




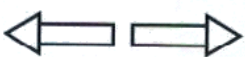


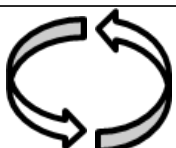








MATERIALS AND CONSTRAINTS

Mythbusters for the Impatient - Square Wheels.mp4






Constraints

Constraints are external forces that are exerted on materials and that have a tendency to deform them.

Constraint	Examples	Description	symbol
Compression	 	crushing force	
Tension	 	stretching force	
Torsion	 	twisting force	
Deflection	 	bending force	
Shearing	 	cutting force	

Deformations:

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

Type of deformation	Example	Description
Elastic		Temporarily changes shape, then goes back to original form
Plastic	 	Permanent change in shape even when constraint removed
Fracture	 	Constraint causes material to break

Properties

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

	Definition	Example
Hardness	Resists indentation or scratching	diamonds ceramic
Elasticity	Returns to original shape when constraint removed	elastics bedsprings
Resilience	Resists shock by becoming deformed and then returning to its original shape	plastic metal
Ductility	Can be stretched into wires without breaking	elastics metal
Malleability	Can be flattened or bent without breaking	metal plastic
Stiffness	Retains shape when subject to constraints	ceramics concrete
Fragility	Material has the capacity to break without undergoing a deformation	ceramics glass

other properties

resists corrosion	Does not rust in the presence of salt and water	ceramics plastics
electrical conductivity	Allows current to flow through it	metals salt water
thermal conductivity	Allows heat to flow through it	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.

Shape Memory Alloy.mp4

Corrosion and rust- Science.mp4







C00 What Are Alloys.mp4

Carpenter Ant Infestation.mp4


Termite Video.mp4

	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.

Characteristics of matrices and reinforcements

Matrix	Reinforcement	Properties
Plastic		Durable, lightweight, resilient, inexpensive
Metal		Ductile, good conductor, stiff
Ceramic		Durable, heat resistant
	Fiberglass	Stiff, resists corrosion
	Kevlar	Low density, resilient
	Carbon	Still. low density, conducts electricity

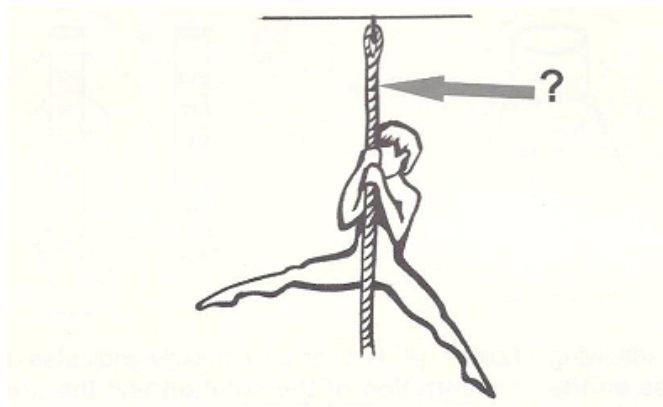
 Mybustars bulletproof badge [HD].mp4

 Chemistry of Kevlar.mp4

 Bullet Proof Vest Testing in Slow Motion.mp4

Past exam question













1. A circus 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

Attachments

-  Bullet_Proof_Vest_Testing_in_Slow_Motion.mp4
-  Chemistry_of_Kevlar.mp4
-  Mythbusters_bulletproof_badge_[HD].mp4
-  Mythbusters_for_the_Impatient_-_Square_Wheels.mp4
-  Shape_Memory_Alloy.mp4
-  Carpenter_Ant_Infestation.mp4
-  Corrosion_and_rust-Science.mp4
-  C00_What_Are_Alloys.mp4
-  Termite_Video.mp4
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