

Specific Heat Capacity Worksheet

- Enthalpy can often be thought of as “the internal energy of a system, and the energy required to create it”.
- Change in enthalpy (ΔH) is the difference in enthalpy between one system and another.
- Remember, the change in enthalpy [ΔH] is the **heat energy gained or lost during a process** at constant pressure.
- [q] is often used to symbolize energy transfers, and $q = \Delta H$ at constant pressure. Thus.....

$$q = \Delta H = mC\Delta T$$

1. Convert each of the following quantities. Remember that [1 calorie = 4.184J], and [1 Calorie = 10^3 calories]

a. 240 Joules to calories 57 cal

b. 1850 Calories to calories 1.85×10^6 cal

c. 4.25 Calories to Joules 1.78×10^4 J

2. How much heat is required to raise the temperature of 32.4g of mercury from 20.0 °C to 98.0 °C? The specific heat of mercury is 0.1395 J/g °C.

+353J

3. 4490 J is absorbed by 258g of water. What is the ΔT of the water?

4.16 °C

4. What is the specific heat of a substance if 250 cal are required to raise the temperature of 2.5g from 10.0 °C to 22.5°C? (convert cal to joules)

8.0cal/g°C or 33J/gK

5. Find the final temperature if 1932.7 J of energy is added to 27.5g of water at 21.1 °C.

37.8 C

6. A rectangular aquarium, 20.3cm by 47.7cm by 84.7cm, is filled with water at 15.4 °C. How much energy in Joules is required to raise the temperature of the water to 24.9 °C? (Hint: $1\text{cm}^3 = 1 \text{ mL}$, and $1 \text{ mL} = 1\text{g}$)

$+3.3 \times 10^6$ J

7. A lead mass is heated and placed in a foam cup calorimeter containing 40.0 mL of water at 17.0 °C. The temperature increases to 20.0 °C. How many joules of heat are released by the lead?

Hint: (solve the equation for the joules of heat released by the water because it is the same for lead)

-5.0×10^2 J

Combination Problems Worksheet

Given Information for H₂O:	$\Delta H_{\text{fus}} = 6.01 \text{ kJ/mol}$	$\Delta H_{\text{vap}} = 40.8 \text{ kJ/mol}$
$c_{\text{(solid)}} \text{ of H}_2\text{O} = 2.06 \text{ J/g}^\circ\text{C}$	$c_{\text{(liquid)}} \text{ of H}_2\text{O} = 4.18 \text{ J/g}^\circ\text{C}$	$c_{\text{(gas)}} \text{ of H}_2\text{O} = 1.87 \text{ J/g}^\circ\text{C}$

1. A cup contains about 450 grams of water. How many joules are released when the water is cooled from 25°C to 4°C?

Circle the formula you use: $q = m \times C \times \Delta T$ or $Q = m \times \Delta H$

$$q = -39501 \text{ J}$$

2. How many joules are required to melt 100 grams of H₂O?

Circle the formula you use: $q = m \times C \times \Delta T$ or $Q = m \times \Delta H$

$$Q = 33.66 \text{ kJ}$$

3. At what temperature will water freeze? _____ melt? _____ vaporize? _____ condense? _____

Steps for solving Combined problems (problems that use both equations):

1. Draw a quick Heating Curve
2. Label the temperature for Melting Point and Boiling Point (0°C and 100°C for water)
3. Circle the line segments that are involved in the problem being asked
4. Use the chart provided to separate your calculations for each segment
 - Write the temperature(s) for each segment
 - Decide which state(s) of matter exist at each segment
 - Decide which equation to use at each segment:
 - **Use $Q = m\Delta H$ for the phase changes**
 - **Use $q = mc\Delta T$ for the temperature changes**
5. Solve each segment of the problem
6. **Make sure all the energies are in the same units (kJ!!!)**
7. Add up the energies to get your final answer

How many joules are required to heat 200 grams of water from 25 °C to 125 °C? The heat capacity of steam is 1.87 J/g°C

Temp change	state of water	Formula to use	Heat change (KJ)	1 KJ=1000J
25 °C to 100 °C	Liquid	$q_1 = m \times C \times \Delta T$		
100 °C	Liquid → Gas	$Q_2 = m \Delta H_{\text{vap}}$		
100 °C to 125 °C	Gas	$q_3 = m \times C \times \Delta T$		
		Total		

$$524.25 \text{ kJ}$$

How many KJ are given off when 120 grams of water are cooled from 25 °C to -25°C? The heat capacity of ice is 2.1 J / g ·°C.

Temp change	state of water	formula	Heat change (KJ)
25 °C to 0°C	Liquid	$q_1 = m \times C \times \Delta T$	
		Total	

-59 kJ

How many KJ are required to heat 45 grams of water from 45 °C to 105 °C?

Temp change	state of water	formula	Heat change (KJ) 1 KJ=1000J
		Total	

113 kJ

How many KJ are required to cool 800 grams of water from 76 °C to -1 °C? Is this process exo or endothermic?

Temp change	state of water	formula	
		Total	

-522.5KJ

More Combination Problems - Side A

1. How many KJ are required to heat 45 grams of water from -5°C to 105°C ? Is this process exothermic or endothermic?

136.72KJ

2. How many kilojoules of heat are required to change the temperature of 246g H_2O from 45°C to 123°C ? Is this process exothermic or endothermic?

624.87 KJ

More Combination Problems - Side B

3. How much heat energy is needed to raise the temperature of 50.0 grams of ice at -10.0 C to form steam at 120.0 C ?

153 KJ

4. Calculate the amount of heat lost by 120.0 grams of steam at 150.0 C to form ice at -15.0 C .

-377.32 KJ