Materials Worksheet

1. In the table below, write the type of constraint described and draw its symbol.

Description	Constraint	Symbol
1. Sandra and Melanie are going to twist the towel that fell in the water to wring the water out of it.	Torsion	
2. Rachel is stretching the plastic wrap over the bowl of macaroni she has made.	Tension	
3. The weight of the snow has bent the metal fence at the bottom of the yard.	deflection	
4. Aviation snips can be used to cut sheet metal.	shearing	
5. A hammer blow has left a mark on the wooden worktable in the technology workshop.	compression	
6. Gerald is finding it difficult to drive a screw through a knot in a wooden plank.	Torsion	

2. Which type of deformation do the following statements describe?

a) The hood of a car was bent in a collision. plastic

b) A flagpole was broken during a windstorm. fracture

c) David screwed a decorative switch plate onto the wall too hard, and the switch plate cracked. Fracture

3. Match each of the examples below with a mechanical property (A–E).

A. hardness B. elasticity C. resilience D. stiffness E. resistance to corrosion

a) The fibres in a trampoline bounce mat must be able to recover their original shape rapidly. B

b) It is very difficult to hammer a nail through a knot in a piece of wood. A or C

c) Chrome on the hubcaps of a car enhances its look and prevents rust at the same time. E

d) Marble is an expensive floor covering, but it is very difficult to deform. D

4. Do the following statements describe the degradation or the protection of a material?

a) A wooden patio is treated with an anti-fungal coating. Protection

b) The plastic pot that was left out all winter has cracks all over its surface. degradation

5. Match each example below with one of the categories of materials (A–F).

A. wood B. modified wood C. ceramics
D. metals E. ferrous alloys F. nonferrous alloys

a) I am the category of materials that degrades the most slowly. C

b) Cast iron, made primarily of iron but also of carbon and other elements, belongs to this category of materials. E

c) Katia received a pure gold ring when she became engaged. d

d) Bronze, which is mainly a mixture of copper and tin, is used to make Olympic medals. F

e) To obtain materials with larger dimensions, particles of wood can be glued together. B

6. At breakfast, Sandra unscrews the lid of the peanut butter jar and uses a knife to spread some peanut butter on her toast. She presses so hard that she squashes the toast. To read her newspaper as she eats, she pulls on the chain that turns on the table lamp. Finally, she cuts out a newspaper article about jobs in summer camps to show her classmates.

In the light of Sandra's actions at breakfast, name the constraint each of the following objects undergoes:

a) the peanut butter jar Torsion
b) the knife Deflection
c) the toast Compression
d) the lamp chain Tension
e) the newspaper Shearing

7. Among the objects that have been subjected to a constraint in question 6, which have undergone . . .

a) elastic deformation? Explain your answer. Knife + lampchain - goes back to shape.

b) plastic deformation? Explain your answer. Toast - remained deformed.

c) fracture? Explain your answer. Newspaper -> was cut

8. Circle the property desired in each of the following situations.

a) a material for a car bumper :
resilience thermal conductivity electrical conductivity

b) a material that will hold food during cooking, with minimal energy loss:
elasticity stiffness thermal conductivity

c) a material for skis made specially for skiing moguls, with the ability to recover their original shape even after bending between moguls:
elasticity resilience thermal conductivity

d) another material for skis, this time with the ability to sustain the shock of landing after a jump:
elasticity resilience thermal conductivity

e) a highly resistant material for a boardwalk in a very busy park so that it can withstand pedestrian wear :
hardness ductility thermal conductivity

9. Yui goes out for dinner with her family to celebrate her birthday. At the table, she notices the glistening cutlery made of sterling silver. Her side plate, on the other hand, is made of a fragile-looking material. Her father tells her that a restaurant employee, who is also a potter, handcrafts all the dinnerware, so each plate is unique. Yui also notices that the two bread trays seem to be made of the same material but that one is darker than the other. When she picks up one tray to take a piece of bread, she finds it very light in spite of its heavy appearance.
Identify the category of material used to make each of the following objects from the text above.

a) the cutlery metals or alloys
b) the side plates ceramic
c) the bread trays wood or plastic

10. In toasters with slots, the electric current flows through heating filaments. Part of the electrical energy is converted into thermal energy, which toasts the bread. Refer to different properties of materials to explain why it is dangerous to use a metal utensil to remove toast that is stuck in the toaster while the appliance is plugged into an outlet.

metals conduct electricity = electric shock.

11. Many bathtubs are made of acrylic and fibreglass. The two materials are combined so well that they appear as one. That is why people often say that bathtubs are made of fibreglass, even though their main component is really acrylic.

a) Which category of material does the bathtub material described above belong to? composite

b) What is the matrix made of? acrylic

c) What is the reinforcement made of? fiberglass

d) Given that acrylic softens enough when heated to be remoulded and retains its shape once cooled, which subcategory of plastics does acrylic belong to? thermoplastic

12. Ian's grandfather's cottage has been neglected and needs extensive repairs. The wooden siding has started to rot, and the abandoned metallic flagpole is flaking due to corrosion. In addition, the plastic around the south-facing windows has turned yellow in the sun.

a) How could Ian's grandfather have delayed the degradation of the wooden siding? Suggest two means of protection.

degradation = wear down of metal, plastic + wood

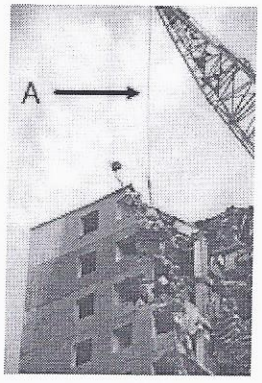
b) How could Ian's grandfather have delayed the degradation of the metal flagpole? Suggest two means of protection.

Treated wood with water resistant coating + anti fungal coatings

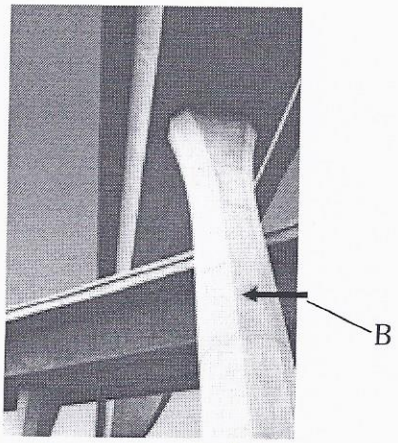
c) What could have been added to the plastic during manufacture to make the material more sun-resistant?

Pigments to absorb UV rays

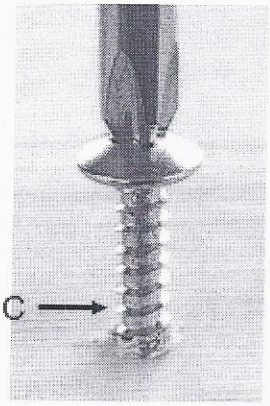
13. Depending on how they are used, technical objects are likely to be subjected to stress. Name the constraint at work in the part of the object indicated in the photos below.



Tension

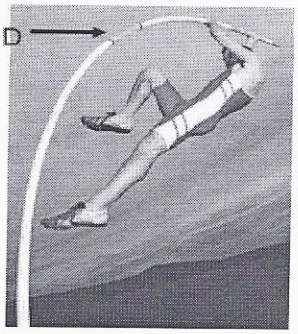


Compression



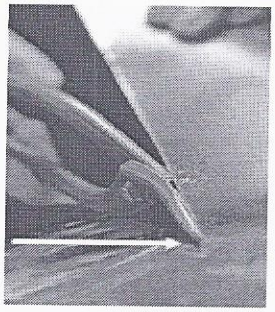
Torsion

D



deflection

E



Shearing

14. Identify the category of material used to make the following objects. Choose from the following categories (each category may be used only once):
- wood and modified wood – metals and alloys
- plastics – ceramics – composites

a)	coins metals + alloys		d)	a soft-drink bottle plastic	
b)	a sheet of plywood wood + mod		e)	a bulletproof vest composite	
c)	a pane of glass ceramic				

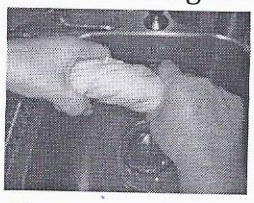
15. During an experiment, a student puts two iron nails in a beaker containing an aqueous solution. One of the two nails was previously coated in grease. Which of the two nails will take longer to rust? Explain your answer. The one coated with grease. Grease slows down reaction.

16. The photo opposite shows a handsaw, a tool often used to saw wood. The cutting part of this tool is made out of steel, while the handle is made of acrylonitrile.

a) Which category of material does the cutting part belong to? metal
b) Since ABS can be remoulded when heated, which subcategory of plastics does this material belong to? thermoplastic
c) When the saw is used, the blade sometimes bends and then returns to its original shape. Which constraint is this part being subjected to and which mechanical property allows it to return to its original shape? blade - deflection property = elasticity
d) One of the important features of the handle is that it is difficult to deform permanently. Which mechanical property does the handle exhibit?

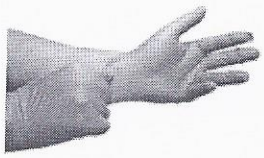
stiffness

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

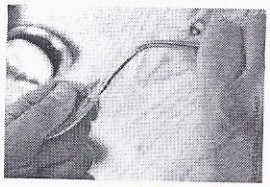


Torsion

Compression



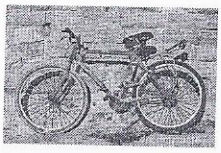
Tension



deflection

18. What am I? Indicate the property described in each of the statements below:
a) I enable a material to resist being crushed stiffness / resilient
b) I allow a material to return 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) I allow a material to stay intact when being stretched ductility

19. The image shows a rusted bicycle:
a) Explain why the materials of the bike have changed.



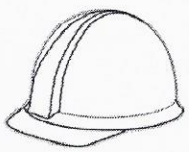
It was scratched & metal began to rust due to air, salt + water
b) How could the problem have been avoided?
Repaint right away.

20. What am I? Associate each of the following with the appropriate materials:
I have been made from a mineral ore in the ground metal + alloys
I am used for my good thermal and electrical conductivity, my ductility and malleability metals+alloys
I can be used to make fences metal/wood/plastic
I am an alloy made from carbon and iron ferrous metal

21. Why is it better to have a ceramic floor in a bathroom or kitchen instead of a wooden floor? Does not ruin from water. Very hard so will not scratch.

22. Patio furniture is usually made of coated aluminum and not wood.
a) Name one advantage of using aluminum instead of wood for outdoor furniture:
Will not degrade from insects.
b) What property explains why an aluminum chair in the sun will be hotter to touch than a wooden one in the same spot? Conducts heat

23. What mechanical properties should materials for a hard-hat have? Explain your answer.



hard, resilient & stiff.