

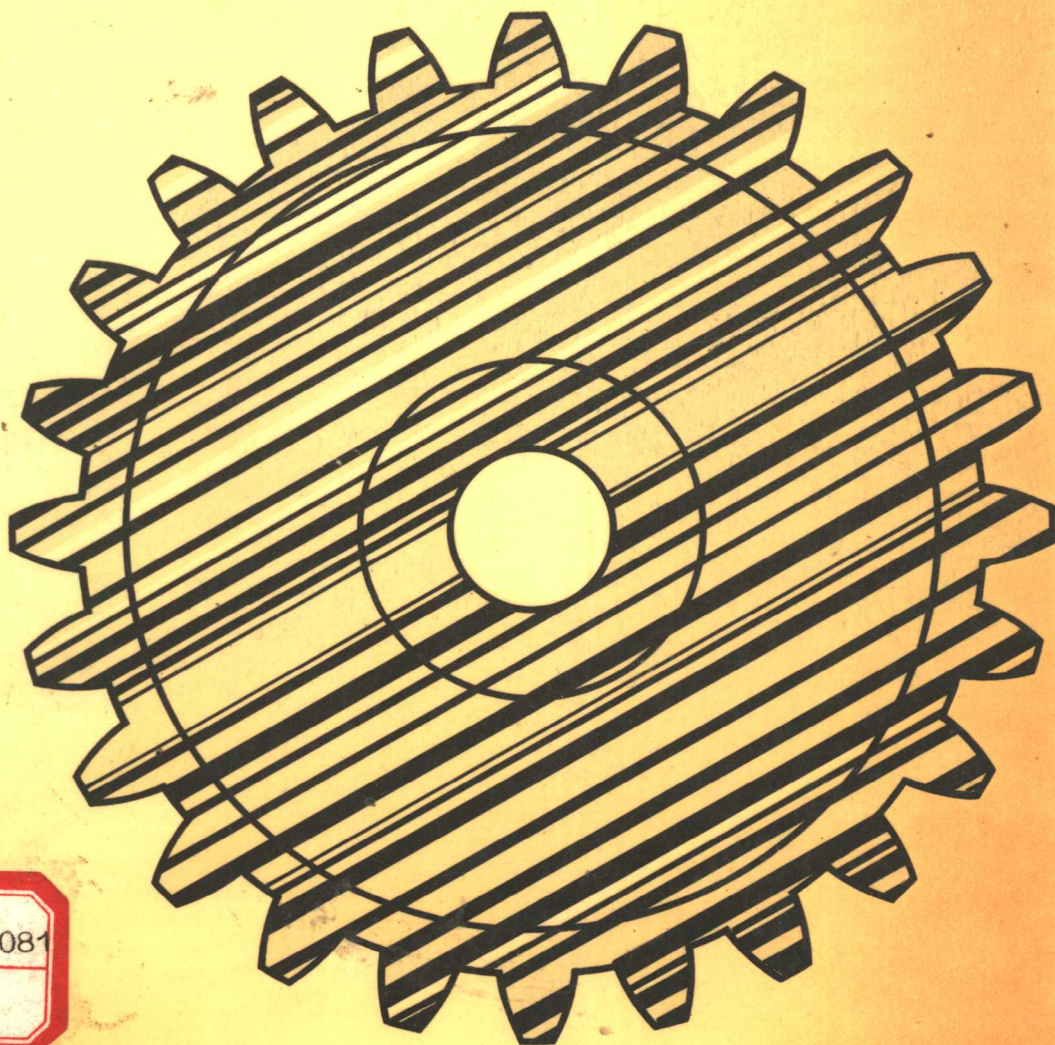
NUCLEUS

English for Science and Technology



ENGINEERING

Tony Dudley-Evans/Tim Smart/John Wall



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NUCLEUS

ENGLISH FOR SCIENCE AND TECHNOLOGY ENGINEERING

**Tony Dudley-Evans
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We wish to thank Roger Timings for his invaluable help with the engineering text and illustrations and suggestions for suitable topics; Donald Adamson for his very helpful comments on the exercises; Fred Cooper for his constructive advice and Lynda Ballantine who made a marvellous job of the typing.

T.D.E., T.S. and J.W.

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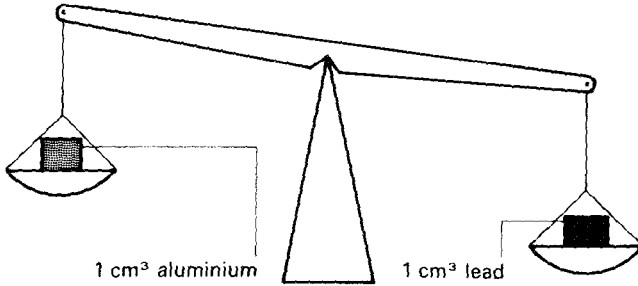
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Unit 1 Properties

Section 1 Presentation

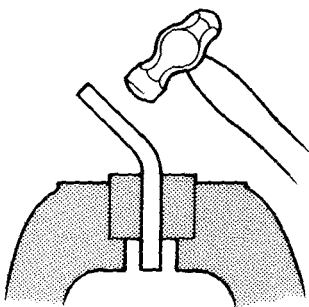
1. Look and read:

Here are some properties of materials which are important in engineering:

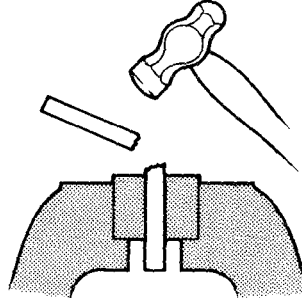


a *light* material
(it has low mass)

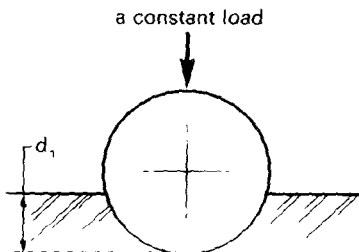
a *heavy* material
(it has high mass)



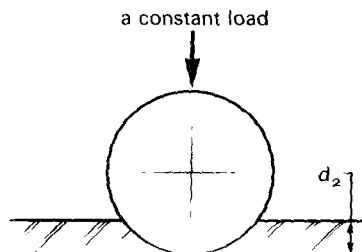
a *tough* material
(it does not break easily)



a *brittle* material
(it breaks easily)

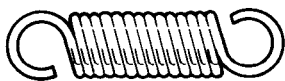


a *soft* material
(it can be dented or scratched easily)



$$d_1 > d_2$$

a *hard* material
(it cannot be dented or scratched easily)



spring

an *elastic* material

(it returns to its original shape when the deforming force is removed)

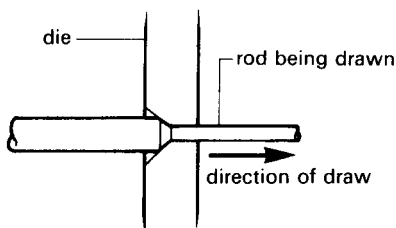


coin

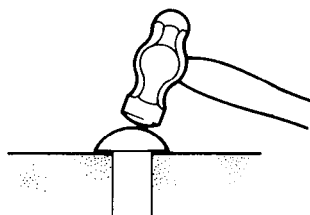
a *plastic* material

(it does not return to its original shape when the deforming force is removed)

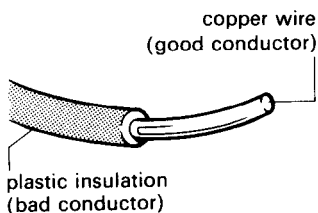
Plastic materials can be divided into two different groups, malleable and ductile materials.



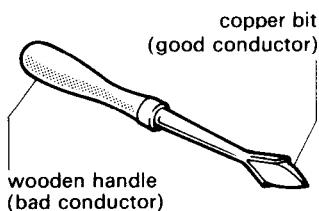
a *ductile* material
(it can be stretched)



a *malleable* material
(it can be hammered into shape)



a *good conductor of electricity*
a *bad conductor of electricity*



a *good conductor of heat*
a *bad conductor of heat*



unprotected
mild steel
corrodes
(goes rusty)
easily



polished
stainless
steel does
not go rusty

corrosion resistant
not corrosion resistant

Look at this table and the example:

In this table properties of materials are graded on a scale from A (maximum) to E (minimum): e.g. the property of heaviness is graded from very heavy (A) to very light (E).

Example: Copper is very heavy.

Nylon and rubber are very light.

Cast iron is heavy, but lighter than copper.

Glass is lighter than copper and cast iron, but heavier than aluminium.

Aluminium is light, but it is heavier than nylon and rubber.

	Copper	Aluminium	Cast iron	Glass	Nylon	Rubber
Heavy (A) — light (E)	A	D	B	C	E	E
Tough (A) — brittle (E)			D			
Hard (A) — soft (E)						E
A good conductor of electricity (A) — a bad conductor of electricity (E)		B				
A good conductor of heat (A) — a bad conductor of heat (E)						

Now complete the table with information from these sentences:

Copper is the toughest of the materials.

Aluminium, nylon and rubber are tough, but less tough than copper.

Cast iron is much more brittle than these materials but less brittle than glass.

Rubber is a very soft material.

Glass is a very hard material.

Cast iron is a hard material but it is not as hard as glass.

Nylon is harder than rubber.

Copper and aluminium are softer than cast iron and glass but harder than nylon and rubber.

Glass, nylon and rubber are very poor conductors of electricity and heat.

Copper, aluminium and cast iron are good conductors of electricity and heat, but copper is a better conductor than aluminium, and aluminium is a better conductor than cast iron.

2. Look at this sentence:

Glass is light compared with copper but heavy compared with nylon.

Now make similar true sentences from this table:

Copper Aluminium Cast iron Glass Nylon Rubber	is	light heavy brittle tough soft hard a good conductor of electricity a bad conductor of electricity a good conductor of heat a bad conductor of heat	compared with	copper aluminium cast iron glass nylon rubber
--	----	--	---------------	--

but	heavy light tough brittle hard soft a bad conductor of electricity a good conductor of electricity a bad conductor of heat a good conductor of heat	compared with	copper. aluminium. cast iron. glass. nylon. rubber.
-----	--	---------------	--

3. Look at this table:

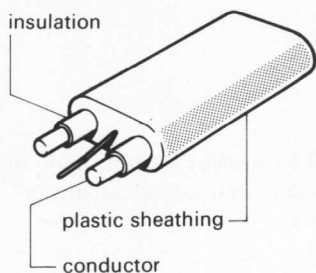
	Copper	Aluminium	Cast iron	Glass	Nylon	Rubber
Elastic (A) — plastic (E)	D	D	D	B	C	A
Ductile (A) — not ductile (E)	A	B	E	E	E	E
Malleable (A) — not malleable (E)	A	A	D	E	E	E

Now say whether the following statements are true or false. Correct the false statements. Some statements refer to the table on page 7.

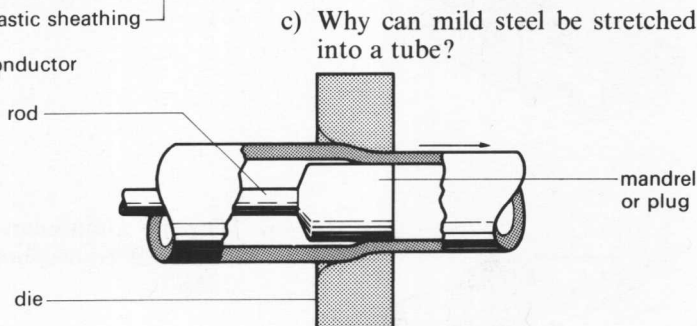
- Rubber is more elastic than nylon.
- Glass is not a malleable material.
- Copper is not very ductile.
- Aluminium is a ductile material but it is less ductile than copper.
- Copper is a very elastic material.
- Cast iron is very malleable.

- g) Nylon is more malleable than cast iron.
- h) Cast iron is heavier than copper.
- i) Nylon is harder than rubber.
- j) Cast iron is a better conductor of electricity and heat than aluminium.

4. Answer the following questions:

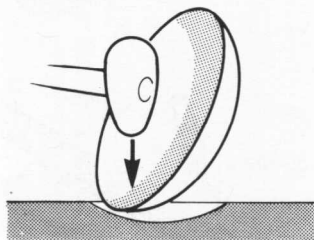


- a) Why is copper used for electrical wire?
- b) Why is plastic used to insulate electrical wire?

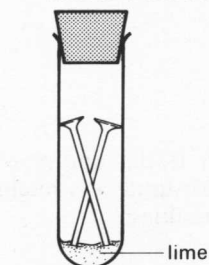


- c) Why can mild steel be stretched into a tube?

- d) Why can silver (Ag) be hammered into shape?



- e) Why does steel need to be protected from moist air?



polished nails in dry air will not rust



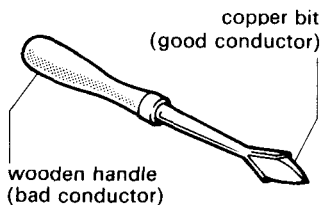
polished nails in air free (boiled) water will not rust



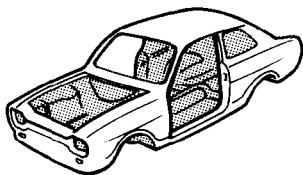
polished nails in water containing air will rust



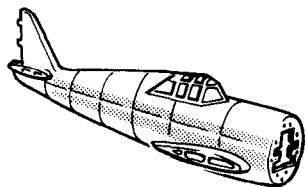
f) Why does a car spring keep its shape?



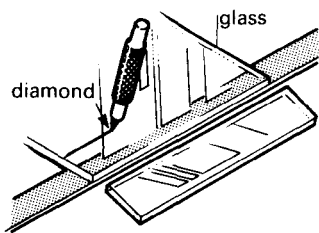
g) Why does this soldering iron have a wooden handle and a copper bit?



h) Why are car bodies made of steel sheets and not glass sheets?



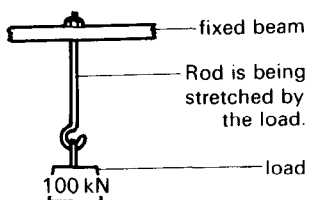
i) Why are aluminium alloys used in aircraft bodies, but not copper alloys?



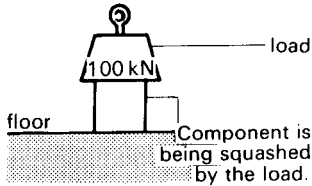
j) Why are diamonds used to cut glass?

Section 2 Development

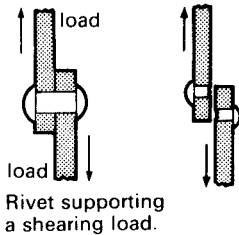
5. Look and read:



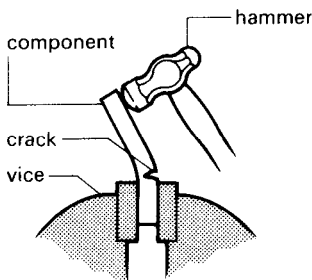
Tensile strength is the ability of a material to withstand a stretching load without breaking.



Compressive strength is the ability of a material to withstand a compressive load without breaking.

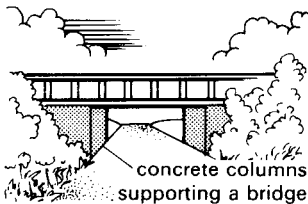


Shear strength is the ability of a material to withstand a shearing load.

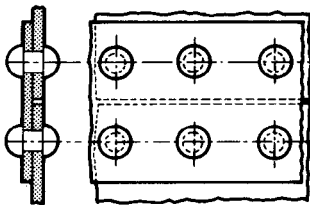


Impact strength (toughness) is the ability of a material to withstand an impact load.

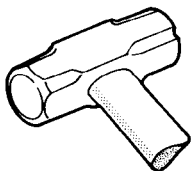
Now complete these using the terms introduced above:



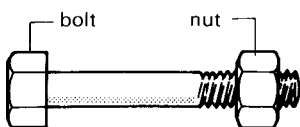
a) Concrete is used for columns which support heavy loads because it has high ____ strength.



b) Rivets are made of metal which has high ____ ____.



- c) The head of a hammer is made of a metal which has high ____.



- d) Nuts and bolts are made of metal which has high ____.

6. Read the following definition:

A material which changes shape under load and returns to its original shape $\left\{ \begin{array}{l} \text{possesses} \\ \text{has} \\ \text{exhibits} \end{array} \right\}$ the property of *elasticity*.

Now make sentences from this table:

A material	which changes shape	under a compressive load	possesses has exhibits	the property of	malleability. plasticity. ductility.
		under a tensile load			
	which exhibits plasticity	under load and keeps its new shape			

Now answer these questions:

- What property does rubber possess?
- When a metal bar is drawn into a rod, what property does it exhibit?
- When the head of a rivet is hammered into shape, what property does it exhibit?
- When gold (Au) is hammered, does it exhibit elasticity or plasticity?

7. Read these definitions:

Hardness is the ability to withstand scratching or indentation.

Corrosion resistance is the ability to resist chemical or electro-chemical attack.

A material which allows electricity to pass possesses *electrical conductivity*.

A material which melts easily has *high fusibility*.

A material which melts at a very high temperature has *low fusibility*.
A light material has *low density*. A heavy material has *high density*.

Now say whether the following statements are true or false. Correct the false statements.

- a) A compression spring possesses ductility.
- b) Aluminium has low resistance to corrosion by moist air.
- c) Metals with a low shear strength may be cut easily.
- d) Coins are not made with materials which possess elasticity.
- e) Solder has low fusibility.
- f) Plastics are used to insulate electrical wire because it has high thermal conductivity.
- g) Metals which are used in air frame parts have a low density.

8. What is the most important property needed by each of the following?

- | | |
|-------------------|--------------------------------------|
| a) a table leg | e) a railway line |
| b) a car radiator | f) a chisel |
| c) a fire brick | g) a battery terminal |
| d) a rivet | h) the cables on a suspension bridge |

Section 3 Reading

9. Read this passage:

Ferrous metals

Ferrous metals contain iron (Fe). One kind of ferrous metal is cast iron. It has high compressive strength, and is easy to cast, because it has high fluidity and relatively high fusibility. However, it has low malleability and a relatively low tensile strength.

Wrought iron has greater toughness than cast iron. It is very malleable and ductile. It has relatively high corrosion resistance. It is often used for the chains of anchors and cranes.

Mild steel is more often used in industry because it has a lower cost and a slightly higher strength than wrought iron. It has high malleability and ductility. It can be easily worked when it is cold and when it is hot. It has many uses, including the production of car bodies, rods and bars, nuts and bolts etc.

Now answer these questions:

- a) Which is the most important element which is common to all ferrous metals?
- b) Why are motor cycle cylinders made of cast iron?
- c) Why are chains not made of cast iron?
- d) Why are anchor chains made of wrought iron?
- e) Why is mild steel commonly used in industry?
- f) Why can mild steel be used for car bodies?
- g) Why is mild steel used for rods and bars?

Section 4 Listening

10. Read the following statements then listen to the passage and number the statements in the order in which you hear them:

- a) Lead is very heavy.
- b) Aluminium possesses high ductility.
- c) Zinc possesses resistance to atmospheric corrosion.
- d) Copper is a good conductor of electricity.
- e) Aluminium is very malleable.
- f) Lead cannot withstand a heavy tensile load.
- g) Zinc is a non-ferrous metal.
- h) Aluminium is a light metal.
- i) Zinc is soft.
- j) Lead possesses relatively high fusibility.

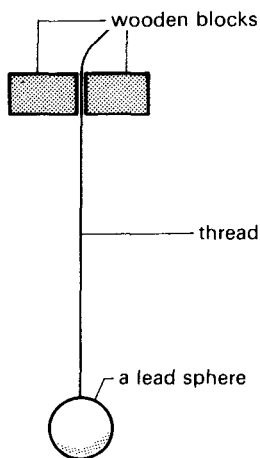
11. Answer these questions:

- a) Why is copper used for a soldering iron bit?
- b) Why does solder contain lead?
- c) Why are steel sheets sometimes covered with zinc?
- d) Which has higher tensile strength, aluminium or copper?
- e) Which is heavier, lead or zinc?
- f) Which has a higher melting point, lead or zinc?

Unit 2 Location

Section 1 Presentation

1. Look and read:



A simple pendulum

The wooden blocks are *at the top of* the pendulum.

The lead sphere is *at the bottom of* the pendulum.

The thread is *between* the wooden blocks.

The wooden blocks are *opposite* each other.

The wooden blocks are *on either side of* the thread.

The thread is *held in place by* the wooden blocks.

The wooden blocks are *over* the lead sphere.

The lead sphere is *under* the wooden blocks.

The lead sphere is *at the end of* the thread.

Now ask and answer questions like the following:

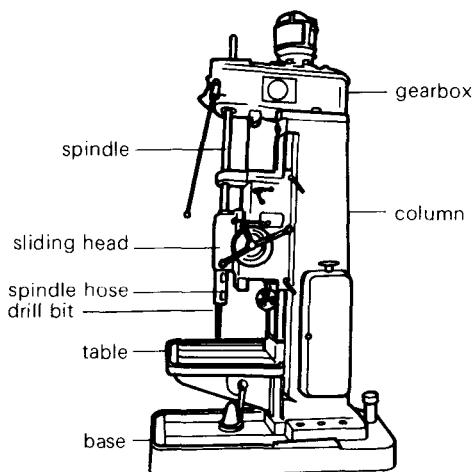
Where are the wooden blocks located?

At the top of the pendulum *or* on either side of the thread etc.

What is at the end of the thread?

A lead sphere.

2. Now look at this diagram:



Column type drilling machine

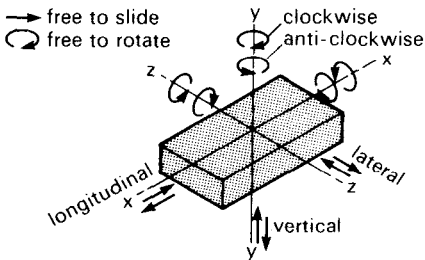
Note the use of *in alignment with*.

Example: The drill bit must be *in alignment with* the centre of the hole in the workpiece.

Complete these sentences:

- The gearbox is the drill.
- The base is the drill.
- The table is the drill and the drill bit.
- The drill bit must be with the spindle.
- The drill bit is by the spindle nose.
- The column is the gearbox and the base.
- The spindle nose is the spindle.

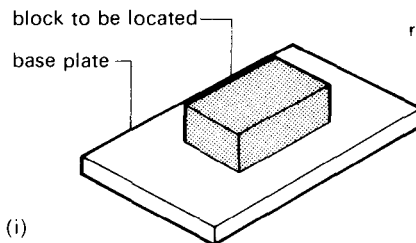
3. Read this:



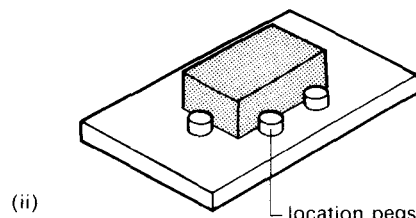
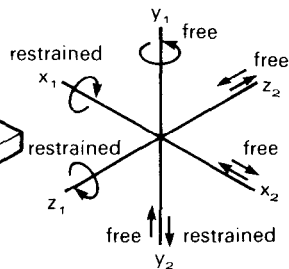
The body in the diagram can be moved *longitudinally* (back and forth), *laterally* (from side to side) and *in the vertical plane* (up and down). The body is thus *free to slide* along the X, Y, Z axes (plural of axis). The body is also *free to rotate* clockwise and anti-clockwise about the X, Y, Z axes.

When a body is worked upon, it is held in place by restraining its movement. The diagram below shows how these restraints are built up.

Six degrees of freedom



(i)



(ii)

Restraints

