VIVEKANAND COLLEGE, KOLHAPUR (EMPOWERED AUTONOMOUS)

Department of physics

Thermodynamics

BY

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Outline

- Background
- Exothermic vs Endothermic Reactions
- Heat Capacity
- Specific Heat
- Specific Heat of Selected Substances and Mixtures
- Relevance

Background

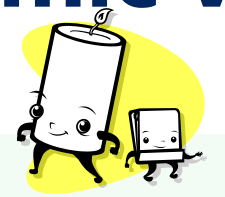
Thermodynamics: Study of interactions among work, energy, and heat

Calorimetry: Experimental measurement of heat

How did they first measure heat?

- Antoine Lavoisier (1782)
- World's first ice-calorimeter
- Published in his book "Elements of Chemistry"

Exothermic vs. Endothermic Reactions



EXOTHERMIC

Reaction that gives off heat to its surroundings

- A candle flame 
- Burning sugar
- Rusting iron
- Making ice cubes
- Forming bonds

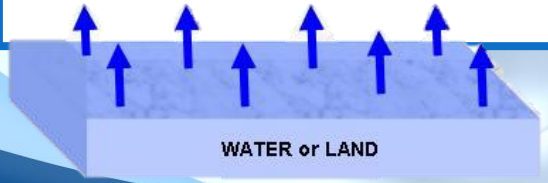
ENDOTHERMIC

Reaction that absorbs heat from its surroundings

- Forming cation from atom in gas phase
- Producing sugar by photosynthesis
- Cooking an egg 
- Melting ice cubes
- Breaking bonds

Pop Quiz!

Is evaporation of water H_2O (l) → H_2O(g) an endothermic or exothermic reaction?



Heat Capacity

Objects differ in their abilities to transform heat transfer into temperature change

- Heat Capacity (denoted by letter "C")
  - Measurement of the amount of heat required to change a substance's temperature by a certain amount

$$C = \frac{q}{\Delta T}$$

An object has a heat capacity of 57.5 J/K. If its temperature changes from 150.4°C to 121.8°C, how much heat is transferred?

-1,640 J

1640 joules of heat are released by the object

C= Heat Capacity (J/K)
q= quantity of heat transferred
ΔT= temperature change

Specific Heat

Heat capacity per unit mass

- Specific Heat (denoted by letter "C_p")
  - Measurement of the amount of heat required to change a substance's temperature by a certain amount

$$C_p = \frac{C}{m} = \frac{q}{m\Delta T}$$

Calculate the heat absorbed by 50.0 g of Cu(s) as it changes its temperature from 300 K to 500K.

3,850J

3850 joules of heat are absorbed by Cu(s)

C= Heat Capacity (J/ g K)
q= quantity of heat transferred
m= mass
ΔT= temperature change

Specific Heats of Selected Substances and Mixtures

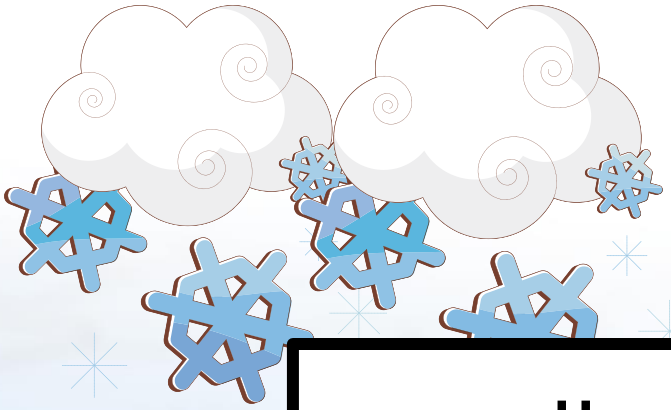
Substance	Cp (J/g K)
Ag(s)	0.235
Al (s)	0.897
Au(s)	0.129
Ca(s)	0.647
$CaCO_3$ (s)	0.920
Cu(s)	0.385
Fe(s)	0.449
H_2O (s)	2.06
H_2O (l)	4.19
H_2O (g)	2.02

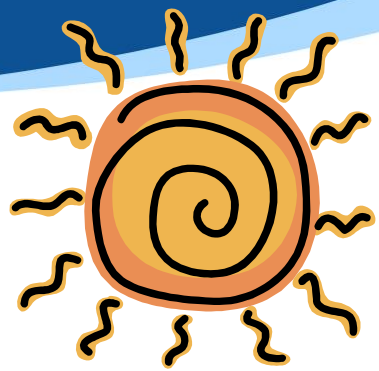
Did you notice anything peculiar?

Cp(Ag) < Cp (H2O)
Cp (metal) < Cp (nonmetal)

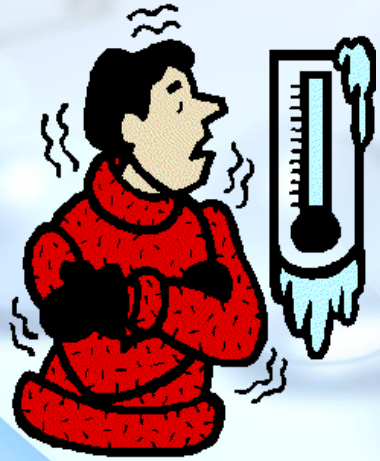
Small specific heat= substance translate heat transfer to relatively large temperature change

Relevance





How do these work?



References

1. You Tube videos
2. Wikipedia
3. www.google.com

THANK YOU