GCSE DESIGN & TECHNOLOGY

REVISION WORKBOOK

AUTHENTIC EDUCATION

SECTION A ONLY

This booklet is to prepare you for your GCSE Design and Technology exam. SECTION A

It will help you:

- Understand key Design and Technology topics
- Learn important words and ideas

About the Exam

In the exam:

Section A – You must answer **ALL questions**

Section B – You answer **ONE question only**

Our Specialism which is - Natural and Manufactured Timbers

2024 Paper

📘 **QUESTION 1 — Design and Technology and Our World**

This question is about how Design and Technology affects the world around us.

It focuses on sustainability, consumer demand, and how products change over time.

Knowledge Organiser- Design and Technology and our World

🌎 1. New and Emerging Technologies – Their Impact

New and emerging technologies are new ideas, materials, systems or machines that change how products are designed and made.

They affect:

- **Industry** – how factories make products
- **Enterprise** – new businesses and jobs
- **People** – how we live and work
- **Culture & Society** – trends, lifestyles, expectations
- **The Environment** – pollution, waste, sustainability
- **Production techniques** – CAD, CAM, automation
- **Systems** – smart systems, electronics, digital control

🏭 Industry, Enterprise & Consumer Demand

Market Pull

- Products are made because customers want them
- Example: reusable bottles due to environmental concerns

Technology Push

- New materials or machines allow new products to be made
- Example: carbon fibre, 3D printing

Consumer Choice

- Consumers want the latest and best technology
- Influenced by trends, social media, fashion

🔄 The Product Life Cycle

Shows how a product changes over time.

1.Introduction – product launched
2.Growth – sales increase
3.Maturity – sales peak
4.Decline – sales fall

➡️ **Fad products** have a **short life cycle**

🌐 Global Production

Products made in different countries can:

- Reduce costs
- Create jobs
- Cause poor working conditions
- Affect local cultures

⚖️ Legislation & Consumer Rights

Why laws are needed

- Keep products **safe**
- Protect the **consumer**
- Protect the **environment**

Consumer Rights

Products must be:

- Safe
- Fit for purpose
- Good quality

⚠️ Moral & Ethical Issues

Designers must think about:

- Child labour
- Fair pay
- Working conditions
- Environmental damage
- Honesty in advertising

♻️ Sustainability

Sustainability means:

Meeting today's needs without harming the future.

The Six R's

- Rethink
- Reuse
- Recycle
- Repair
- Reduce
- Refuse

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Knowledge Organiser- Design and Technology and our World

💻 CAD – Computer Aided Design

Advantages

✓ Accurate designs
✓ Easy to edit
✓ Save time

Disadvantages

✕ Expensive software
✕ Needs training
✕ Less hands-on skills

🏭 CAM – Computer Aided Manufacture

What CAM is

Using machines controlled by computers to make products.

Examples

- CNC embroidery
- Vinyl cutting
- CNC routing
- Laser cutting
- 3D printing

Advantages

✓ High accuracy
✓ Fast production
✓ Consistent quality

Disadvantages

✕ Expensive machines
✕ Less jobs for workers
✕ Needs skilled operators

🔋 Energy Generation & Storage

Non-Renewable Energy

- Coal
- Oil
- Gas
- Nuclear

❌ Causes pollution
❌ Will run out

Renewable Energy

- Wind
- Solar
- Hydroelectric
- Biomass
- Wave

✓ Sustainable
✓ Cleaner for the environment

Energy in Products

- **Vehicles:** petrol, diesel, electric
- **Household products:** batteries, solar, mains electricity
- **Manufacturing:** solar panels, wind turbines

🧠 Key Words to Remember

Market pull
Technology push
Sustainability
CAD/CAM
Product life cycle
Renewable
Non-renewable
Ethics
Legislation
Consumer rights

📘 QUESTION 1 — Design and Technology and Our World

1. Market Pull
Explain what is meant by *market pull*.

2. Technology Push
Explain what is meant by *technology push*.

3. Fad products
What is a Fad product? Explain its life cycle using a diagram

4. CAD or CAM
State one advantage of using CAD or CAM in manufacturing and explain why it is useful.

5. The Six R's of Sustainability
Name the six R's of sustainability and explain one of them.

6. Renewable Energy
Explain one reason why renewable energy is better for the environment than fossil fuels.

📘 QUESTION 2 — Smart, Composite and Technical Materials

This question is about how different modern materials are used to design and make products.

It focuses on: **Smart materials, Composite materials and Technical textiles**

Knowledge Organiser – Smart, Composite and Technical Materials

🧱 Why Materials Matter

The design and manufacture of products depends on the materials used.

Designers must understand:

- New materials
- Smart materials
- Composite materials
- Technical textiles

These materials can:

- Improve performance
- Increase safety
- Make products lighter, stronger or more comfortable

💡 Electroluminescent Materials

Give off light when electricity passes through them

Used in:

- Displays
- Signs
- Backlit panels

🤖 Smart Materials

Smart materials change when their environment changes.

They respond to:

- Heat
- Light
- Pressure
- Movement
- Electricity

Examples of Smart Materials

Thermochromic

- Changes colour when heated
- Example: colour-changing mugs or kettles

Photochromic

- Changes colour in sunlight
- Example: transition lenses in glasses

Shape Memory Alloy (SMA)

- Can return to its original shape when heated
- Example: bendable glasses frames

Polymorph

- Becomes soft in hot water
- Can be shaped and then hardens when cooled

Quantum Tunnelling Composite (QTC)

- Changes electrical resistance when pressed
- Used in switches and pressure sensors

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Knowledge Organiser – Smart, Composite and Technical Materials

🧵 Smart Fibres & Fabrics

These materials react to the environment or the body.

Examples

Micro-encapsulation – releases chemicals (e.g. fragrance or heat)

Biometrics – measure body data (heart rate, movement)

Phase-changing materials – help control body temperature

Used in:

- Sportswear
- Outdoor clothing
- Medical clothing

🧶 Technical Textiles

Technical textiles are fabrics designed for a **job**, not fashion.

Examples of Technical Textiles

Microfibres

- Very fine fibres
- Lightweight
- Used in sports clothing

Sun-protective clothing

- Blocks UV rays
- Protects skin

Nomex

Fire-resistant fabric

Used in:

- Firefighter clothing
- Racing suits

Geotextiles

- Used in landscaping and construction
- Helps prevent erosion

Rhovyl

- Antibacterial fibre
- Used in medical and hygiene products

🧩 Composite Materials

Composite materials are made from **two or more materials combined**.

They are designed to:

- Be strong
- Be lightweight
- Improve performance

Examples of Composite Materials

Carbon Fibre

- Very strong and very light
- Used in bikes, cars and sports equipment

Kevlar

- Very tough
- Used in helmets and protective clothing

GRP (Glass Reinforced Plastic)

- Plastic reinforced with glass fibres
- Used in boats and car panels

🧠 Interactive & Electronic Textiles

These fabrics can act like **electronic devices**.

They can:

- Sense movement
- Measure heart rate
- Track location

Examples:

- Smart clothing
- Wearable technology
- GPS tracking in fabric

🧠 Key Words to Remember

Smart material		
Composite	SMA	GRP
Technical textile	Microfibres	Biometrics
Thermochromic	Carbon fibre	Phase-changing
Photochromic	Kevlar	Nomex

📘 QUESTION 2 — Smart, Composite and Technical Materials

1. Smart Materials
Explain what is meant by a *smart material*.

2. Thermochromic or Photochromic
Explain how a thermochromic or photochromic material works and give one example of where it is used.

3. Composite Materials
Explain what a *composite material* is and name one example.

4. Carbon Fibre, Kevlar or GRP
State one property of carbon fibre, Kevlar or GRP and explain why this property is useful in a product.

5. Technical Textiles
Explain what is meant by a *technical textile* and give one example of where it is used.
.

6. Modern Materials in Products
Explain one reason why designers use modern or smart materials in products.

📘 QUESTION 3 — Electronic Systems, Programmable Components and Mechanical Devices

This question is about how products use electronics, programmable components and mechanical parts to work.

It focuses on: It focuses on: **Mechanical devices, Electronic systems, Programmable components**

Knowledge Organiser- Electronic Systems

🔌 Why Electronic Systems Are Important

Many everyday products use **electronic systems** to work properly.
Designers use electronic and programmable components to:

- Make products **safer**
- Make products **automatic**
- Improve **control and accuracy**
- Allow products to **respond to users and the environment**

🔁 The Systems Approach

Most electronic systems follow the same pattern:

Input → Process → Output

- **Input** – information goes into the system
- **Process** – the information is decided or changed
- **Output** – something happens

Example

- Input: light sensor
- Process: control unit
- Output: LED turns on

🧠 Control Systems

A **control system** controls how a product works.
It uses:

- **Sensors** (inputs)
- **Control devices** (process)
- **Output components**

📥 Input Devices (Sensors)

Sensors detect changes in the environment.

Examples

LDR (Light Dependent Resistor)

- Detects light levels
- Used in automatic lights

Thermistor

- Detects temperature
- Used in kettles and heaters

Sensors can be:

- **Analogue** – gives a range of values
- **Digital** – on or off (0 or 1)

⚙️ Processing Devices

These decide what the system should do.

Examples

- **Integrated Circuit (IC)**
- **Microprocessor**
- **Microcontroller**
- **Computer**

They receive input data and send instructions to outputs.

📤 Output Devices

Outputs carry out an action.

Examples

- **LED** – gives light
- **Buzzer** – gives sound
- **Motor** – creates movement

🔄 Feedback

Feedback is information sent back to the system to help it adjust.

Why feedback is important

- Improves accuracy
- Makes systems safer
- Allows automatic control

Example

A thermostat turns heating on and off to keep a room at the right temperature.

📊 Communicating Electronic Systems

Designers use diagrams to explain systems.

Types of diagrams

- **Circuit diagrams** – show electronic components
- **Block diagrams** – show input, process and output
- **Flowcharts** – show steps in order

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Knowledge Organiser- Electronic Systems

💻 Programmable Components

A **programmable component** can be programmed to control a system.

Microcontrollers

A **microcontroller** is a small computer on a chip.

It can:

- Take inputs from sensors
- Process information
- Control outputs

Limitations of Microcontrollers

❌ Need programming skills

❌ Can fail if programmed incorrectly

Benefits of Microcontrollers

✓ Can be reprogrammed

✓ Small and low cost

✓ Very accurate

✓ Can control many outputs

🧠 Key Words to Remember

Input	Thermistor	Microcontroller
Process	Control system	PIC
Output	Feedback	Analogue
Sensor	Output device	Digital
LDR		

🧩 PIC (Programmable Interface Controller)

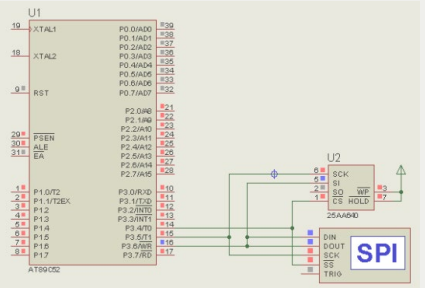
A **PIC** is a type of microcontroller.

It is used to:

- Control products
- Control systems
- Interface with other devices

Examples:

- Alarms
- Automatic lighting
- Motor control systems



🆚 Microprocessor vs Microcontroller

Both are used to **control electronic systems**, but they are used in different ways.

Microprocessor

- Acts as the **brain** of a computer
- Needs **other parts** to work (memory, input and output devices)
- Used in **complex systems**

Examples:

- Desktop computers
- Laptops
- Tablets

Key point:

👉 A microprocessor **needs external components** to work

Microcontroller

- A **small computer on one chip**
- Has **input, processing and output** built in
- Used in **everyday products**

Examples:

- Washing machines
- Traffic lights
- Electric bikes
- Microwaves

Key point:

👉 A microcontroller can **work on its own** inside a product.

📘 QUESTION 3 — Electronic Systems, Programmable Components and Mechanical Devices

1. The Systems Approach
Explain what is meant by *input, process and output*.

2. Sensors (Inputs)
State what a sensor is and name one example of a sensor used in products.

3. Output Devices
Name one output device and explain what it does in a product.

4. Feedback
Explain why feedback is important in a control system.

5. Microcontroller
Explain what a microcontroller is and give one product where it is used.
.

6. Microprocessor vs Microcontroller
State one difference between a microprocessor and a microcontroller.

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Knowledge Organiser- Mechanical Devises

⚙️ What are Mechanical Devices?

Mechanical devices are parts that **help products move, lift, turn or change direction**.

They are used to:

- Make work easier
- Change speed or direction
- Increase force
- Control movement

🔄 Types of Motion

Mechanical devices create different types of motion.

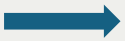
Types of Motion

Rotary – turning in a circle

- Example: wheels, gears

Linear – moving in a straight line

- Example: sliding door



Reciprocating – back and forth

- Example: piston

Oscillating – moving side to side

- Example: windscreen wipers

⚙️ Gears

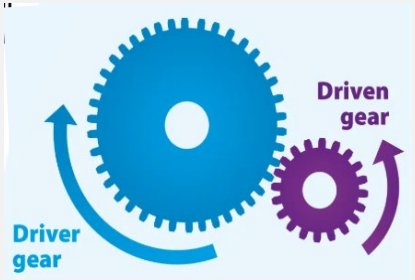
Gears are wheels with teeth that mesh together.

They are used to:

•Change **speed**

•Change **force**

•Change **direction** of rotation



🔁 Driver and Driven Gears

•**Driver gear** – the gear that turns first (input)

•**Driven gear** – the gear that is turned by the driver (output)

⚙️⚙️ Gear Trains

A **gear train** is **two or more gears working together**.

Used to:

- Transfer movement
- Change speed over a longer distance
- Change direction multiple times

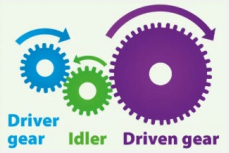
Idler Gear

A gear placed between driver and driven

Does NOT change speed or ratio

Used to:

- Change direction
- Space gears apart



📌 **Key point:**

An **idler gear does not affect the gear ratio**.

📐 Gear Ratio

Gear ratio compares the number of teeth on the gears.

Formula

Gear Ratio = Number of teeth on driven ÷ number of teeth on driver

Example

•Driver gear = 10 teeth

•Driven gear = 30 teeth

👉 Gear ratio = **3:1**

👉 Driven turns **once** for every **3 turns** of the driver

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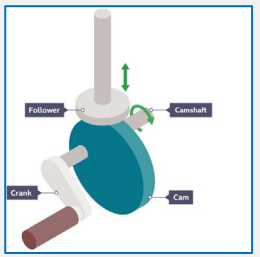
Knowledge Organiser- Mechanical Devises

🐎 Cams

A **cam** is a rotating shape that changes **rotary motion** into: **Reciprocating motion**



🦴 Followers

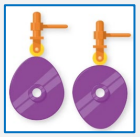
A **follower** rests on the cam and moves when the cam rotates.

Types of followers

•Flat follower

•Roller follower

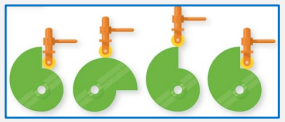
🔄 Types of Cams



Pear Cam

- Smooth rise and fall
- Used when gentle movement is needed

Snail Cam



- Slow rise, sudden drop
- Used in automata toys

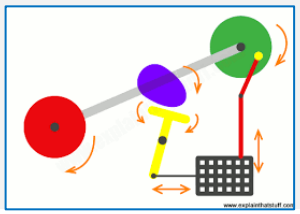
Eccentric Cam

- Off-centre circular cam
- Produces smooth reciprocating motion

🧸 Cams in Products

Used in:

- **Automata toys**
- Sewing machines
- Mechanical toys



🧰 What is a Lever?

A **lever** is a simple mechanical device that:

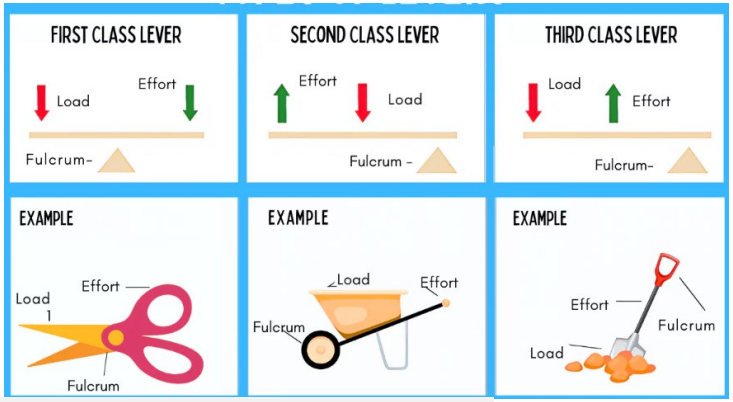
Helps move or lift a load

Changes the **size of a force**

Changes the **direction of movement**

A lever always has:

- **Pivot (fulcrum)** – the turning point
- **Effort** – the force applied
- **Load** – the object being moved

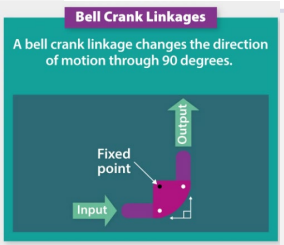


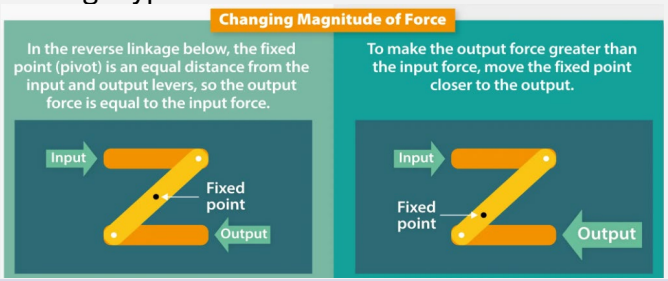
🔗 What are Linkages?

Linkages are systems of connected levers.

They are used to:

- Transfer movement
- Change direction
- Change type of movement





🧠 Key Words to Remember

Gear

Driver Driven

Gear train

Idler gear

Gear ratio

Speed

Force

Direction

Cam

Follower

Rotary

Reciprocating

Oscillating

📘 QUESTION 3 — Electronic Systems, Programmable Components and Mechanical Devices

1. Mechanical Devices
Explain what a mechanical device is.
(Think about movement, force or direction.)

2. Gears
Explain how gears can change the speed or direction of movement.

3. Gear Ratio
A driver gear has 10 teeth and the driven gear has 40 teeth.
Calculate how many times the driver must turn for the driven to turn once.

4. Cams and Followers
Explain what a cam and follower does and name one product where it is used.
.

5. Levers and Linkages
Explain how levers or linkages make work easier in everyday products.
.

6. Bell Crank Lever
What is the function of a bell crank lever?

📘 **QUESTION 4 — Materials**

This question is about **how different materials are chosen and used to make products**.

. This question focuses on. **Material properties, Timbers. Metals, Polymers, Papers and Textiles.**

Knowledge Organiser – Natural & Manufactured Timbers

🌳 Natural & Manufactured Timbers

Natural Timbers

Hardwoods – deciduous trees (e.g. oak, beech, mahogany)
Leaves fall off in autumn, winter.

Softwoods – coniferous trees (e.g. pine, spruce) Needles and cones, evergreen

Properties

- **Strength** resists forces without breaking
- **Grain structure** direction and pattern of fibres
- **Surface finish** smoothness and appearance
- **Absorbency** soaks up moisture
- **Durability** resists rot and wear
- **Ease of working** how easily it's shaped

Forms Available

Plank, board, strip, square, dowel

Timber Discriminators (Exam Term ✅)

Natural timbers can be identified using the following **discriminators**:

- **Colour** – light or dark appearance
- **Grain** – straight, wavy, open or closed
- **Texture** – smooth or rough feel
- **Weight** – density of the timber
- **Durability** – resistance to rot and moisture
- **Ease of working** – how easily it can be cut, shaped and finished

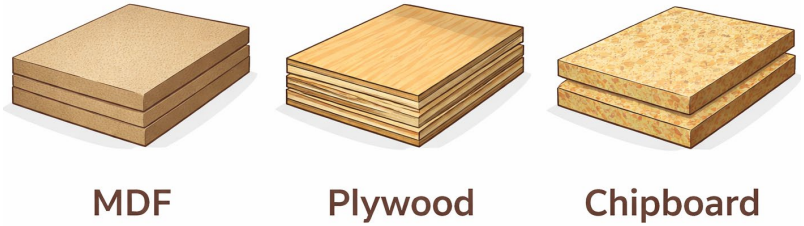
💡 **Exam tip**

"Discriminators are the features used to tell one timber apart from another."

Manufactured Timbers

Made from **particles, fibres, or layers**
Standard sizes and consistent quality
Types:

- Plywood
- MDF
- Chipboard
- Hardboard
- Veneered board



Finishes

- Oils, varnish, paint, lacquer
- Protect timber and improve appearance

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Knowledge Organiser – Metals and Polymers

🔩 Ferrous & Non-Ferrous Metals

Categories

- **Ferrous metals** – contain iron (can rust)
- **Non-ferrous metals** – no iron (do not rust)
- **Alloys** – mixture of metals (or metals + non-metals)

Properties

- **Hardness** – resistance to scratching and wear
- **Toughness** – ability to absorb impact energy
- **Elasticity** – returns to original shape
- **Ductility** – can be drawn into wire
- **Malleability** – can be hammered into shape
- **Tensile strength** – resistance to pulling forces
- **Conductivity** – ability to conduct heat/electricity

Forms Sold As

Sheet, bar, rod, tube, angle

Ferrous Metals

- Cast iron
- Mild steel (alloy)
- High carbon steel (alloy)
- Stainless Steel (alloy)

Non-Ferrous Metals

- Aluminium
- Copper
- Brass
- Bronze
- Pewter

Finishes

- Paint, powder coating, plating
- Prevent corrosion and improve aesthetics

🧪 Polymers (Plastics)

Categories

- **Thermoplastics** – can be reheated and reshaped
- **Thermosetting plastics** – permanently set after heating

Sources

Natural and synthetic resources

Forms

Sheet, film, bar, rod, tube

Properties

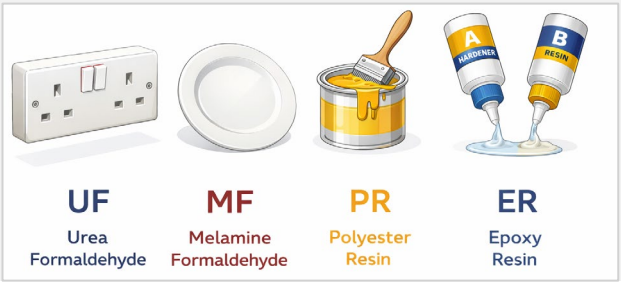
- **Lightweight** – low mass for its size
- **Hardness** – resists scratching and wear
- **Elasticity** – returns to original shape
- **Toughness** – withstands impact without breaking
- **Strength** – resists applied forces
- **Electrical insulation** – resists electrical current

Thermoplastics

- Acrylic
- Polythene (LDPE/HDPE)
- Polypropylene
- PVC

Thermosetting Plastics

- UF – urea formaldehyde
- MF – melamine formaldehyde
- PR – polyester resin
- ER – epoxy resin



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Knowledge Organiser – Textiles, Papers and Boards

🧶 Fibres & Textiles

Fibre Categories

Natural Synthetic Blended Mixed

Natural Fibres

- **Animal** – wool, cashmere, alpaca
- **Insect** – silk
- **Plant** – cotton, linen, hemp, jute, rayon, viscose

Synthetic Fibres

- Polyester, nylon, acrylic
- Elastane / Lycra
- Aramid fibres
- Microfibres (Tactel, Tencel/Lyocell)

Fabric Construction

- **Woven**
- **Knitted**
- **Non-woven**

Fibre Properties

- **Strength** – resists breaking under load
- **Elasticity** – stretches and returns shape
- **Absorbency** – ability to soak up liquids
- **Durability** – resists wear over time
- **Insulation** – traps air to retain heat
- **Flammability** – how easily it ignites
- **Water repellence** – resists water penetration
- **Anti-static** – reduces static electricity build-up
- **Resistance to chemicals and sunlight** – withstands chemicals and UV

Blending & Mixing

•Improves performance and usability

•Combines best properties of fibres

📄 Papers and Boards

Categories

- **Paper** – thin, flexible (e.g. copier paper)
- **Card** – thicker than paper (measured in *microns*)
- **Board** – thick, rigid (e.g. corrugated board)
- **Composite boards** – layered materials (e.g. corrugated card)

Key Properties

- **Strength** – resistance to tearing/crushing
- **Folding ability** – ability to crease without cracking
- **Surface finish** – smooth/rough, suitable for printing
- **Absorbency** – how much liquid/ink is absorbed

Key Knowledge

- **ISO paper sizes**: A0 → A6 (each size halves)
- **Grammage (gsm)** measures *weight*
- **Microns** measure *thickness*
- **Lamination** improves strength, finish, durability
- Often made using **recycled fibres**

Common Papers & Boards

- Layout paper, tracing paper, copier paper
- Cartridge paper, recycled paper
- Corrugated board, mounting board
- Folding boxboard (FBB)

📘 QUESTION 4 — Materials - Timbers. Metals, Polymers, Papers and Textiles.

1. Papers and Boards

What does **gsm** measure when selecting paper?

Explain two advantages of laminating card.

Name two properties of corrugated board that make it suitable for packaging

2. Timbers

State one difference between hardwoods and softwoods.

.

Give two discriminators natural timber can be identified.

.

Explain one advantage of MDF over natural timber.

📘 QUESTION 4 — Materials - Timbers. Metals, Polymers, Papers and Textiles.

3. Metals

What makes a metal ferrous?

Name two properties that make aluminium suitable for products.

Explain why alloys are used instead of pure metals.

2. Polymers

State one difference between thermoplastics and thermosetting plastics.

Name two thermoplastics and one of their properties.

Explain one use of epoxy resin based on its properties.

📘 QUESTION 4 — Materials - Timbers. Metals, Polymers, Papers and Textiles.

5. Textiles

Name three natural fibres from different sources.

Explain one benefit of blending fibres.

State one difference between woven and knitted fabrics.

Extension /Mixed materials

A food container is lightweight, waterproof and recyclable.
Suggest a suitable material and justify your choice

A school chair must be strong and durable.
Suggest one suitable material and explain why.
.

📘 QUESTION 5 — Product design

Question 5 is about understanding how the choice of material affects a product and the user.

It is not just about naming materials. It is about explaining **why a material is suitable**.

How to answer question 5

Choosing the Right Product (Very Important!)

Before you tick a product, **STOP and read the whole question first.**

Why this matters

You are **not marked** on which product you choose.

You are marked on **how well you answer the question**.

How to choose the best product

✓ Choose the product **you understand best**

✓ Choose the product where you can:

- Identify a clear **target market**
- Describe **problems** users might have
- Explain **materials and properties**

•Talk about **function, ergonomics and anthropometrics**

❌ Do NOT choose a product just because it looks interesting

❌ Do NOT choose a product you don't understand

Student Exam Strategy

1. **Read all parts of the question first**
2. Think: *"Which product can I talk about most confidently?"*
3. Choose the product that lets you answer **every part** of the question
4. Tick that product and stick with it

What you should always think about

When answering Question 5, think about how the material affects:

🔧 **Function** – how well the product works

🎨 **Aesthetics** – how the product looks

🖐️ **Ergonomics** – how comfortable and easy it is to use

📏 **Anthropometrics** – how well it fits the user's body

⚠️ **Ergonomics and anthropometrics come up almost every year.**

Even if the question does not say the words, you can still use them.

Function, Aesthetics, Ergonomics and Anthropometrics

🔧 Function

Function is **what the product does and how well it works.**

When talking about function, think about:

- Strength
- Durability
- Safety
- Reliability
- Does it do its job properly?

🎨 Aesthetics

Aesthetics is **how the product looks and feels.**

When talking about aesthetics, think about:

- Colour
- Texture
- Shape
- Surface finish
- How attractive it is to the user

Ergonomics – How easy it is to use

Ergonomics means **comfort and ease of use.**

Think about:

- Grip
- Weight
- Comfort in the hand
- User fatigue

Anthropometrics – How well it fits the user

Anthropometrics means **matching the product to the size of the user.**

Think about:

- Hand size
- Reach
- Age of the user
- Body dimensions

👥 Target Market

The **target market** is **the specific group of people the product is designed for.**

You can describe a target market using:

- Age (children, teenagers, adults)
- Skill level (beginner, experienced)
- Interests (sport, fashion, DIY, technology)
- Needs (comfort, safety, durability)

📘 QUESTION 5 — Function, Aesthetics, Ergonomics and Anthropometrics

1. What is aesthetics?

2. Explain the term Function

3. Why is ergonomics important when designing?

4. What anthropometric data would be needed when designing a desk and chair for an adult?

5. Why is it important to understand your target Market

6. Why are exploded drawing useful when assembling a product?