
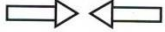

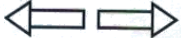

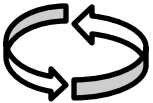

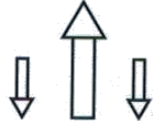




Constraints and Material Notes


Constraints

Constraints	Examples	Description	Symbol
Compression			
Tension			
Torsion			
Deflection			
Shearing			

Deformations

Depending on the constraints there are three types of deformations which can occur.

Type of deformation	Example	Description
Elastic		
Plastic		

Fracture		
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Properties

Mechanical properties describe how a material reacts when subjected to one or more constraints.

Property	Description	Example
Hardness		Diamonds Ceramic
Elasticity		Elastics Bedsprings
Resilience		Plastics Metals
Ductility		Elastics Metals
Malleability		Metal Plastics
Stiffness		Ceramics Concrete
Fragility		Ceramic Glass

Other properties

Resists corrosion		Ceramics Plastic
Electrical conductivity		Metals Salt water
Thermal conductivity		Metals

Materials

Looking at characteristics, degradation and protection.

Degradation: breaking down or wearing down of a material.

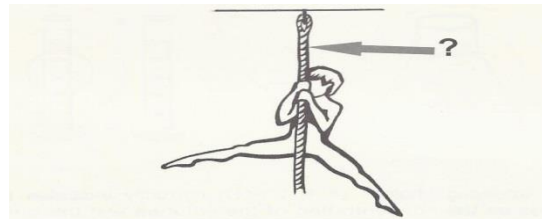
5 Materials

	Wood and modified wood	Ceramics	Metals and alloys
Fact	Wood is produced by the harvesting of trees and modified wood is wood mixed with other substances (glue, plastics)	Created by heating inorganic matter Usually formed using an oxide, sand and clay.	A metal is extracted from an ore. An alloy is made up of many metals and or other substances. Ferrous alloy has iron in it.
Pros	Resilient and does not conduct. Can recover from water damage	Hard, does not rust and does not conduct. Used in building materials.	Conducts heat and electricity. Malleable and ductile.
Cons	Can be ruined by too much water. Damaged by insects	Very fragile	Will rust
Degradation	Sun, insects and water	Can be deteriorated by certain acids and bases.	Rust due to water and salt
Protection	Treating wood with a solution containing copper	Care in baking process can determine its resiliency	Coatings are put on the metal (paint and oils). Galvanized-coated with zinc.

	Plastics	Composites
Fact	Plastics are made from fossil fuels. Thermoplastics will soften when heated and changes shape when cooled. Thermosetting plastics remain hard even when heated.	Made up of 2 parts: 1- Matrix (skeleton and gives shape) 2- Reinforcement (fills the matrix). Used in airplane wings, bulletproof vests and sport equipment.
Pros	Can be used for basically everything and anything. Cheap to produce. Can be molded in all colours and sizes.	Produces high quality products.
Cons	All thermosetting plastics are not recyclable. Cheap, therefore creates a lot of waste.	Very expensive to produce.
Degradation	Water, oxygen and UV rays can damage them.	Matrix and reinforcement loses its adherence. Deformation or fracture of materials.
Protection	Use waterproof coating, add antioxidants and add pigments which absorb UV rays.	Using products which will adhere together well.

Past exam question

1. A circuit performer holds onto a twisted rope, maintaining the same position for a few seconds.



Which of the following choices indicates the two mechanical constraints to which the rope is subjected at the location where the arrow is pointing?

- A) tension and compression
- B) compression and deflection
- C) deflection and torsion
- D) torsion and tension