Unit 6: Energy balances on non-reactive systems

Reminders

- HW 5B is due October 28
- No class on Monday, October 28
- Quiz 2 will be on October 30 (covering content from HW 4 and 5A)
- Exam on Material Balances is November 8 (cumulative units 1-5)

Announcements

- No office hours over fall break, but feel free to email me with specific questions

Day	Time	Location	Personnel
Monday	4 – 5 PM	AW Smith 105	Shruti
Tuesday	1 -2 PM	AW Smith, 152	TA
Wednesday	3:30 – 4:30 PM	AW Smith, 147	Shruti
Thursday	2:30 – 3:30 PM	AW Smith 152	TA

Helpful sections of the book: Chapter 7 (excluding 7.7)

Learning Objectives

After today's lecture, students should be able to:

- Write the first law of thermodynamics and explain the physical meaning of each term

- Simplify the first law of thermodynamics to describe a chemical system

Why do we care about thermodynamics and energy balances?

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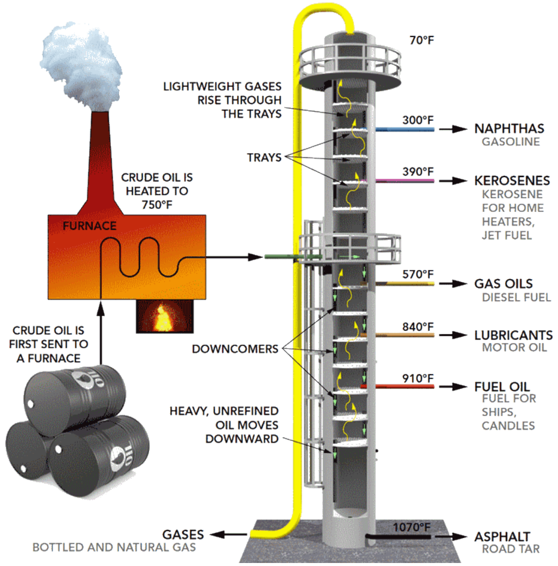
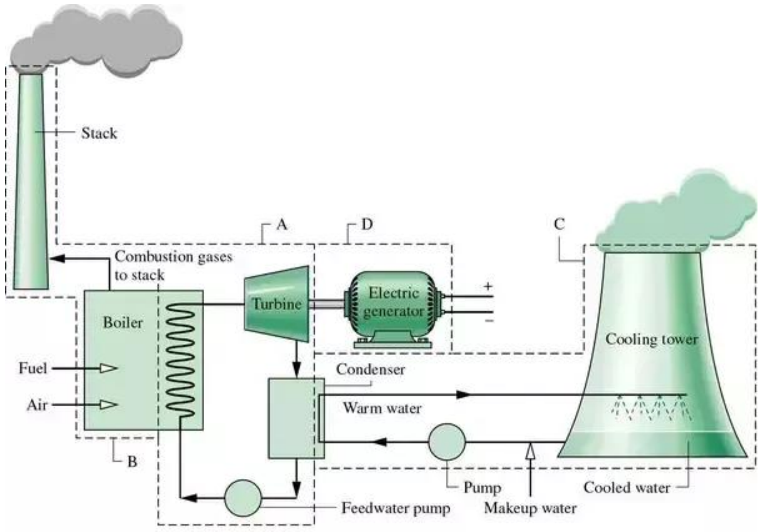


Add heat for a reaction or separation to happen



Harness energy produced by heat for electricity

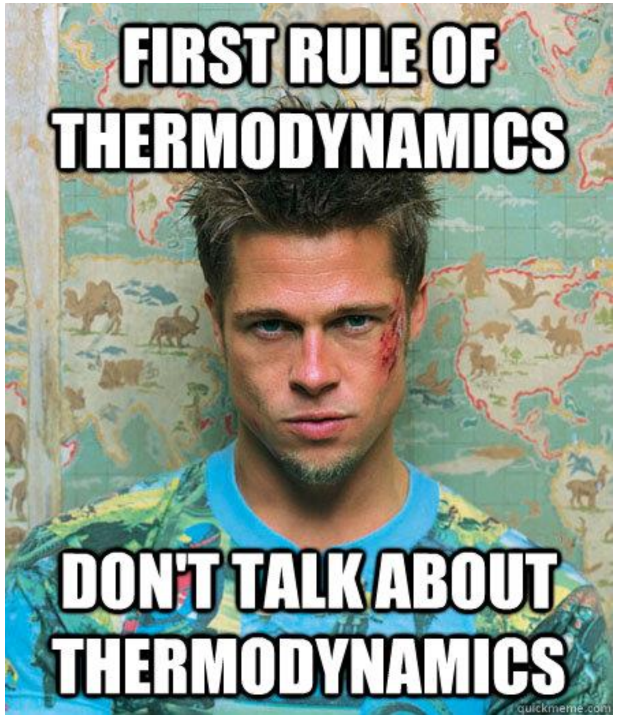
Temperature control!

Remember…

- **Open** system
  - Mass crosses its boundaries
  - Example: ____________ reactors

- **Closed** system
  - Mass does not cross its boundaries
  - Example: _____________ reactors

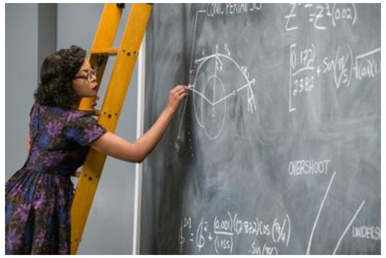
First Law of Thermodynamics



Energy cannot be created or destroyed—it can only be transformed from one form to another.

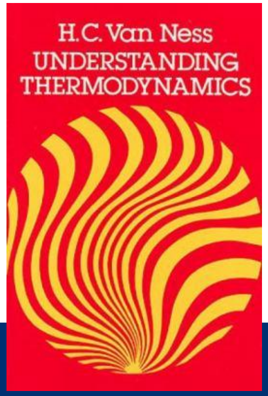
Where did this law come from?

Data Collection



How can we describe that data with an equation?

First Law of Thermodynamics



How do we account for processes that we can't see?

Easy read! ~10 pages of this are posted on Canvas in **Module 6**.

Unit 6: Energy balances on non-reactive systems

Reminders

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- No class on Monday, October 28
- Quiz 2 will be on October 30 (covering content from HW 4 and 5A)
- Exam on Material Balances is November 8 (cumulative units 1-5)

Announcements

- Review material & practice problems are posted on Canvas

Day	Time	Location	Personnel
Monday	4 – 5 PM	AW Smith 105	Shruti
Tuesday	1 -2 PM	AW Smith, 152	TA
Wednesday	3:30 – 4:30 PM	AW Smith, 147	Shruti
Thursday	2:30 – 3:30 PM	AW Smith 152	TA

Helpful sections of the book:
Chapter 7 (excluding 7.7)

Learning Objectives

After today's lecture, students should be able to:

- Explain the concept of reference states and why they are important
- Define and name the state properties
- Write a theoretical process path for a chemical process

State Properties

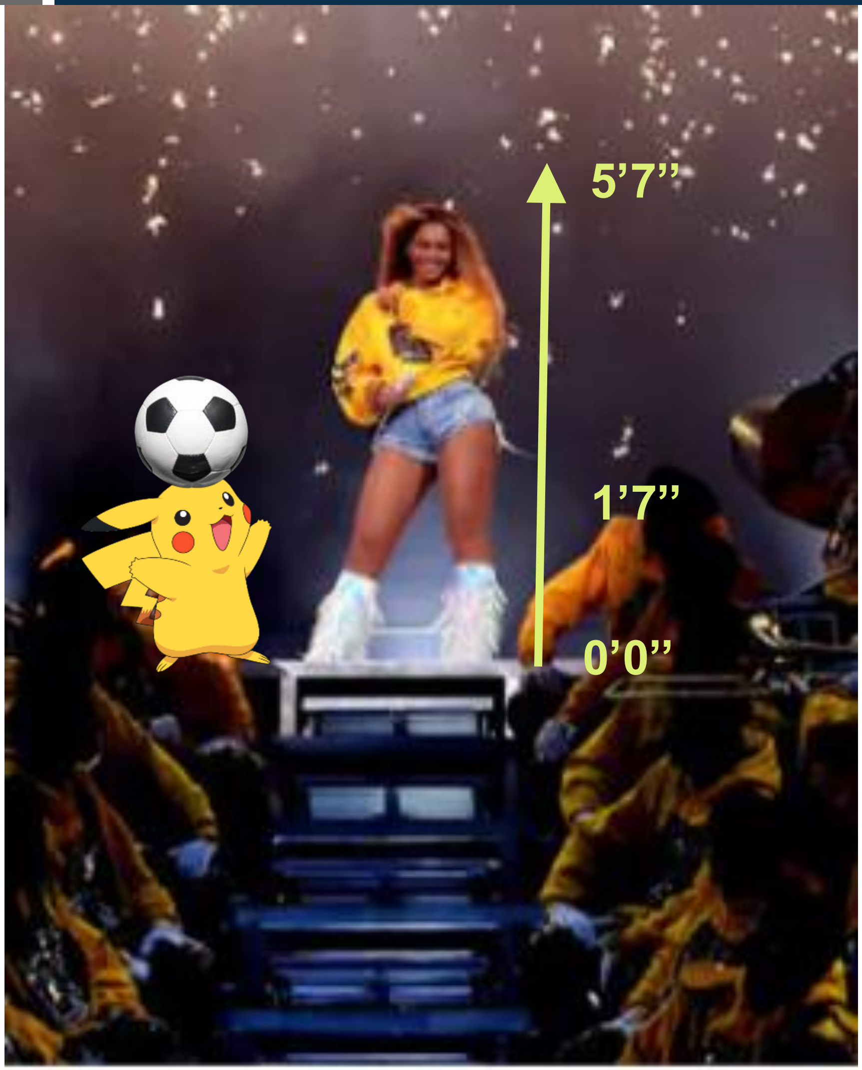
State properties only depend on the state of current the system NOT the process path.

For **H and U**, state is defined by T, P, phase.

For **Ek**, state is defined by mass, velocity.

For **Ep**, state is defined by mass and position.

Example of a state property: Potential Energy

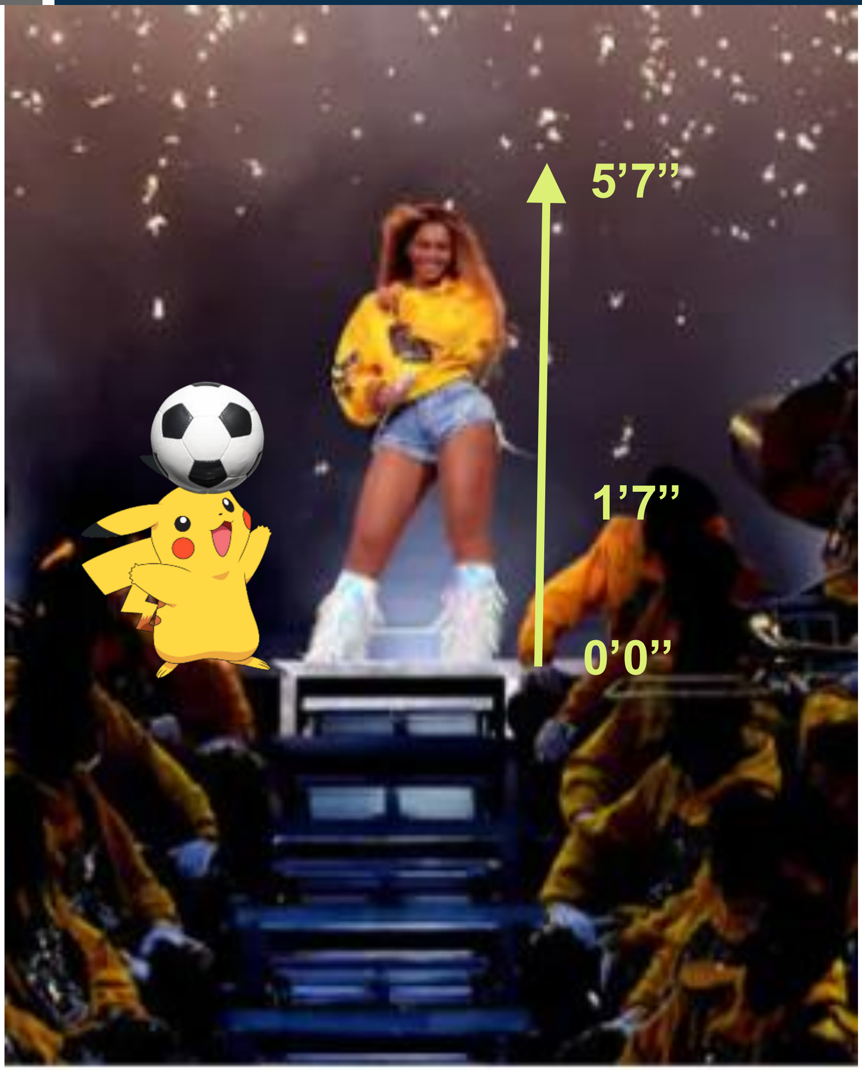


State properties only depend on the state of current the system NOT the process path.

$$\Delta E_p = mg\Delta z$$

Path 1: $\Delta E_p = mg * 4ft$

Example of a state property: Potential Energy



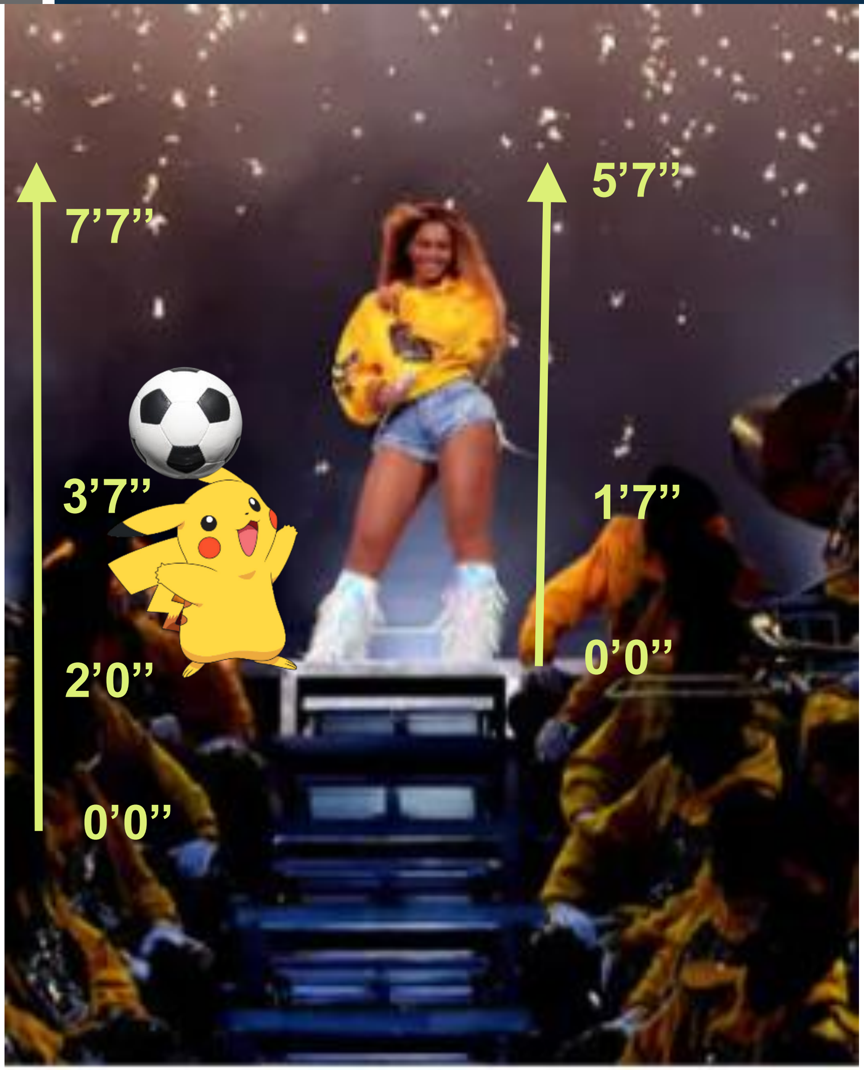
State properties only depend on the state of current the system NOT the process path.

$$\Delta E_p = mg\Delta z$$

Path 1: $\Delta E_p = mg * 4ft$

Path 2: $\Delta E_p = mg * 4ft$

Example of a state property: Potential Energy



Reference state: arbitrary state to which all other states are compared

$$\Delta E_p = mg\Delta z$$

Using a lower step as a reference state… what is Δz?

Unit 6: Energy balances on non-reactive systems

Reminders

- Exam on Material Balances is on Friday, November 8 (cumulative units 1-5)

Announcements

- Cumulative practice problems are posted in the modules section
- Quiz 2 will be returned by Wednesday (after class) at the latest

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Monday	4 – 5 PM	AW Smith 105	Shruti
Tuesday	1 -2 PM	AW Smith, 152	TA
Wednesday	3:30 – 4:30 PM	AW Smith, 147	Shruti
Thursday	2:30 – 3:30 PM	AW Smith 152	TA

Helpful sections of the book:
Chapter 7 (excluding 7.7)

Learning Objectives

After today's lecture, students should be able to:

- Write a hypothetical process path for a chemical process
- Calculate ΔH and ΔU for processes with:
  - ΔT at constant P and phase
  - ΔP at constant T and phase
  - Δphase at constant T and P

Unit 6: Energy balances on non-reactive systems

Reminders

- HW 6 is posted and is due on November 20
- HW 7 will be assigned on November 20 and is due on Nov 27

Announcements

- We will have in-person class on Wednesday Nov 27 (before break) and I will post a recording for anyone who is traveling
- No office hours on Wednesday, November 27

Day	Time	Location	Personnel
Monday	4 – 5 PM	AW Smith 105	Duval
Tuesday	1 -2 PM	AW Smith, 152	TA
Wednesday	3:30 – 4:30 PM	AW Smith, 147	Duval
Thursday	2:30 – 3:30 PM	AW Smith 152	TA

Helpful sections of the book:
Chapter 7 (excluding 7.7)

Learning Objectives

After this unit, students should be able to:

- Write a hypothetical process path for a chemical process
- Calculate ΔH and ΔU for non-reactive processes with:
  - ΔT at constant P and phase
  - ΔP at constant T and phase
  - Δphase at constant T and P