



# Science Virtual Learning

## MPI Physics 240

### Thermodynamics 8: Calorimetry 2

May 1, 2020



Lesson: MPI Thermodynamics 8 - Calorimetry 2  
May 1, 2020

**Objective: To be able to solve calorimetry problems including phase changes**

This video how to solve  
calorimetry problems when  
there is a phase change.

<https://youtu.be/HN99geGpUtc>

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Video: Calorimetry 2



A McDonald's employee adds 0.184 kg of ice at  $-12.0\text{ }^{\circ}\text{C}$  to a 0.500 kg cup of soda (which is mostly water) at  $20.0\text{ }^{\circ}\text{C}$ . Some, but not all, of the ice melts, creating a mixture of ice and water at the melting point,  $0\text{ }^{\circ}\text{C}$ . How much ice is left in the cup?

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Example from Video



**TABLE 19.2** Latent Heats of Fusion and Vaporization

Substance	Melting Point (°C)	Latent Heat of Fusion (J/kg)	Boiling Point (°C)	Latent Heat of Vaporization (J/kg)
Helium <sup>a</sup>	-272.2	$5.23 \times 10^3$	-268.93	$2.09 \times 10^4$
Oxygen	-218.79	$1.38 \times 10^4$	-182.97	$2.13 \times 10^5$
Nitrogen	-209.97	$2.55 \times 10^4$	-195.81	$2.01 \times 10^5$
Ethyl alcohol	-114	$1.04 \times 10^5$	78	$8.54 \times 10^5$
Water	0.00	$3.33 \times 10^5$	100.00	$2.26 \times 10^6$
Sulfur	119	$3.81 \times 10^4$	444.60	$3.26 \times 10^5$
Lead	327.3	$2.45 \times 10^4$	1 750	$8.70 \times 10^5$
Aluminum	660	$3.97 \times 10^5$	2 450	$1.14 \times 10^7$
Silver	960.80	$8.82 \times 10^4$	2 193	$2.33 \times 10^6$
Gold	1 063.00	$6.44 \times 10^4$	2 660	$1.58 \times 10^6$
Copper	1 083	$1.34 \times 10^5$	1 187	$5.06 \times 10^6$

<sup>a</sup>Helium does not solidify at atmospheric pressure. The melting point given here corresponds to a pressure of 2.5 MPa.

# Latent Heat Table

**TABLE 19.1** Specific Heats of Some Substances at 25°C and Atmospheric Pressure

Substance	Specific Heat (J/kg · °C)	Substance	Specific Heat (J/kg · °C)
<i>Elemental solids</i>		<i>Other solids</i>	
Aluminum	900	Brass	380
Beryllium	1 830	Glass	837
Cadmium	230	Ice (−5°C)	2 090
Copper	387	Marble	860
Germanium	322	Wood	1 700
Gold	129	<i>Liquids</i>	
Iron	448	Alcohol (ethyl)	2 400
Lead	128	Mercury	140
Silicon	703	Water (15°C)	4 186
Silver	234	<i>Gas</i>	
		Steam (100°C)	2 010

*Note:* To convert values to units of cal/g · °C, divide by 4 186.

# Specific Heat Table

## Homework 1

- Try to solve the problem yourself, then watch the solution video:
- <https://youtu.be/fAuZn2T4bp8>

1. A coppersmith pours 0.349 kg of molten copper at its melting point ( $1083^{\circ}\text{C}$ ) into 1.50 kg of water at  $20.8^{\circ}\text{C}$ . The copper solidifies, and cools. What is the final temperature of the copper and water?

## Homework 2

- Try to solve the problem yourself, then watch the solution video:
- <https://youtu.be/CFboP4DDOII>

2. In the previous problem, what if the smith had poured 3.49 kg of molten copper into the water? This time, some (not all) of the water would have boiled away at 100°C. How much water boiled off?





That's it!

