


DESIGN & TECHNOLOGY DEPARTMENT

GCSE PRODUCT DESIGN
 Year 11 Revision
Materials & components:
New materials

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 ENGAGE TASK

QUESTION	ANSWER
1. Hardwoods come from coniferous trees.	
2. Softwoods generally grow quicker than a hardwood.	
3. Manufactured boards come from deciduous or broadleaved trees	
4. MDF is a hardwood	
5. Balsa wood is a hardwood	
6. Oak is a hardwood	
7. Pine is a softwood	
8. Spruce is a hardwood	
9. Hardwoods are generally harder than softwoods	
10. Manufactured boards are made by gluing layers or wood fibres together	

LEARNING OBJECTIVE
 To understand requirements of the exam in the material area: New materials

EXPLORE	ENHANCE	EXCEL
<ul style="list-style-type: none"> To list a variety of smart and modern materials. 	<ul style="list-style-type: none"> To describe a variety of smart and modern materials and their applications. 	<ul style="list-style-type: none"> To evaluate products made from smart and modern materials justifying the benefit of using those materials.
Grade range E - G	Grade range: C/D	Grade range A* - B

Lesson journey:
 The lesson is split into three main areas:
 1. Modern materials
 2. Smart materials
 3. Nanomaterials

You will write notes and complete activities on these areas.

You will then sit a short exam question.

Challenge yourself

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MODERN MATERIALS

Developed in the last 50 years.
 Many consist of a mixture of materials and can be classed as **composite** materials.

Key words:
Composite material – materials made from two or more different materials, each materials still retains its own identity

TASK:
 Put a sub-heading 'Modern materials' and write a short definition.

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MODERN MATERIALS

GORE-TEX TECHNOLOGY

DIRTY WATER
DIRTY AIR
DIRTY PARTICLES
DIRTY OIL
DIRTY DIRT
DIRTY GRASS
DIRTY SAND

FUNCTIONAL FABRIC
PROTECTIVE MATERIAL
GORE-TEX MEMBRANE
SPECIAL INNER LAYER

TASK:
Read through the worksheet. It shows the properties of some common **modern materials**. From the list below match the name of the modern material to the description:

Precious metal clay (PMC)
Maplex
Fibre Optics
Kevlar
Waterproof and breathable fabrics e.g. Gore-tex
Polycaprolactone (PCL), known as Polymorph

Using the pictures on the left, write down some common examples of where these materials are used.

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CASE STUDY

Corn starch polymer

- is used to replace oil-based thermoplastics in packaging.
- It is made from high starch vegetables including potatoes, corn and maize.
- It is *biodegradable* and environmentally friendly.

TASK:
Write up a brief case study on corn starch polymer:
1. Copy the notes from above.
2. Explain two different reasons why the material is environmentally friendly.

Key words:
Biodegradable – something that will decay over time.

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SMART MATERIALS

These materials respond to a **change** in their environment.

TASK:
Put a sub-heading 'Smart materials' and write a short definition.

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COLOUR CHANGING MATERIALS

Thermochromic materials
Change colour in response to **HEAT**


Photochromic materials
Change colour in response to **LIGHT**

Indoor: Clear indoors
Midlight: Medium degree of grey (brown) on a slightly cloudy day
Outdoor: Dark grey (brown) outdoors

Photochromic Umbrella: Photochromic material that changes color in response to light. Not suitable for use in direct sunlight.


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LIGHT EMITTING MATERIALS 

Electroluminescent materials


Produce **LIGHT** in response to a **CURRENT**



<https://www.youtube.com/watch?v=FoVfT4bn3pE>


Fluorescent materials

Produce **LIGHT** when exposed to **UV rays**



Phosphorescent materials

Produce **LIGHT** when exposed to **LIGHT** when the light has been removed.




What is the difference between the terms 'phosphorescence' and 'fluorescence' ?

The atoms of a fluorescent material become 'excited' when they absorb energy, for example, from a UV light. When the UV light is turned off, the atoms return to their normal state very quickly. They give off the energy they absorbed as intense light, over a very short duration of time.

On the other hand, phosphorescence materials, also absorb natural light / artificial light. However, they emit the absorbed light very slowly, often over several hours, at a low intensity.


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MOVING MATERIALS 

Piezoelectric materials


Transfer **MECHANICAL** energy into **ELECTRIC** energy and vice versa.



<https://www.youtube.com/watch?v=Uu1iSqwCT0>

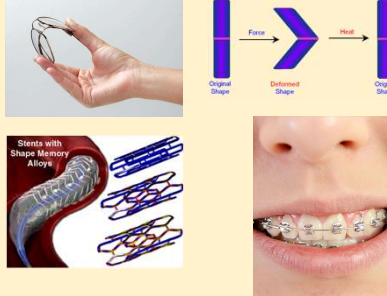
QTCs – Quantum tunnelling composites

Flexible polymer which contains tiny metal particles. It is normally an **insulator** but if it is squeezed it becomes a **conductor**.




Shape memory alloys

Shaped when cool. Can return to original shape with heat.



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Smart materials task 

TASK:
Produce a short case study on a product made from a smart materials. Glue in the picture and produce a case study that:

- States what the smart material is.
- States how the smart material works.
- Explains what benefits using the smart materials has given the product.

Complete one example with your teacher and then choose at least one additional example of your choice.



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FUTURE OF SMART MATERIALS 

Active Disassembly (AD) is a developing technology which is associated with the term **Active Disassembly using Smart Materials (ADSM)**.



Recover components cost-effectively using Active Disassembly

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NANOMATERIALS

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Nanomaterials Have Useful Properties

Nanoparticles of a material often have **different properties** from the 'normal' material — that's why nanomaterials can be very useful. They're used to make products such as:

- 1) **Self-cleaning glass** for windows — the glass has a coating of nanoparticles that cause dirt to break down so it can be easily washed off by rainwater.
- 2) **Self-cleaning fabrics** — fabric is **coated** with nanoparticles that will **resist and break down** dirt and stains.
- 3) **Antibacterial fabrics** — by attaching nanoparticles of **silver** to fabrics they can kill bacteria. These fabrics have lots of **medical** uses, e.g. face masks and dressings. They can also be used to make anti-bacterial **toys** and **odour-free socks**.

When incorporated into fabrics the nanoparticles are so small that they **don't change the feel** of the fabric (unlike conventional finishes, see page 47).

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Exam questions

TASK:
Complete the short exam question. You have 5 minutes.

1 MARK = 1 MINUTE
5 MARKS = 5 MINUTES

EXTENSION TASK:
Describe the benefits of active disassembly using smart materials.

A*	A	B	C	D	E	F	G
93%	88%	74%	62%	50%	39%	28%	17%
5	-	-	4	3	2	1	-

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Plenary

Learning check

1. Go back to the checklist at the front of your books **Materials and Components**. Tick through what you feel you have learned in this sections.
2. **Topic summary**
 - In your book put the heading 'topic summary' and write down a list of things that you would like to revise. It would be a good idea to include a list of key words.
 - This will become a useful list to check back on and ensure that you know what these things are.