

PHYS 250B

Ch 17: Temperature and Heat

Scientific units for measuring temperature:

K	C°	F°
Kelvin	Celsius	Fahrenheit

How do we measure temperature?

With thermometers...to interact with a sample

So, what is temperature?

The measure of the random motion in atoms.
Everything built of atoms has a temperature.

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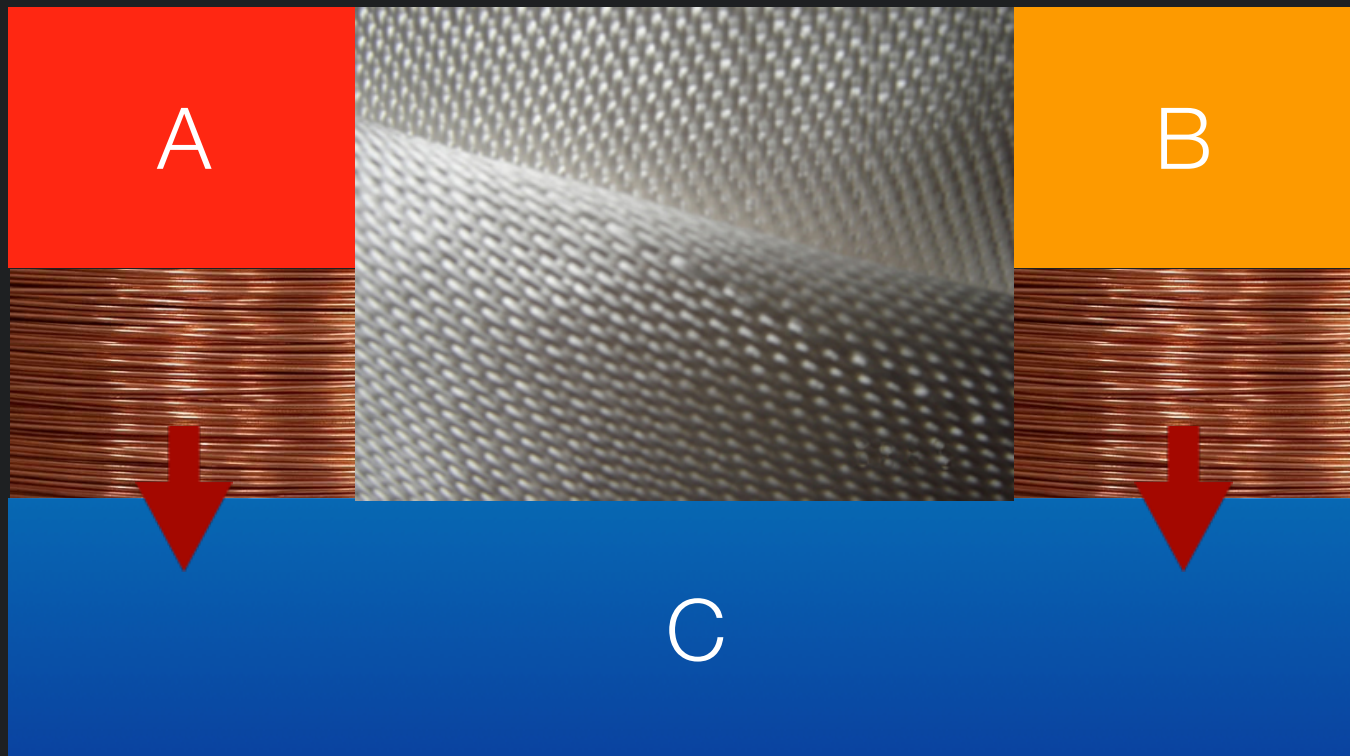


["The Mechanical Universe"](#). California Institute of Technology. Retrieved 22 August 2014. learner.org

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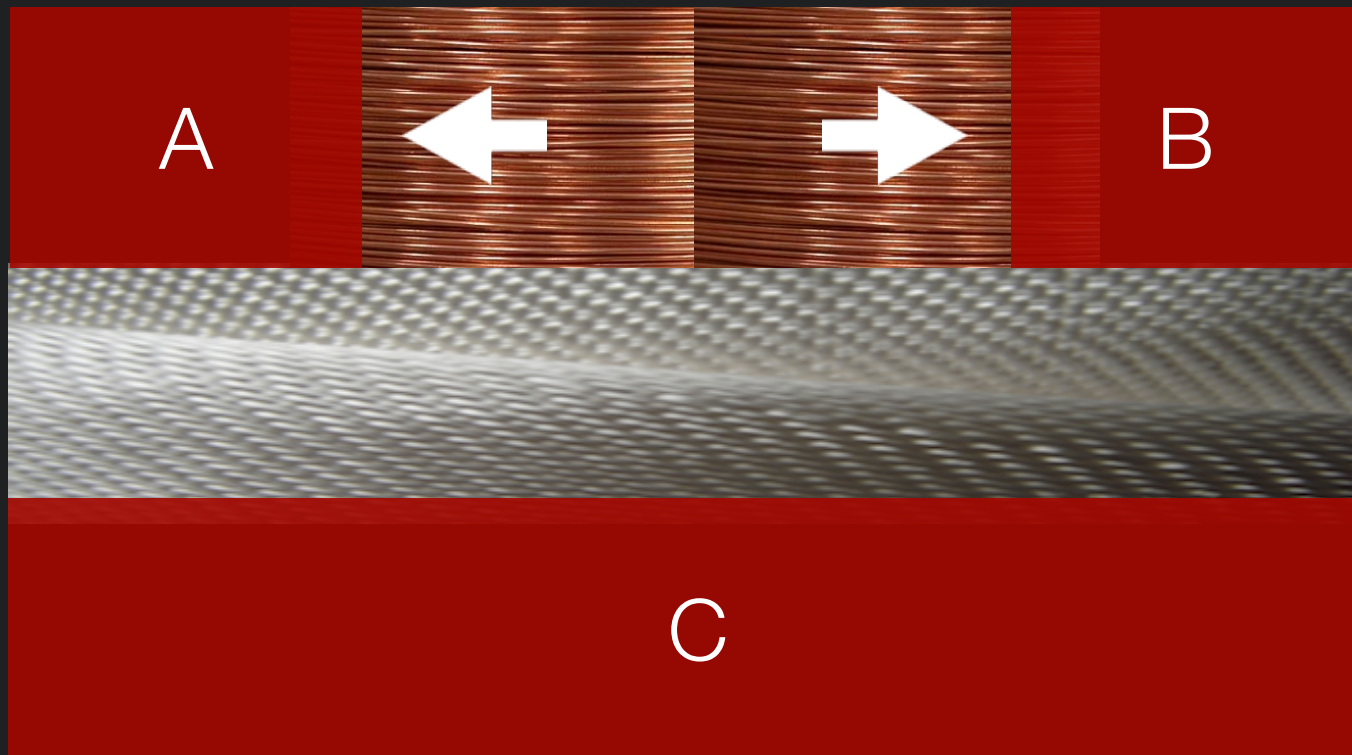
0th Law & Thermal Equilibrium



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0th Law & Thermal Equilibrium



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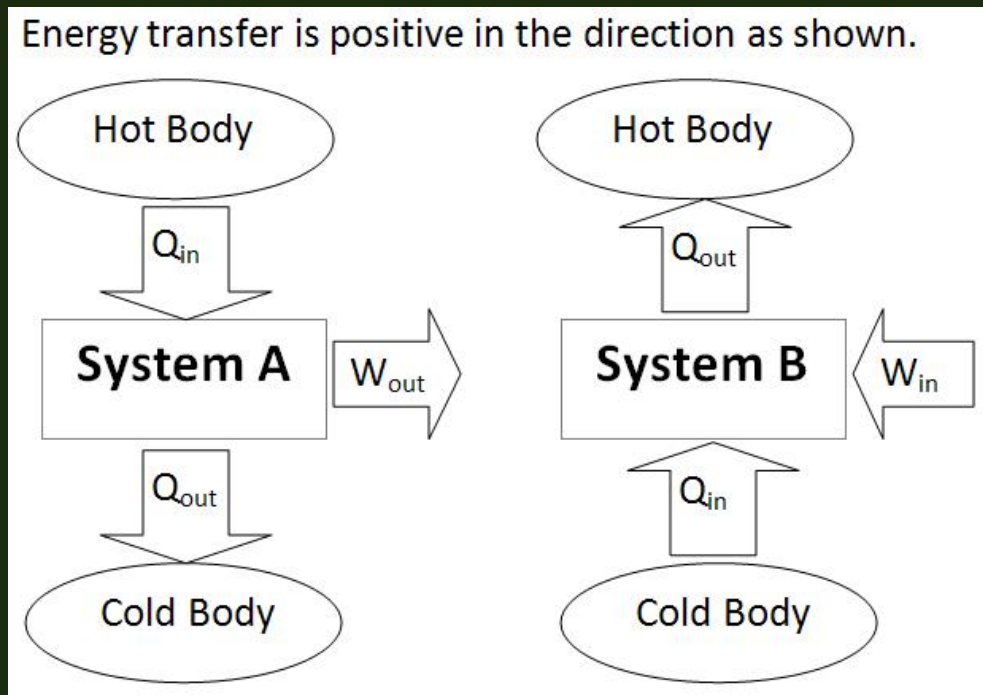
1st Law: Work, Energy, & Heat

$$U = Q - W$$

$$dU = dQ - dW$$

What is the system on the left?

What is the system on the right?



In a closed system energy is, ideally, conserved.

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Thermal Conductivity:

What makes a thermal conductor?

What makes a thermal insulator?

2nd Law & The flow of Heat (dQ/dt)

Heat flows from high to low temperature

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Phenomena linked to Heat transfer:

- ▶ Expansion

Linear ($\bar{\alpha}$) or Volumetric (β) coefficient

- ▶ Contraction

Flow of heat out of a system (Negative heat)

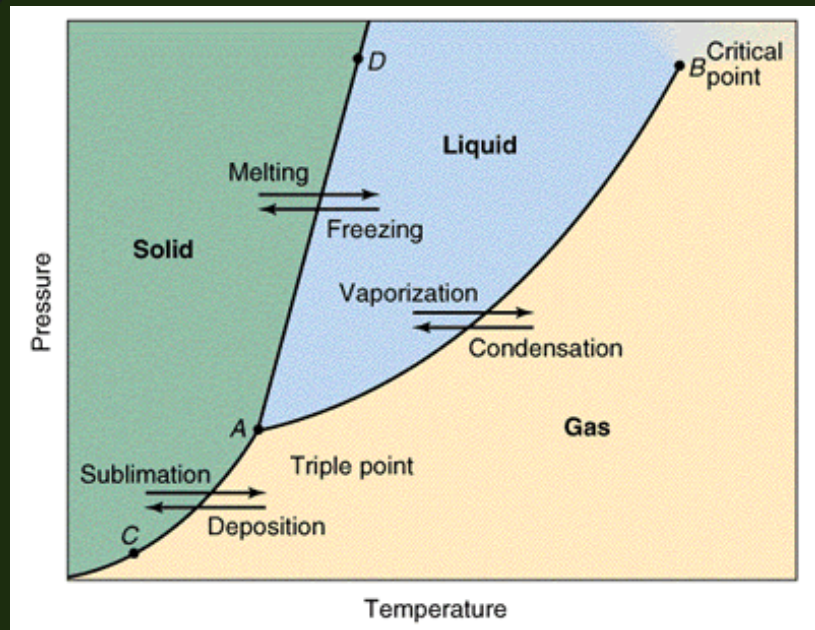
- ▶ Tension

Stress in materials caused by bound heat

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Phase Changes:



<http://crescentok.com/staff/jaskew/isr/chemistry/phaseD1.gif>

3 common phases

✓ Solid

✓ Liquid

✓ Gas

What can cause phase changes?

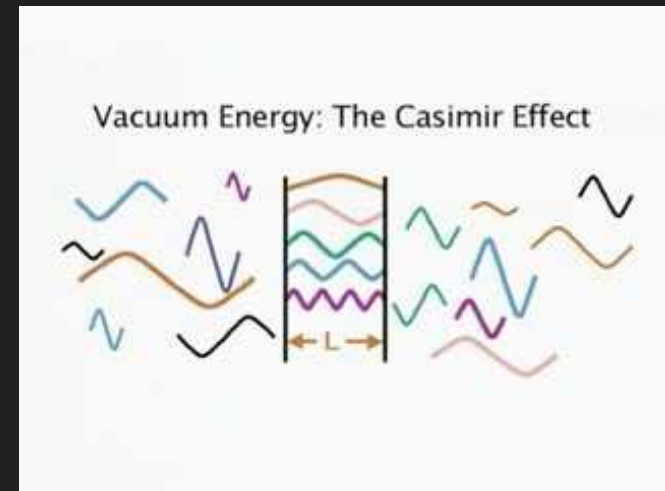
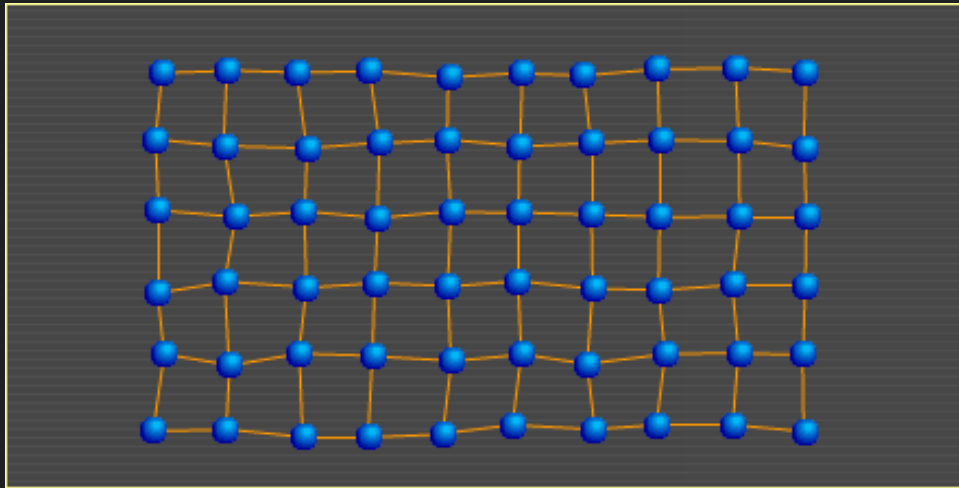
What happens at the origin of the graph?

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3rd Law: Absolute Zero

Theoretical state with no motion
Temperature 0 K



http://www-tc.pbs.org/wgbh/nova/wtc/images/metl_heat.gif http://www.theimagineershome.com/blog/video/45_casimir_effect/casimir_effect.jp

Prevented by Quantum Mechanics
Energy of the vacuum

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Summary

- ★4 Laws of Thermodynamics
- ★Work energy relationship for Heat
- ★Entropy
- ★Phase Changes & Expansion/ Contraction
- ★Pressure, Volume, Temperature
- ★Absolute Zero

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Citation

["The Mechanical Universe"](#). California Institute of Technology. Retrieved 22 August 2014. learner.org

Young, Hugh D., and Roger A. Freedman. University Physics with Modern Physics. 13th ed. Harlow: Addison-Wesley, 2011. Print.