VIVEKANANDA COLLEGE
THAKURPUKUR
KOLKATA-700063

NAAC ACCREDITED 'A' GRADE

Topic: physics of crystalline solids

Course Title: Applied Physics

Paper: CC-3

Unit:

Semester: 2

Name of the Teacher: Romela Dutta

Name of the Department: Electronics

TUESDAY 28 FEB 20

09th Wk. 059-306

CC-3

Brittle and ductile materials

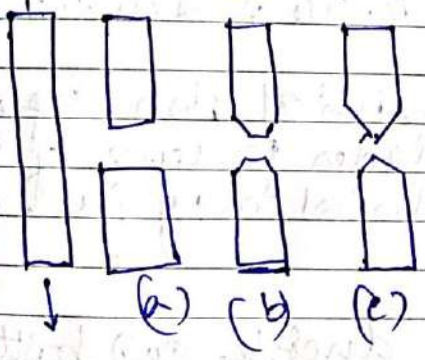
Materials ability to undergo significant-plastic deformation under tensile stress before rupture called ductile properties of materials. In other words if materials ductile, materials stretch under tensile load. The ductile materials are steel, Al, copper etc.

Brittle materials break without significant-plastic deformation under tensile stress. Also called sudden failure. Brittle material absorb little energy prior to rupture. They are glass, plain concrete, cast iron etc.

In the figure you can observe materials (a) break without losing its cross section area means material is brittle. This type of materials fail suddenly without any notice.

Failure of material (b) shows, it's a ductile material.

Material (c) is complete ductile material.



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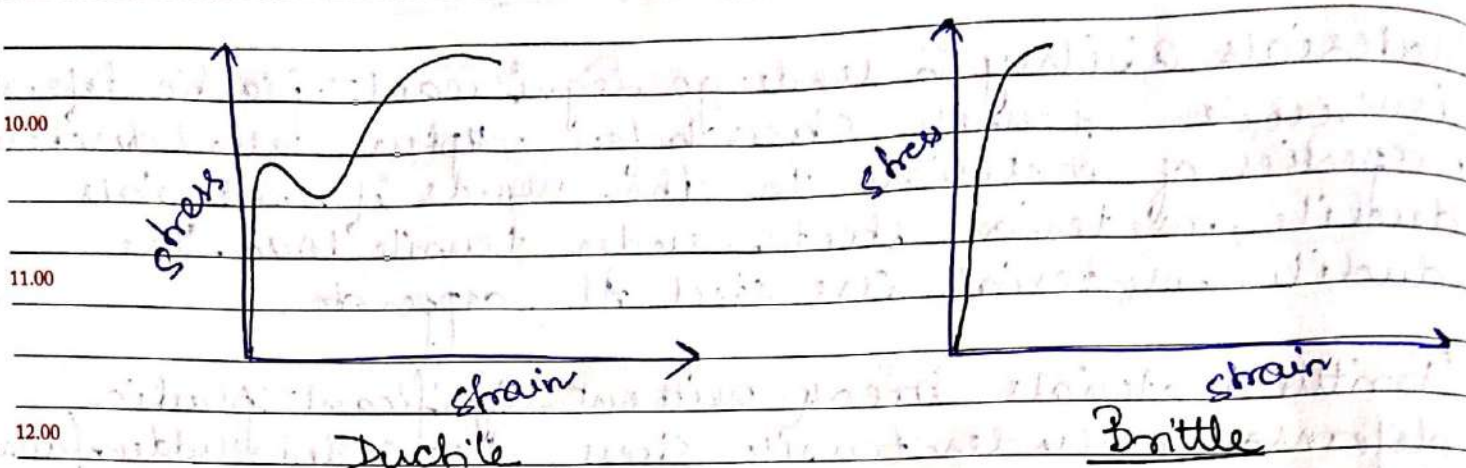
Stress-Strain curve for ductile and



→ Similarities between ductile and brittle material

- Both are associated with plastic deformation of the material under tensile loading.
- Ductility or brittleness is highly temperature dependent. For ex, a brittle material can behave like a ductile one at an elevated temperature. Similarly a ductile material at room temperature, when frozen, can automatically convert into brittle material.
- Ductility or brittleness of a material also depends on the inherit stress level. Under presence of high residual stress, a ductile material may fail without palpable plastic elongation.

Differences between ductile and brittle material

Remember

Ductile	Brittle
Solid materials that can undergo substantial plastic deformation prior to fracture are called ductile materials.	Solid materials that exhibit negligible plastic deformation are called brittle materials.
Percentage elongation of the ductile materials before fracture under tensile testing is higher.	Percentage elongation of the brittle materials before fracture under tensile testing is very less.
Energy absorbed by ductile materials before fracture under tensile testing is more.	Brittle materials absorb very small energy before fracture.
Various metal forming operations (rolling, forging) can be performed on ductile materials.	Brittle materials fail faster when subjected to metal forming
They show longer life when subject to fatigue loading.	They fail when subjected to fatigue loading.
Eg : Mild steel • Al • Cu • Rubber	• Castiron • Ceramics such as glass, cement, concrete • Stone • ice.

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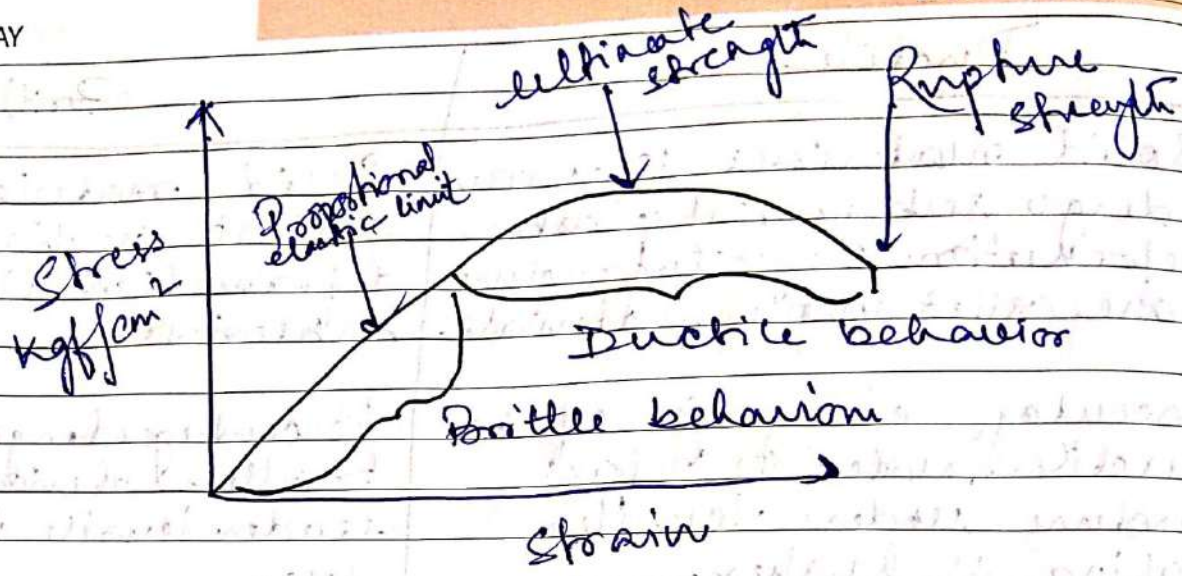

Tensile strength - Maximum load that a material can support without fracture when being stretched divided by the original cross sectional area of the material. Tensile strengths have dimensions of force per unit area. When stresses less than tensile strength are removed, a material returns either completely or partially to its original shape and size.