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INTEGRATION QUESTIONS

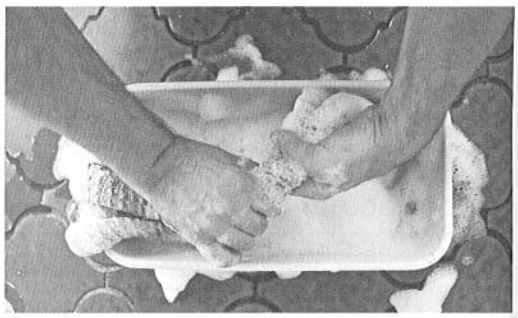
Constraints and material deformations

1. In each of the illustrations below, indicate which type of constraint the material is being subjected to.

a)

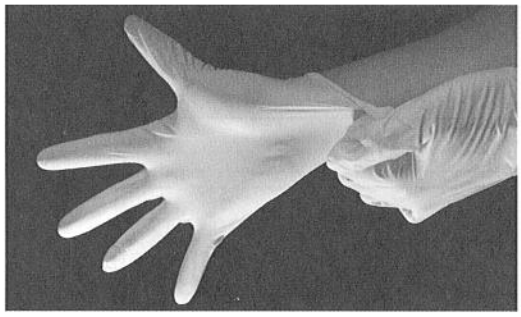
A deflection constraint.

c)



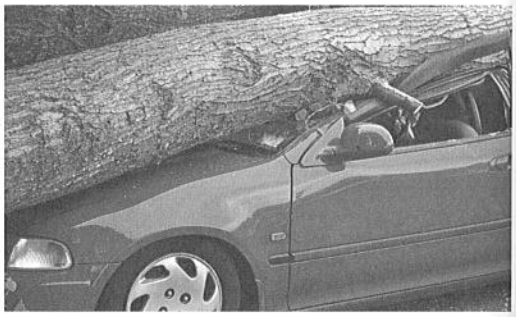
A torsion constraint.

b)



A tension constraint.

d)



A compression constraint.

2. What type of deformation are the objects in the following situations subjected to?

a) You insert paper into a shredder. *Fracture.*

b) You tread on a discarded cardboard container on the sidewalk. *Plastic.*

c) The roof of your carport sags under the weight of snow. *Elastic.*

d) You drive your car over a small bicycle. *Fracture or permanent.*

e) You flatten a milk container before tossing it in the recycling box. *Plastic.*

3. New foam mattresses exist that mould to the shape of your body when you sleep, and spring back to their original form when you get out of bed. Describe this situation in terms of constraints and material deformations.

Answers will vary. Example: The mattress is subjected to a compression constraint that results in an elastic deformation.

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INTEGRATION QUESTIONS

Properties and material degradation and protection

You will need Appendix 5 in the textbook, which is reproduced on page 268 of this book and on the inside back cover, to answer Question 2.

1. What am I? Indicate the property described in each of the statements below.

a) I enable a material to resist being crushed. *Hardness or stiffness.*

b) With me, a material returns to its original shape. *Elasticity.*

c) I allow a material to keep its shape even when subjected to a strong constraint. *Stiffness.*

d) I let a material flatten without any risk of breaking. *Malleability.*

e) Without me, a material might break if it was stretched. *Ductility.*

2. Name a property that influenced engineers in their choice of materials when they designed the following objects.

a) Chrome for car bumpers. *Answers will vary. Examples. Resistance to corrosion or hardness or resilience.*

b) Copper for electrical wires. *Electrical conductivity or ductility.*

c) Iron for buildings. *Ductility.*

d) Rubber for bicycle tires. *Malleability or elasticity.*

e) Aluminum for rowboats. *Malleability or resistance to corrosion.*

3. Study the photo opposite.

a) Explain why the materials of the bike have changed.

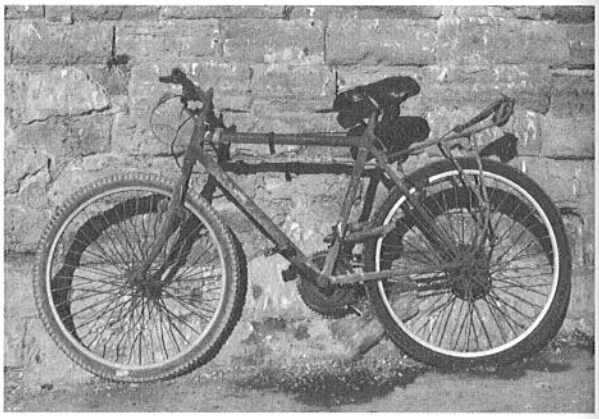
The bike has been attacked by rust.

The materials are degrading.

b) How could the problem have been avoided?

By rustproofing the bike, with paint,

for example, like a painting.



4. Give two examples of things that cause material degradation.

Answers will vary. Examples. Water can cause material degradation along with pollution, sun, heat, weather, improper use, etc.

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INTEGRATION QUESTIONS

Wood, modified wood, ceramics, metals and alloys

1. You are thinking of building a wooden deck. You look at your neighbour's deck and see that it is discoloured and rotten in certain places.

a) How can you explain the state of your neighbour's deck?

Answers will vary. Examples.

Sun, water, time, fungi, microorganisms and insects have degraded the wood, which is a material of living origin. The neighbours did not treat the wood to protect it from this degradation.

b) How could you prevent your deck from suffering the same fate?

By using treated wood or protecting the wood with varnish, paint or a protective coating.

c) Your renovation consultant recommends using green treated wood. What protection process has been used for this wood?

The greenish colour results from dipping it in an alkaline solution containing copper.

2. What am I? Associate each of the following statements with the appropriate material.

a) I have been produced from a mineral ore in the ground. — *Metal.*

b) I am chosen for my good thermal and electrical conductivity, my ductility and my malleability. — *Metal.*

c) I am fragile, but by carefully controlling the raw materials used and the baking method, I can even be used in an engine. — *Ceramic.*

d) I can be used to make fences. — *Treated wood or an alloy.*

e) I am an alloy made primarily from iron and carbon. — *Ferrous alloy or steel.*

f) Because of my low thermal conductivity, I often serve as a thermal insulator. — *Ceramic.*

g) I am made, among other things, from wood residues. — *Modified wood.*

h) I am a natural material found on the Earth's surface. — *Wood.*

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3. Why is it better to have a ceramic floor in a kitchen or bathroom than a wooden floor?

Answers will vary. Examples. Ceramic is more water-resistant than wood. Spills will not damage it. Furthermore, the relative hardness of ceramic makes it more resistant than wood to cuts and impacts caused by pots and other objects falling on the floor.

4. When steel parts are welded together, the material's mechanical properties are often altered in the area where the weld has been made. What is the name of the heat treatment that restores the parts' mechanical properties?

Annealing.

5. To construct a building's steel framework, engineers must ensure that the alloy is highly resistant. What treatments can make steel harder?

Quench hardening and tempering.

6. Today, patio furniture is often made of coated aluminum rather than wood.

a) Name an advantage in using aluminum rather than wood for outdoor furniture.

Coated aluminum resists degradation caused by water, sun and living organisms better than wood.

b) What property explains why an aluminum chair in the sun will be hotter to the touch than a wooden one in the same spot?

Thermal conductivity.

7. True or false?

a) Alloys and ceramics are mixtures. *True.*

b) Metal is often used for its elasticity. *False.*

c) Certain acids stored in ceramic containers will deteriorate the containers. *True.*

d) Metals have better electrical conductivity than wood or ceramic. *True.*

e) Wood conducts electricity well. *False.*

8. Name a possible cause for the degradation of materials in the following situations.

a) A ceramic bowl of ice cubes is placed on a very hot heating plate. *Thermal shock.*

b) A hammer is left out in the snow *Snow accelerates the corrosion.*

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INTEGRATION QUESTIONS

Plastics and composites

You will need Appendix 5 in the textbook, which is reproduced on page 268 of this book and on the inside back cover, to answer Question 2.

1. Today, plastics are among the most commonly used materials.

a) From what natural resources are most plastics made?

Petroleum and natural gas.

b) Give examples of objects made in whole or in part from plastics.

Answers will vary. Examples. Soft drink bottles, food containers, window ledges, plumbing pipes, etc.

c) Which subcategory does a plastic belong to when its shape can no longer be altered once it has hardened?

Thermosetting plastic.

d) Which subcategory does a plastic belong to when it becomes soft when heated, allowing it to be given a new form?

Thermoplastic.

e) Which subcategory of plastics is the most widely used in the world today?

Thermoplastic.

f) Name three plastics that can be recycled when disposed of correctly in a recycling box and when the necessary facilities exist. Specify the recycling code number for each.

Answers will vary. Examples. Polyethylene terephthalate (1), polyethylenes (2 and 4), polyvinyl chloride (3), polypropylene (5) polystyrene (6).

2. Name a possible cause of the degradation of the plastics in the following situations.

a) In a sunny kitchen, a microwave door has yellowed. — *Ultraviolet rays.*

b) A faded plastic toy has been left at the bottom of the pool. — *Penetration by a liquid.*

c) A tarnished plastic test tube contains a corrosive gas. — *Oxidation.*

d) A concentrated solution of sulphuric acid rapidly degrades certain plastics. — *Penetration by a liquid.*

e) A plastic weathervane on a roof is discoloured. — *Ultraviolet rays or penetration by a liquid.*

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3. A composite material has two components: a matrix and a reinforcement. Identify the matrices and reinforcements in the following cases.

a) Fibreglass is often used as a framework in the resin support posts of swimming pools (resin is a thermosetting plastic).

Matrix: *plastic.*

Reinforcement: *fibreglass.*

b) In building foundations, iron rods are installed in concrete walls, making what is known as reinforced concrete.

Matrix: *concrete.*

Reinforcement: *iron rods.*

c) Most walls in our homes are covered with sheets of drywall, which are made from plaster pressed between two sheets of thick paper.

Matrix: *sheets of thick paper.*

Reinforcement: *plaster.*

4. What am I? Identify the matrices and reinforcements in the following statements.

a) It is often called resin. *Plastic matrix.*

b) It is used to increase a material's corrosion resistance. *Fibreglass.*

c) They are obtained by carbonizing polymers. *Carbon fibres.*

d) They are the main plastics used as a reinforcement. *Aramid fibres.*

e) It is chosen for its heat resistance. *Ceramic matrix.*

f) It is often made from glass. *Ceramic matrix.*

5. The following statements concern the properties of plastics. Indicate whether they are true or false and support your answer with two properties.

a) Polypropylene is used in the manufacturing of motor oil.

True. It is waterproof and resistant to penetration by oil and grease.

b) Polyamides are excellent for making water pitchers.

False. They are soft and water-absorbent.

c) Food packaging is made from polyethylenes.

True. This plastic is easy to cut and is flexible.