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General Revision
Materials (Woods)

What is required from you by the exam board.
• To know about different types of wood
• Be aware of the characteristics of different types of wood
• Be able to visually identify a number of wood types.

Hardwoods

<table>
<thead>
<tr>
<th>Name</th>
<th>Properties and working features</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beech</td>
<td>Close grained, hard wearing and strong. Finishes Well</td>
<td>Furniture, toys, kitchen utensils.</td>
</tr>
<tr>
<td>Oak</td>
<td>Tough and durable. Finishes well but stains in contact with steel.</td>
<td>Furniture, garden furniture</td>
</tr>
<tr>
<td>Ash</td>
<td>Tough and Flexible – can be bent if steamed. Open grained.</td>
<td>Tool handles, laminating, sports equipment.</td>
</tr>
<tr>
<td>Mahogany</td>
<td>Durable and easy to work.</td>
<td>Outdoor furniture, shop fittings, veneers.</td>
</tr>
<tr>
<td>Teak</td>
<td>Strong and durable. Resistant to moisture. Colour darkens when exposed to light.</td>
<td>Outdoor furniture, boats, science laboratories.</td>
</tr>
</tbody>
</table>
## Softwoods

<table>
<thead>
<tr>
<th>Name</th>
<th>Properties and working features</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine</td>
<td>Easy to work, relatively cheap and readily available. May contain knots, which weaken the wood.</td>
<td>Mainly building frames and construction. Needs protection if used outdoors.</td>
</tr>
<tr>
<td>Cedar</td>
<td>Light in weight but not very strong, expensive, durable against moisture due to natural oils.</td>
<td>Outdoor buildings, external wood panelling.</td>
</tr>
</tbody>
</table>

## Manufactured Boards

<table>
<thead>
<tr>
<th>Name</th>
<th>Manufacturing Process</th>
<th>Properties and working features</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plywood</td>
<td>Veneers glued together with each layer having a grain at right angles to the previous one. There are always an odd number of layers.</td>
<td>Flat, stable boards with constant strength and thickness. Interior and exterior varieties are available.</td>
<td>Furniture, toys.</td>
</tr>
<tr>
<td>Chipboard</td>
<td>Thousands of tiny chips of timber are mixed with glue and compressed into sheets.</td>
<td>A cheap board that is difficult to join and is not very strong. Easily damaged by moisture. Edges are easily damaged and need some form of protection.</td>
<td>Often in kitchens when a protective, decorative surface has been added.</td>
</tr>
<tr>
<td>MDF</td>
<td>Tint particles of timber are glued together and then compressed with a resin adhesive to produce large, dense solid boards.</td>
<td>A solid and stable board that has a wide range of uses and can be produced economically. Easily damaged</td>
<td></td>
</tr>
</tbody>
</table>
Exam Questions – Materials – HARDWOODS

1. Describe in as much detail as you can, the properties of Beech. (2 marks)

2. Give 3 uses for Ash? (3 marks)

3. Describe the properties of Oak? (2 marks)

   • Match the uses A, B, C and D with the woods 1-4 in the table. Enter the appropriate number in the boxes provided.

   A  An outdoor table
   B  A child's toy
   C  A hockey stick
   D  A indoor dining table

<table>
<thead>
<tr>
<th>Wood</th>
<th>Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ash</td>
</tr>
<tr>
<td>2</td>
<td>Mahogany</td>
</tr>
<tr>
<td>3</td>
<td>Teak</td>
</tr>
<tr>
<td>4</td>
<td>Beech</td>
</tr>
</tbody>
</table>

5. (a) Why are thin layers of hardwood often glued onto manufactured board such as chipboard and MDF? (3 marks)

6. What is the name given to this technique? (1 mark)
1. Match the uses A, B, C and D with the woods in the table

<table>
<thead>
<tr>
<th>Wood</th>
<th>Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cedar</td>
<td>1</td>
</tr>
<tr>
<td>Pine</td>
<td>2</td>
</tr>
<tr>
<td>Yew</td>
<td>3</td>
</tr>
<tr>
<td>Parana Pine</td>
<td>4</td>
</tr>
</tbody>
</table>

A  An indoor shelf
B  A Fence
C  Kitchen cupboards
D  A staircase

(4 marks)

2. Which of the following properties make cedar a good timber to choose for the timber cladding of buildings? Tick two options.

A  It has a beautiful deep reddish-brown colour
B  Its available in large sheets
C  Its much cheaper than softwood
D  Its unlikely to warp
E  It resists insect and fungal attacks

(2 marks)
Exam Questions – Materials – MANUFACTURED BOARDS

1. What does MDF stand for?

2. Circle the correct options in the following sentences.
   a) Plywood/Chipboard is a manufactured board made from waste materials.
   b) Plywood/Chipboard is a manufactured board made from veneers.

3. Give three advantages of using manufactured boards.

4. Give three disadvantages of using manufactured boards.

5. Give two uses for chipboard.
General Revision

Materials (Metals)

Terminology

**Strength:** Withstand force without breaking or bending permanently

**Work hardness:** The ability to be easily pressed, spread and hammered into shapes.

**Elasticity:** The ability to regain its original shape after it has been deformed.

**Hardness:** Resistance to scratching, cutting, denting and wear

**Malleability:** The ability of a material to be reshaped in all directions without cracking.

There are two basic types of metal: **ferrous** and **non-ferrous**.

**Ferrous metals** contain iron and small amounts of other metals or elements, which are added to produce alloys with different properties. Almost all ferrous metals are magnetic. One major disadvantage of many ferrous metals is that they rust and therefore protective coatings need to be added, such as paint, galvanising. Stainless steel is one form of a ferrous alloy that is widely available and has anti-corrosion properties.

**Non-Ferrous** metals contain no iron and therefore do not rust like ferrous metals and many do not require a protective coating. This makes them very useful for jobs where the metal might come into contact with moisture. Some non-ferrous metals can be expensive and most have very versatile characteristics. They are used in a wide range of products from the containers to electrical equipment.

<table>
<thead>
<tr>
<th>Name</th>
<th>Properties</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ferrous Metals (contain metal)</td>
<td>Ductile</td>
<td>General structural work. Nuts and bolts</td>
</tr>
<tr>
<td></td>
<td>Relatively inexpensive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quantity production</td>
<td></td>
</tr>
<tr>
<td>Cast Iron</td>
<td>Strong</td>
<td>Car drum brakes</td>
</tr>
<tr>
<td></td>
<td>Resistant to wear</td>
<td></td>
</tr>
<tr>
<td>Non-Ferrous metals (do not contain iron)</td>
<td>Corrosion resistant</td>
<td>Car bodies</td>
</tr>
<tr>
<td></td>
<td>Good strength to weight ratio</td>
<td>Cookware</td>
</tr>
<tr>
<td>Copper</td>
<td>Good conductor of heat and electricity</td>
<td>Plumbing fitting Electrical equipment</td>
</tr>
</tbody>
</table>
Alloys

**Alloy:** Combination of two or more metals.

Combining pure metals to produce alloys has become increasingly important in the production of more sophisticated metals required by the aeronautical, oil and space industries. Two or more metals are combined to produce a new type of metal that often has unique characteristics to meet specific demands.

<table>
<thead>
<tr>
<th>Name</th>
<th>Properties</th>
<th>Composition</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brass</td>
<td>Heavy, quite hard and gold in colour.</td>
<td>Copper 65%</td>
<td>Taps and valves</td>
</tr>
<tr>
<td></td>
<td>Easily machined and joined by soldering.</td>
<td>Zinc 35%</td>
<td>Garden ornaments</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bronze</td>
<td>Reddish-Yellow, harder than Brass, corrosion resistant.</td>
<td>Copper 80-90%</td>
<td>Bearings and gears,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tin, aluminium or</td>
<td>Architectural fittings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nickel in different</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>percentages.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Titanium</td>
<td>It has a low density and is a strong. It is</td>
<td>Titanium can be alloyed with</td>
<td>Aerospace (jet</td>
</tr>
<tr>
<td></td>
<td>corrosion resistant. It is a silver colour.</td>
<td>iron, aluminium,</td>
<td>engines, missiles, and spacecraft),</td>
</tr>
<tr>
<td></td>
<td>It has the highest strength-to-weight ratio of</td>
<td>vanadium, molybdenum,</td>
<td>military, prostheses, dental</td>
</tr>
<tr>
<td></td>
<td>any metal.</td>
<td></td>
<td>instruments and files, sporting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>equipment.</td>
</tr>
</tbody>
</table>
Exam Questions – Materials – METALS

1. Match descriptions A, B, C, D, E and F with the properties 1-6 in the table. Enter the appropriate number in the boxes provided.
   A  The ability to regain its original shape after it has been deformed.
   B  Resistance to scratching, cutting, denting and wear
   C  The ability to be easily pressed, spread and hammered into shapes.
   D  Withstand force without breaking or bending permanently
   E  The ability of a material to be reshaped in all directions without cracking.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1   Hardness</td>
<td></td>
</tr>
<tr>
<td>2   Malleability</td>
<td></td>
</tr>
<tr>
<td>3   Strength</td>
<td></td>
</tr>
<tr>
<td>4   Elasticity</td>
<td></td>
</tr>
<tr>
<td>5   Work hardness</td>
<td></td>
</tr>
</tbody>
</table>

2. What metal would be used for car brakes and why? (2 marks)

3. What is the difference between ferrous and non-ferrous metals? (2 marks)

4. What metal would you use for plumbing and electrical equipment and why? (2 marks)

5. What is an alloy? (1 mark)

6. Why does the aeronautical industry use titanium for jet engines? (2 marks)
General Revision

Materials (Plastics)

Plastics mainly come from crude oil. Chemical engineers are able to mix several chemicals to produce plastic materials with almost any of the characteristics that manufacturers require. There are several types of plastic, often with complex chemical names, but many also have common names, for example, PVC, acrylic. To make them easier to identify, plastics are divided into two families: thermoplastics and thermosetting plastics.

There are two main groups of plastics: thermoplastics and thermosetting plastics.

Thermoplastics
This is the most commonly used plastic because it can be reshaped when reheated. Thermoplastics are heated during manufacture, and heated again to shape them.

Advantages of using thermoplastics:
- Soften when heated
- Recyclable
- Comes in a variety of colours
- Safe for children
- Relatively cheap
- Can be used in a variety of different processes e.g. vacuum forming, injection moulding, blow moulding.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Working Name</th>
<th>Characteristics</th>
<th>Common Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>PET</td>
<td>Polyethylene terephthalate</td>
<td>Moderate chemical resistance, mainly used in transparent form</td>
<td>Bottles for drinks, Food containers</td>
</tr>
<tr>
<td>HDPE</td>
<td>High density polyethylene</td>
<td>Strong and stiff with excellent chemical resistance. Another popular plastic that is easily coloured with an excellent finish</td>
<td>Crates, bowls, Buckets and pipes</td>
</tr>
</tbody>
</table>
## Thermoplastics cont.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Working Name</th>
<th>Characteristics</th>
<th>Common Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC</td>
<td>Polyvinyl chloride</td>
<td>Good chemical and weather Resistance. Available in a Number of forms with Different properties.</td>
<td>Pipes, guttering, window frames, Bottles, Flexible hoses, cable insulation.</td>
</tr>
<tr>
<td>LDPE</td>
<td>Lower density polyethylene</td>
<td>Tough and flexible with good chemical resistance. A Popular plastic that is easily coloured and gives a very smooth finish.</td>
<td>Detergent and shampoo bottle, toys, carrier bags And transparent packaging</td>
</tr>
<tr>
<td>PP</td>
<td>Poly propylene</td>
<td>Lightweight, food safe with excellent chemical resistance. Good electrical insulator</td>
<td>Food containers, string, rope, medical equipment, kitchenware</td>
</tr>
<tr>
<td>HIPS</td>
<td>High impact polystyrene</td>
<td>Good stiffness and impact resistance. Lightweight</td>
<td>Toys, refrigerator linings</td>
</tr>
<tr>
<td>Acrylic</td>
<td>Acrylic</td>
<td>Tough, can be machined, but can be brittle, readily available and food safe</td>
<td>Light units, shop signs, car parts</td>
</tr>
<tr>
<td>Nylon</td>
<td>Nylon</td>
<td>Hard, tough and resistant to wear. Low friction</td>
<td>Bearings, gears and clothing.</td>
</tr>
<tr>
<td>ABS</td>
<td>Acrylonitrile butadiene styrene</td>
<td>High impact strength, lightweight, durable and scratch resistant</td>
<td>Kitchen Products, mobile phone cases, toys and safety helmets.</td>
</tr>
</tbody>
</table>
**Thermosetting Plastics**
The chemical polymers that make up these types of plastics **bond permanently when heated and set hard as they cool**. They cannot be reheated and are usually formed into products by heating powder in shaped moulds. Many of these plastics are selected for their hardness and resistance to chemicals, oils and common solvents, but they end to be more expensive.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Characteristics</th>
<th>Common Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoxy resins</td>
<td>Good chemical and wear resistance, high strength when reinforced, adhesive to many surfaces</td>
<td>Surface coatings, adhesives (Araldite)</td>
</tr>
<tr>
<td>Melamine formaldehyde</td>
<td>Rigid, good strength and hardness; scratch resistant and can be coloured</td>
<td>Laminates for work surfaces, tableware</td>
</tr>
<tr>
<td>Phenol formaldehyde</td>
<td>Very good heat resistance but very dark, hard and quite brittle</td>
<td>Saucepan handles and cheap electrical fittings</td>
</tr>
<tr>
<td>Urea formaldehyde</td>
<td>Rigid, brittle, good strength, Heat resistant and a good electrical insulator</td>
<td>Adhesives, electrical fittings such as light switches, plugs, etc.</td>
</tr>
</tbody>
</table>
Exam Questions – Materials – Plastics

1. Circle the correct options in the following sentences.
   a) Plastics that can be re-softened by heating are: **thermosetting plastics /thermoplastics**
   b) Plastics that can't be re-softened by heating are **thermosetting plastics /thermoplastics**: (1 mark each)

2. Match the descriptions A, B, C and D with the properties 1-4 in the table.

   A Different plastics differ greatly in colour
   B Plastics vary from weak to very strong
   C Some plastics are much easier to work with than others
   D Some plastics can be recovered at ‘end of life’

<table>
<thead>
<tr>
<th>Properties</th>
<th>Letter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workability</td>
<td>1</td>
</tr>
<tr>
<td>Can be recycled</td>
<td>2</td>
</tr>
<tr>
<td>Appearance</td>
<td>3</td>
</tr>
<tr>
<td>Structural Strength</td>
<td>4</td>
</tr>
</tbody>
</table>

   (1 mark each)

3. What do the following acronyms stand for?
   a) HDPE: 
   b) PP: 
   c) HIPS: 
   d) PVC: 

   (1 mark each)

4. What is low-density polythene used for? Tick the two correct options.
   A Milk crates  
   B Carrier bags  
   C Windows  
   D 'Squeezy' detergent bottles

5. What property of nylon makes it suitable to use for making clothing? Tick the correct option.
   A It doesn't rust  
   B It's resistant to wear and tear  
   C It's a weak fabric  
   D It's very strong
## Thermoplastics

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Characteristics</th>
<th>Common Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenol formaldehyde</td>
<td>Very good heat resistance but very dark, hard and quite brittle</td>
<td>Adhesives, electrical fittings such as light switches, plugs, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melamine formaldehyde</td>
<td>Rigid, good strength and hardness; scratch resistant and can be coloured.</td>
<td></td>
</tr>
</tbody>
</table>
A composite material is produced when two or more materials are combined. This gives you a material with improved properties.

**GRP (glass-reinforced plastic)**
GRP consists of strands of glass fibres that have been coated in polyester resin. It is used in the manufacture of boat hulls (Photo A) and 'kit cars' (Photo B).

![Photo A](image)

![Photo B](image)

**Carbon Fibre reinforced Plastic**
Carbon Fibre reinforced Plastic is a similar material to GRP. It consists of strands of carbon that have been coated in polyester resin. It is used in the manufacture of high-performance products such as racing bikes (Photo C) and tennis rackets (Photo D).

![Photo C](image)

![Photo D](image)

**Kevlar**
Kevlar is a similar material to carbon fibre matting. It consists of strands of a very strong plastic material that is woven to form a mat. It is used for body armour (Photo E), such as the bullet-proof vests and face masks that are used by the army and the knife-proof vests that are used by the police.

![Photo E](image)
Exam Questions – Materials – Composites

1. Circle the correct words from the options given to complete the following sentences.
   a) Resin that has been reinforced by the addition of strands of spun glass fibres is known as reinforced polyester I concrete.
   b) Cement mixed with water; sand and aggregate, which has been reinforced by the addition of steel bars, is known as reinforced polyester I concrete.

(1 mark each)

2. What is GRP used for? Tick the two correct options. (1 mark each)
   A Building car bodies
   B Construction of bridges
   C Construction of buildings
   D Construction of boat hulls

3. What is reinforced concrete used for? Tick the two correct options. (1 mark each)
   A Building car bodies
   B Construction of bridges
   C Construction of buildings
   D Construction of boat hulls

4. What is Kevlar used for? Tick the two correct options. (1 mark each)
   A Protective equipment
   B Body armour
   C Marine environments outdoors
   D Situations requiring very long life
General Revision
Materials – Smart Materials and Modern Materials

Smart and Modern Materials
Smart materials are materials that have a reactive capability. This means that their physical properties change when they are influenced by something else.

Polymorph
Polymorph comes in the form of plastic granules. It has the reactive capacity to change from a solid to mouldable state when heated. When warm water (60°C) is applied to the plastic granules they melt and can then be moulded into shape. You can change the shape by reheating it, using warm water or even a hairdryer. It is particularly useful for producing models of ergonomically designed handles.

Thermochromic Pigments
A thermochromic pigment can be added to a plastic before it is moulded into shape. It has the reactive capacity to change colour as its temperature changes. The plastic product will then change colour as its temperature changes when it is being used. Designers and manufacturers have used this technology in several everyday products. Russell Hobbs make a kettle that changes colour as it boils. Tommy Tippee produce a range of baby feeding products that change colour to warn you if the baby’s food is too hot.

Shape Memory Alloys
Shape memory alloys have the reactive capability to change their shape when heated. Nitinol is a smart wire that changes length when heat is applied to it. You may have already had some in your mouth! If you have ever had a brace fitted to your teeth, the chances are that it was made from Nitinol. Your body heat attempted to shorten the wire, which then pulled your teeth back into shape.

Memoflex spectacles are made from a shape memory alloy and have the ability to return to their original shape even when they have been very badly bent.
1. Explain what a Smart material is? (1 mark)

2. Name two examples of Smart Materials? (2 marks)

3. At what temperature does Polymorph melt at? (1 mark)

4. Give me two examples of products that use Thermochromic Pigments. (2 marks)

5. Name two examples of Shape Memory alloys?

6. Circle the correct answer.
   a) Nitinol/Memoflex is used for braces.
   b) Nitinol/Memoflex is used for glasses.
Exam Questions – Materials

This question is about materials.

Study the products shown below.

Name one suitable, specific material that has been used to make each product. Give one reason for each choice.

Product A

Material: (1 mark)

Reason: (1 mark)

Product B

Material: (1 mark)

Reason: (1 mark)

Product C

Material: (1 mark)

Reason: (1 mark)
Sustainability of Materials

Plastics and metals use the earth's resources in their production. If these materials are not reused or recycled, the planet will run out of them. There is a limited amount of the ores (rocks or minerals) that make metals, and a limited amount of oil from which most plastics are made. If trees are not replanted as quickly as they are felled, we will run out of timber. A material is said to be sustainable if it can be replaced continuously, or if it can be recycled or reused indefinitely.

In the life cycle of a product, the materials need to be:
• harvested from forests (timber) or extracted from the ground (oil and ore)
• transported to a place of processing
• transported to a place of manufacture
• transported to the consumer
• transported to a place of disposal, reuse or recycling.

Each of these stages can use huge amounts of energy, causing pollution. One way to reduce the consumption of energy is to process materials and manufacture products close to the source of the material.

The Diagrams A, B and C show the life cycle of materials, and the possibilities for making them sustainable.

The Life Cycle of Wood
Sustainability of Materials

The Life Cycle of Metals

The Life Cycle of Plastics

Exam Question

1. Discuss the sustainability issues of producing and using products from wood.

(8 marks)