



Science Virtual Learning

MPI Physics 210

Thermodynamics 7: Latent Heat

May 15, 2020



Lesson: MPI Thermodynamics 7 - Latent Heat
May 15, 2020

Objective: To understand heat flows during phase transitions, and why they happen at constant temperature

This video discusses heat flows during phase transitions, and why they happen at constant temperature.

<https://youtu.be/SInuVK4J3wM>

Video: Latent Heat



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 ^a | -272.2 | 5.23×10^3 | -268.93 | 2.09×10^4 |
| Oxygen | -218.79 | 1.38×10^4 | -182.97 | 2.13×10^5 |
| Nitrogen | -209.97 | 2.55×10^4 | -195.81 | 2.01×10^5 |
| Ethyl alcohol | -114 | 1.04×10^5 | 78 | 8.54×10^5 |
| Water | 0.00 | 3.33×10^5 | 100.00 | 2.26×10^6 |
| Sulfur | 119 | 3.81×10^4 | 444.60 | 3.26×10^5 |
| Lead | 327.3 | 2.45×10^4 | 1 750 | 8.70×10^5 |
| Aluminum | 660 | 3.97×10^5 | 2 450 | 1.14×10^7 |
| Silver | 960.80 | 8.82×10^4 | 2 193 | 2.33×10^6 |
| Gold | 1 063.00 | 6.44×10^4 | 2 660 | 1.58×10^6 |
| Copper | 1 083 | 1.34×10^5 | 1 187 | 5.06×10^6 |

^aHelium 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

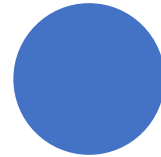
Ex 1. How much energy does it take to completely boil off 2 liters (2.00 kg) of water that starts at 20.0°C? If the burner heating the water has a power of 1200 W, how much time does it take to boil off the water?

Ex 2. If you put 0.250 kg of water at 18.0°C in an ice tray and stick it in the freezer, how much heat must be removed from the water to turn it into ice at -15.0 °C?

Part 1: https://youtu.be/qK0esR_Q3_4

Part 2: https://youtu.be/IWch_atPLnl

Latent Heat - Examples



Homework 1

- Try to solve the problem yourself, then watch the solution video:
- <https://youtu.be/qP2Dt39kTyY>

1. How much heat must be added to 0.500 kg of lead at 15.0°C to raise its temperature to the melting point (327°C) and then melt it completely?

Homework 2

- Try to solve the problem yourself, then watch the solution video:
- <https://youtu.be/4BxtTyMn3ho>

2. A 0.100-kg ice chunk at its melting point (0°C) is added to 0.644 kg of water.

- a) How much energy must the ice absorb to melt completely?
- b) How much did the temperature of the water lower due to the ice melting?



That's it!

