to liquid at a constant temperature is called the heat of fusion at that temperature. For a substance, exactly the same amount of heat is released when a unit mass of liquid is changed to a solid at a constant temperature. This heat is called the heat of crystallization. FOR ANY GIVEN SUBSTANCE, THE HEAT OF CRYSTALLIZATION IS NUMERICALLY EQUAL TO THE HEAT OF FUSION!

$Q = m \times \Delta H_{crystallization}$ $\quad$ $Q = 155\ g \times 334\ J/g =$

questions continued on next page

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Example #7: Do this one as a class.

Calculate the heat that is evolved when 211 g of steam at 100 °C condenses to form water at the same temperature.

$$\Delta H_{vap} = 2260 \text{ J/g}$$
$$\Delta H_{condensation} = 2260 \text{ J/g}$$

- You already know that the quantity of heat needed to change a unit mass of liquid to gas at a constant temperature is called the heat of vaporization at that temperature. For a substance, exactly the same amount of heat is released when a unit mass of vapor is changed to liquid at a constant temperature. This heat is called the heat of condensation. FOR ANY GIVEN SUBSTANCE, THE HEAT OF CONDENSATION IS NUMERICALLY EQUAL TO THE HEAT OF VAPORIZATION!

$Q = m \times \Delta H_{condensation}$ $\qquad$ $Q = 211 \text{ g} \times 2260 \text{ J/g} =$