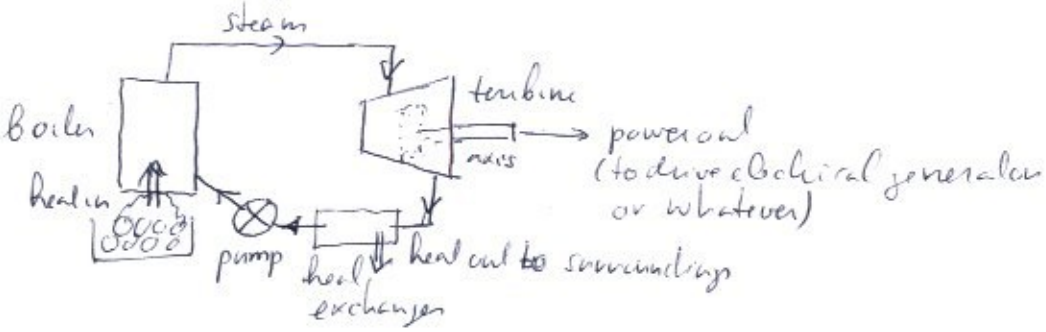
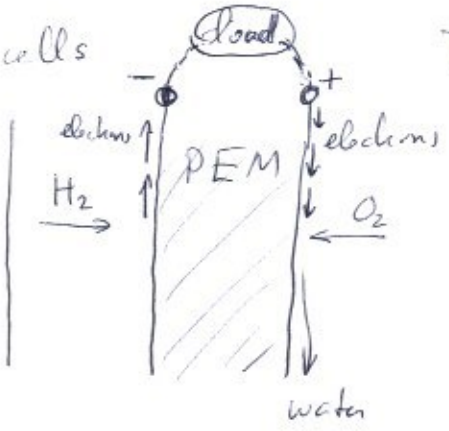
Chapter 1

Intro

1.1 Simple steam power plant



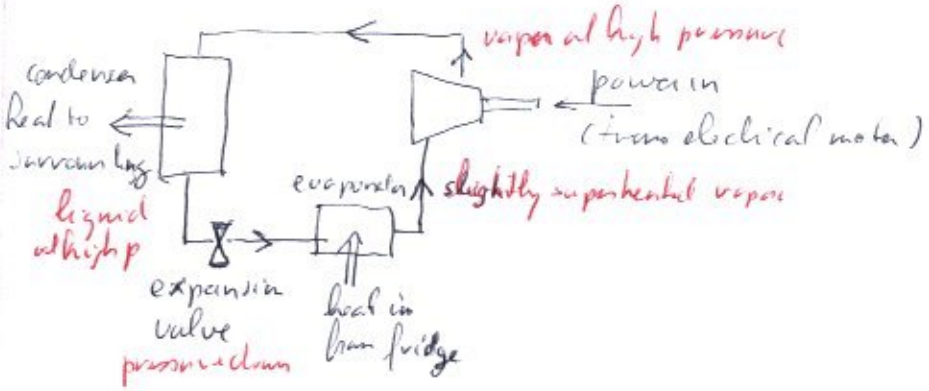
1.2 Fuel cells



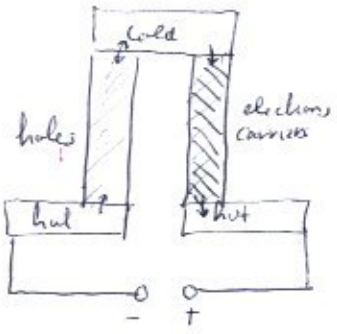
Turn fuel directly into electricity

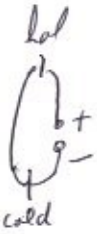
1.3 Refrigeration cycle

like a steam power plant in reverse



1.4 The thermoelectric refrigerator
Direct heat removal ⇒ electricity conversion





thermocouple

Seebeck effect $\Delta T \rightarrow j$

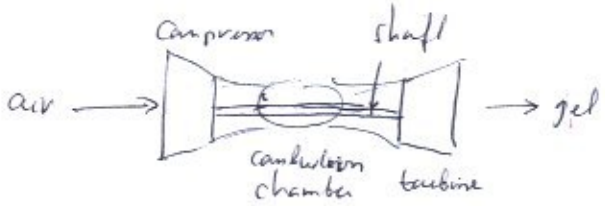
→ may fail
= thermocouple

Peltier effect

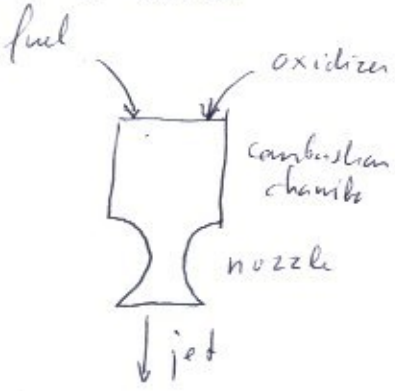
Thomson effect

1.5 Air separation plant
Uses expansive cooling
See book

1.6 Gas turbine



1.7 Chemical rocket



1.8 Other

Thermodynamics

Deals with heat and work

System

Whatever is being studied

Two examples

the gas in a closed container ↑ Closed System: no mass goes in or out

jet engine ↑ Open system: mass goes in and/or out

Its region is called control volume (CV)
Its outside surface control surface

Phase

An amount of matter that is homogeneous throughout
(liquid phase, solid phase, gas phase)

Extensive properties

Proportional to the amount of material
(volume, mass, ...)

Intensive properties

Independent of the amount of material
(pressure, temperature, ...)

Extensive properties become intensive by taking them per unit mass, or unit volume, or per mole

Extensive	Intensive
V : volume	$v = \frac{\text{volume}}{\text{mass}}$ = specific volume
	$\overline{v} = \frac{\text{volume}}{\#\text{ of moles}}$ = molal specific volume
m : mass	$\rho = \frac{\text{mass}}{\text{volume}}$ = density $\quad \boxed{\rho = \frac{1}{v}}$

Notation: Upper case : Extensive
Lower case : Intensive (normally per unit mass)

Exception: T temperature : intensive
P pressure

State: Condition of a system (pressure, temperature, ...)

Process: Sequence of states

Important examples
- T constant → isothermal
- p constant → isobaric
- v constant → isochoric
- entropy s constant → isentropic (no heat conduction)

Cycle: Series of processes where the material ends up in the same state that it began with

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