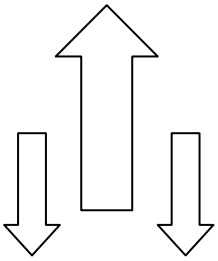
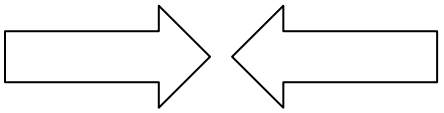
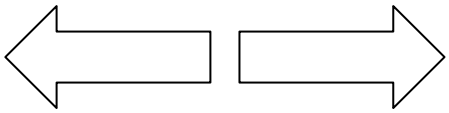
Manufacturing Technical Objects

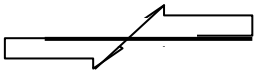


TOPIC	Pages in textbook
Constraints and types of material deformations	387
Mechanical Properties of Materials	388-89

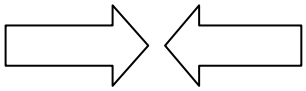
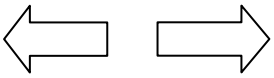
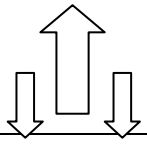
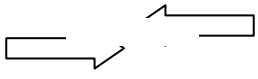


1. Constraints





Materials have to be able to withstand various constraints. A constraint is what describes the effect of external forces on a material.

Type of constraint	Description of forces	Symbol (choose from above)	Examples
Compression	Crushing		Crushing a can Garbage truck compression
Tension	Stretching Deflection		Stretching muscle; Stretching wire
Torsion	Twisting		Earthquake Squeezing water out of rag
Deflection	Bending		Skis; rubber
Shearing	Cutting		Cutting paper; cutting thin sheet of metal

2. **Mechanical properties** describe how an object reacts to constraints.

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Mechanical Property	Definiton
hardness	Resists dents
elasticity	Reverts back to original after compression, deflection, tension or torsion
ductility	Can be stretched without breaking; ie. into wires
malleability	Can be flattened without breaking
stiffness	Resists deflection especially; not elastic

Other Material Property	
Resistance to Corrosion	Will not react with water, oxygen, acids, salts or bases
Electrical Conductivity	G= 1/R; allows electricity to flow through it
Thermal Conductivity	Thermal conductivity is the measure of the quantity of (heat) energy which flows through a unit length, in unit time, when there is a unit temperature difference between the two ends of the length.

In Class Examples

1. What kind of wood is hard? Soft?

   Maple , oak: hard
   Pine: soft

2. a) What elements of the periodic table are ductile and malleable?
   metals

   b) What family of elements are ductile, malleable but nowhere near as hard as the rest of the metals?

   Alkali metals

   b) List six elemental metals with at least some resistance to corrosion.
   Au, Cu, Ag, Pt
   Ti, Al, Ni = resistant due to protective oxide coating

   d) Which elements corrode very easily and why?
   Fe, alkali and alkaline earth metals

   e) List four elements with an atomic number less than 10 that have poor thermal conductivity.

He, H, C, N, O, F

3. a) Which elements have low electrical conductivity?

Non metals and noble gases

b) STE only---What is the difference between specific heat and thermal conductivity?

Specific heat : J/(g^{o}C)

Thermal conductivity: J/(m*s*K)

3. **Ceramic Materials**: do not include just tiles on floors and walls but also bricks, blocks, glass and dishes. They are prepared by the action of **heat** and subsequent cooling.

A) What do they have in common form the point of view of chemistry?

Brick composition	**Tile composition**	**Glass composition**
1. Silica (SiO_2) - 50% to 60% by weight 2. Alumina (Al_2O_3) - 20% to 30% by weight 3. Lime (CaO)- 2 to 5% by weight 4. Iron oxide(Fe_2O_3) - 5 to 6% (not greater than 7%) by weight 5. Magnesia(MgO) - less than 1% by weight	Al_2O_3, BeO, CeO_2, ZrO_2 and sometimes with non oxides but carbides	SiO_2 ,Na_2CO_3, CaO, MgO and Al_2O_3

Example: STE --- Give the charges of Fe, Al, Mg, Zr and carbonate in the above compounds.

Al: +3; Zr : +4 Mg = +2

Fe:+3 Here's how: Fe_2O_3 2 Fe + (-2)(3) = 0
2 Fe = 6
Fe = 6/2 = 3.

Ceramic Material Property	

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B)

Resistance to Corrosion	**Can resist attack form oxygen and water but not form chloride, acid and base**
Electrical Conductivity	**Usually poor conductors; but newer materials can conduct**
Thermal Conductivity	**Poor conductors; good insulators**