

1.13 Contexts which inform outcomes

Mechanical Properties

Elements of a material that resist deformation from external forces and loads

Physical Properties

Elements of a material that can be defined and measured, such as colour, size or weight.

Exam Tip: It is vital that you apply your knowledge and understanding of materials when answering questions about designing products and you should always be able to justify your choices, where appropriate. Why have you selected that material what benefits does it offer through its properties?

Different materials share the same mechanical property, common properties for different materials include Durability and Toughness. The 3 main properties for the materials covered are listed below.

Timbers	Textiles	Metals	Polymers	Papers and Boards
<p>Durability - Withstanding deterioration over time, wear and tear. Examples: Timber that is dried and kept dry is durable such as Beech Oak Mahogany and Pine. Used for products such as toys and construction that will need to last for a long time.</p>	<p>Durable fabrics resist wear and tear, withstanding repeated use, washing and abrasion. Examples: polyester, nylon and leather</p>	<p>Hardness is the ability to withstand cutting and abrasion. A very hard metal is likely to crack or shatter upon impact or force. Example: Cast iron would be described as hard but brittle.</p>	<p>Toughness is the ability to absorb energy and not fracture A tough material may scratch easily on the surface but can withstand large impacts. Examples; Riot shields are tough, they are not hard as they won't shatter.</p>	<p>Flexibility refers to how easily a material will bend or flex (opposite of stiffness). The flexibility of a material is easily compared or tested.</p>
<p>Hardness – ability to resist deformation, indentation or penetration. Cutting and scratching. Certain timbers are harder than others such as Oak is harder than Balsa.</p>	<p>Resilient fibres and materials will spring back into shape following a deforming or compressive force Resilient materials are springy and crease resistant. Resilience refers to a materials ability to resist deforming and compression forces, whereas durability refers to a material's ability to resist wear</p>	<p>Ductile will stretch without being damaged. Can be drawn or stretched out into long wires. Example: Copper is highly ductile and can be drawn into long, thin wires.</p>	<p>Electrical insulators - do not conduct electricity. Thermosetting plastics are used in electrical equipment as they are stable at high temperatures; if circuits warm up during use, they hold shape. Example: urea formaldehyde</p>	<p>Printability refers to a material's ability to accept print, inks or paints. The printable surface is sized so that it is less absorbent, so the ink dries on the surface as opposed to sinking into the paper. The result is brighter, richer, deeper colours</p>
<p>Toughness - Absorption of energy through shock before splitting. Example: Cedar is a tough wood it can be hit with a hammer and it may dent but will not break easily. It is shock resistant</p>	<p>Elasticity measures how much a material will stretch and return to its original shape. All materials have an elastic limit a point at which a material is stretched so much that it does not return to its original shape</p>	<p>Malleable metals can be hammered into a shape without breaking. Can be rolled or pressed into sheets easily but will deform if compressed. Example: Aluminium can be rolled into sheers for foil.</p>	<p>Thermal insulation refers to a materials ability to limit heat transfer; good thermal insulators maintain a given temperature (hot or cold).</p>	<p>Biodegradable materials typically originate from plant or animal sources and require microbes to decompose or rot. Pulp-based and absorbent materials are broken down faster than synthetic.</p>

Additional examples of properties that you will need to know are listed below.

Mechanical Properties

Elements of a material that resist deformation from external forces and loads

Strength – Ability to withstand force. *Example;* by resisting squashing (compression) or stretching (tension)

Plasticity – Ability to permanently deform without breaking when subjected to a force.

Brittleness – Inability to withstand sudden stress or shocks (the opposite to toughness)

Stability – Ability to resist changes in shape over time. (Wood may not be stable if it gets damp as it will start to twist and warp)

Stiffness – Ability to resist bending

Physical Properties

Elements of a material that can be defined and measured, such as colour, size or weight.

Density – Compactness of a material, defined as mass per unit volume. MDF has a medium density of fibres that form its structure.

Size – The dimensions of the material. Materials might come in stock forms or specific shapes and sizes.

Corrosion – Metal is eaten away as it reacts with oxygen and water in the air. Ferrous and non ferrous metals either rust or oxidise which are forms of corrosion. *Example;* Rust is formed through the corrosion of iron or steel so occurs in ferrous metals.

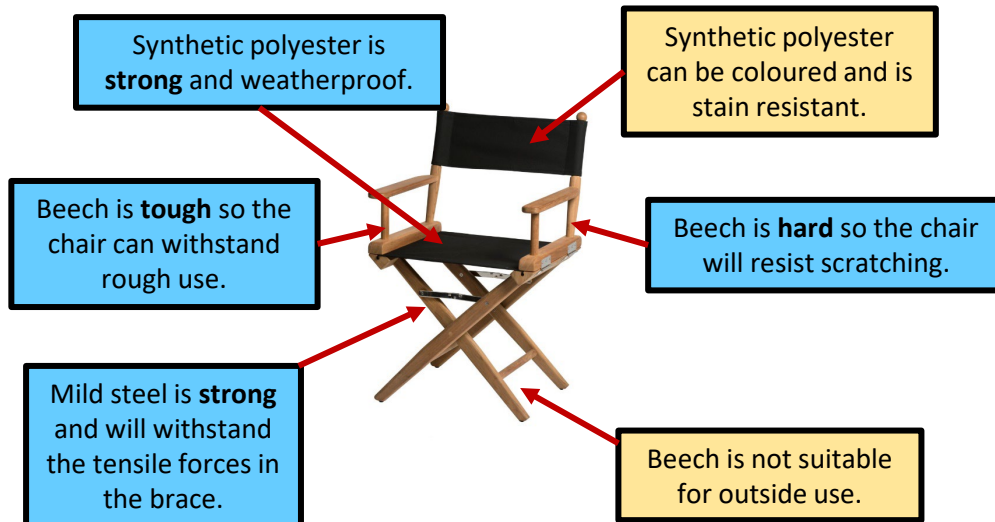
Aesthetics – The appearance of a material. *Example;* Oak and Mahogany both have attractive grains

Optical – Ability to absorb or reflect light.

Joining – Ability to be joined to other materials.

Magnetism – Attraction to magnetic material.

Examples:



Printability

Folding boxboard makes an excellent printing surface

Lightweight

Rigid polystyrene is lightweight, water resistant and rigid

Stiffness

Folding boxboard has excellent creasing abilities to create a rigid box shape

Malleability

Rigid polystyrene can be easily vacuum formed into shape.

