SEPT. 5/17

THERMAL SCIENCES

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RL building - where all labs are conducted
↳ meet infront of CB1041 for first lab
RL1001 (LAB 2 + 4)
RL1002 (LAB 1 + 3)

LAB MANUAL to be in bookstore at some point next week.

Take LU WHMIS course on mycourselink.
Labs are due one week from experiment date, @4pm

Study materials: 1) Textbook
2) MyCourseLink / D2L (ENGI 2518)
↳ presentation slides

Thermo - Chapter 1: Introduction & Basic Concepts
Objectives: 1) Review of SI + English units
2) Explain basic concepts of thermodynamics
↳ System, Property, State, Process, Cycle)
3) Discuss properties of system in detail
↳ Types, density, sp. gravity, sp. weight)
4) Review concepts of temp., temp. scales, pressure (absolute, gage)

Thermodynamics and Energy
Energy - ability to do work
Thermodynamics - science of energy
Thermo - heat
Dynamics - power

Application areas of thermodynamics:

1) Household appliances → electric/gas range, microwave, Fridge, etc.

2) Design + Analysis of Automobile Engine, Power Plants, etc.

Dimensions

→ Characterization of Physical quantity

two types: 1) Primary / Fundamental

2) Secondary / Derived

$$\left.\begin{array}{l} L - \text{length} \\ m - \text{mass} \\ t - \text{time} \\ T - \text{temp.} \end{array}\right\} \text{Primary}$$

$$\left.\begin{array}{l} \text{Velocity } (m/s) \\ \text{acceleration } (m/s^2) \\ \text{Force } (Kg\,m/s^2) \end{array}\right\} \text{Secondary}$$

$$\begin{aligned} \text{Force} &= ma \\ &= (kg)\cdot(m/s^2) \\ &= kg\cdot m/s^2 = N \end{aligned}$$

(Newton)

$$\begin{aligned} W &= F \times d \\ &= N \times m \\ &= N\cdot m \rightarrow \text{Joule } (J) \end{aligned}$$

Power

$$P = \frac{W}{t} = \frac{\text{Joule } (N\cdot m)}{\text{Time } (s)} = \text{Watt } (W)$$

Sept. 7/17
THERMAL

Introduction and Basic Concepts

Primary	SI	English
Length	m	ft
Mass	kg	lbm
Time	s	s
Temp.	K / °c	R / °F

Secondary	SI	English
Velocity	m/s	ft/s
Acceleration	m/s^2	ft/s^2
Force	$kg \cdot m/s^2$ (N)	lbm · ft/s (poundal)
Work	N · m (J)	lbs · ft → ft - lbs
Power	J/s (ω)	ft · lbs/s → 1 hp = 550 $\frac{ft \cdot lbs}{s}$

1 lbf = g poundal
1 lbf = 32.2 poundal

$\boxed{1\ hp = 746\ \omega}$

Heat unit 1) cal 2) BTU

1. CGS → cm, gm, s
2. FPS → ft, lb, s
3. MKS → m, ks, s

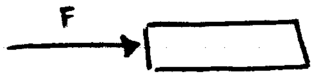
→ SI

1 cal = 1g × 1°c
BTU = 1 lbm × 1°F

$\boxed{1\ BTU = 252\ cal}$

$\boxed{1\ Cal = 4.2\ J}$

Force SI



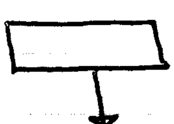
F

m = 1 kg (1lbm)

1 m/s² (1 ft/s²)

$$F = ma = 1\ kg \times 1\ m/s^2 = 1\ N$$

$$\left(1\ lbm \times 1\ ft/s^2 = 1\ poundal \right)$$



1 kg
(1 lbm)

1 kg · f

$$F = mg = 1 \times 9.81 = 9.81\ N$$

$$g = 9.81\ m/s^2$$

$$g = 32.2\ ft/s^2$$

$$\left(F = mg = 1\ lbm \times 32.2\ ft/s^2 = 32.2\ poundal = 1\ lbf \right)$$

1 mi = 1.61 km

1 kg = 2.2 lbm

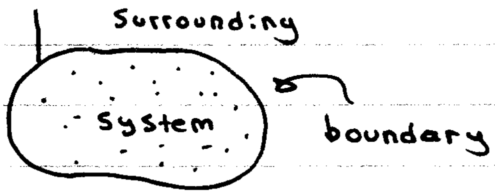
1 ft = 12 inch

1 yard = 3 ft

1 mile = 1760 yard

$\boxed{\text{* 1 TON of refrigeration} \hookrightarrow = \text{? hp}}$

Potential energy formula = mgh



System → 1) closed, 2) open, 3) isolated

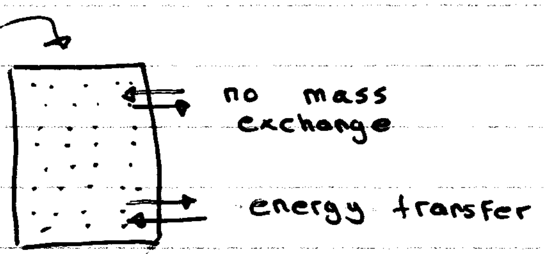
mass contained, but energy not (1) closed, 2) open)

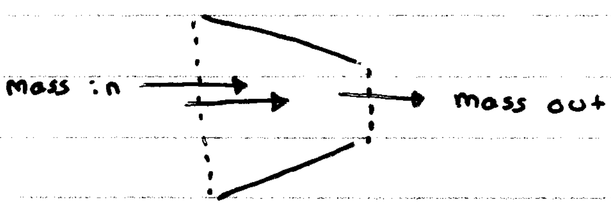
System ↓

1) mass

2) energy

Closed system





Property :

- Intensive (independent)
- Extensive (dependent)

Imp. Properties

P

T

V

ρ

h

s

E

P, T, ρ

$\rho = m/v$

$\rho_{H_2O} = 1000 \ kg/m^3$

$\rho_{air} = 1.2 \ kg/m^3$

Specific Volume = V / m $\qquad \rho = m/V \; (kg/m^3 \text{ or } lbm/ft^3)$

$$\upsilon = V/m = 1/\rho$$

$$\upsilon = m^3/kg \text{ or } ft^3/lbm$$

Specific Gravity (SG) = $\dfrac{\rho}{\rho_{H_2O}}$

$$SG_{H_2O} = 1$$

$$SG_{Hg} = 13.6$$

Specific Weight = $\dfrac{W}{V}$

$= N/m^3$ or lbf/ft^3