Eduqas GCSE D&T Revision Guide Year 10 Mock exams

Topics to revise

- Product Design – design considerations, reasons for material choice
- Sustainability
- Thermoplastics
- Timber
- CAD/CAM – laser cutter
- Finishing methods for Timber
- Finishing methods for plastics
- Mathematics in design - %, selling costs, total numbers of sales

Sustainability

- Sustainability is a huge subject
- It is about protecting and preserving what we have today so that life is easier tomorrow
- Sustainability is all about considering how we design and dispose of products we use in everyday life
- Designers and consumers should consider the 6R's

- **RETHINK:** Do we make too many products? Design in a way that considers people and the environment.
- **REFUSE:** Don't use a material or buy a product if you don't need it or if it's bad for people or the environment.
- **REDUCE:** Cut down the amount of material and energy you use as much as you can.
- **REUSE**: Use a product to make something else with all or parts of it.
- **RECYCLE**: Reprocess a material or product and make something else.
- **REPAIR**: When a product breaks down or doesn't work properly, fix it.

What are the big sustainability issues for designers?

1. Resource use

We use so much and so many materials. Many of the products we use daily use materials that are in scarce supply and are non-renewable. If everyone in the world used as many resources as we do in the UK, we'd need 3 planets to sustain us.

2. Climate change

Many products use a lot of energy to;

Process materials & produce
Transport
Use and dispose

The energy used throughout the product 'lifecycle' releases carbon dioxide, which contributes towards climate change.

3. Product disposal

When a product reaches the end of its use or life it has to be disposed of.

Designers should consider how a product can be taken apart to be recycled and therefore the materials could be reused or made into other products.

This is a choice that should be made when a designer is designing a product at the beginning of the Design Process.

This is extremely important where different materials are used to make products, as they need to be separated in order to be recycled, reused or reprocessed.

- THE DESIGNER HAS A RESPONSIBILITY TO DESIGN PRODUCTS USING SUSTAINABLE MATERIALS AND COMPONENTS.
- THEY MUST ALSO CONSIDER HOW THEY ARE GOING TO BE MADE AND WHAT THEY ARE GOING TO BE MADE FROM.
- PRODUCTS SHOULD ALSO BE DESIGNED SO THAT IF PARTS BREAK THEY CAN BE EASILY REPLACED. HOW THE PRODUCT IS DISPOSED OF SHOULD ALSO BE CONSIDERED.

- If products are DESIGNED and MANUFACTURED well, built to last and cheap to fix or REPAIR, they are also known as sustainable products.
- Sometimes the MANUFACTURER has to spend more money to make products from recycled materials.

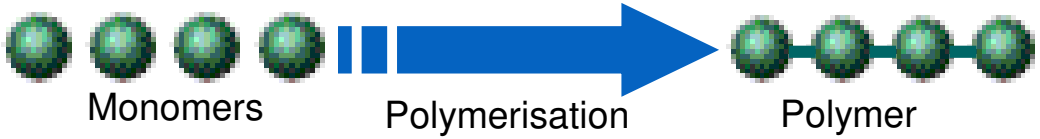
- What DESIGNERS and MANUFACTURERS need to do is design and make products so that the disposal of a product is delayed as long as possible. This is known as PRECYLCING.
- We the CONSUMER decide when to replace or stop using a product.
- As CONSUMERS we need to make decisions to buy or replace products we use. Technology and fashion trends also dictate a product's life span.
- **FINALLY IT'S ABOUT PROTECTING THE ENVIRONMENT**

Polymers

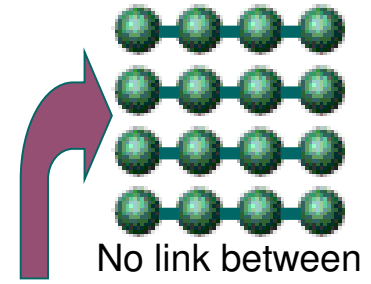
- The most widely used material
- Many different varieties
- Many different uses
- Created from two main sources
- Natural plastics
  - Include materials such as amber (tree resin) and latex (rubber)
- Synthetic plastics
  - Most common
  - Chemically manufactured
  - Made from oil, coal & gas
- Polymers can be strengthened by including other material such as glass, carbon fibre and Kevlar.
- When two or more materials are combined we call this a composite.

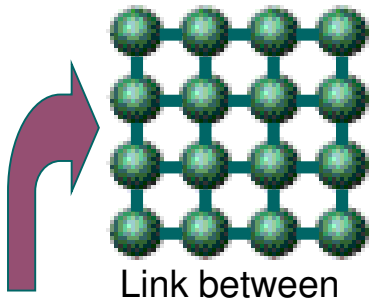
Polymerisation

- Process used to manufacture synthetic plastics
- Monomers are joined together
- Form long chain molecules called Polymers
- Poly = many, mer = part
- E.g. polystyrene = styrene monomers



- **Thermoplastics**
  - Soften when heated
  - Hardens when it cools
  - Can be reheated again
  - Most common type
  - Recyclable
- **Thermosetting**
  - Soften when heated
  - Hardens when it cools
  - Cannot be reheated
  - Interlinked chains
  - Not Recyclable


No link between polymer chains


Link between polymer chains

- Thermoplastics or thermosets; smart polymers.
- Thermoplastics are plastics that can be softened by heat.
- Thermosets are plastics that cannot be softened by heat.
- Smart polymers are plastics that react to stimuli and change their shape.
- Choosing the most suitable polymer depends on its function.
- Polymers can be flexible, soft, bouncy, stiff or hard.
- There are 2 types of polymer
  - Natural Polymers made from natural materials (plants, animals).
  - Synthetic Polymers not made from natural materials, they are manmade.

Thermosets

- Bakelite
- MF - Melamine Formaldehyde (worktops)
- ER – Epoxy Resin (glue, castings)
- PR – Polyester Resin (GRP)
- PF – Phenol Formaldehyde (pan handles, electrical fittings)
- UF – Urea Formaldehyde (plugs, sockets, electrical switches)

Thermoplastics

- HDPE – High Density Polythene (pipes, bowls, crates, buckets)
- LDPE – Low Density Polythene (carrier bags, packaging)
- PP – Polypropylene (stools, chairs, kettles, food containers)
- PS – Polystyrene (food containers, fishing nets, medical)
- PET – Polyethylterephalate (drinks bottles, food containers)
- HIPS – High Impact Polystyrene (packaging, film, bottles)
- Nylon (medical equipment, gears, boxes, nets)
- PVC – PolyVinyl Chloride (packaging, clothing, food boxes)
- PMMA – PolyMethyl-MethAcrylate Acrylic or Perspex (roof lights, machine guards, street signs, tail lights on cars)

- Plastics are either synthetic or natural
- Synthetic plastics - polymerisation
- Two types – thermoplastic or thermoset
- Thermoplastic – most common, can be reheated, recyclable
- Thermoset – can't be recycled

Timber

- Timber is a common material
- It is recyclable, reuseable and renewable
- Different timbers are identified by weight, colour, grain, durability, texture and working properties
- Timber is available as boards, planks, strips, dowels, mouldings and square section

Up to 375mm wide
Over 50mm thick

Over 100mm wide
Up to 50mm thick

Under 100mm wide
Under 50mm thick

Up to 150mm x 150mm

Finishes protect the natural timber and enhances the appearance
Wood stain – change the colour, little protection
Wood preservative – allows the timber to be used outdoors, protects against weather, can be coloured
Varnish – protection against weather & can be coloured when used outdoors. Indoors tend to be glossy & clear
Oil – Danish oil, Teak Oil, used indoors, little protection, can give a shine but not high gloss
Paint – changes the colour & protects from weather
Wax – can be coloured, generally used indoors, good protection from moisture if applied correctly, can give a shiny finish

Hardwood

- Comes from broad leaved trees
- Comes from deciduous trees
- Looses leaves in winter
- Broader shape tree
- Examples:
  - Oak
  - Ash
  - Beech
  - Teak

Generally
Expensive v Lower cost
Harder to work v Easier to work
More durable v Less durable
Slow growing v faster growing
Close grain v wide grain
Stronger v weaker
Harder v Softer
High quality finish v Lower quality
Sustainable v extremely sustainable

Softwood

- Comes from trees with needles
- Comes from coniferous trees
- Known as evergreen
- Does not drop needles in winter
- Conical shape tree, bears cones
- Examples:
  - Pine
  - Spruce
  - Cedar
  - Fir

Manufactured Board

- Developed as an alternative to natural timbers
- Become very popular and proved to be versatile
- Kitchen manufacturing and self-assembly furniture almost exclusively use manufactured boards
- Fall into 2 main categories: **laminated** and **compressed** boards
- Laminated – glued large sheets or veneers e.g. plywood
- Compressed – glued particles, chips or flakes e.g. MDF, chipboard, OSB (oriented strand board)

- **Plywood** – layers of wood, grain of each layer is adjacent to the next, very strong, flexible in thin sheets
- **MDF** – common, cost effective, made from particles of recycled or poor grade timber, smooth flat surface, easily affected by moisture and resin is hazardous to health
- **Chipboard** – chips of wood pressed together with resin, cost effective, often veneered to improve aesthetics or laminated
- **Hardboard** – low-cost board, generally used as a packing material and backing for furniture e.g. drawers, bookcases, one smooth surface, one textured surface, low strength, easily affected by moisture

- Most manufactured boards are given a finish before use, but because they are porous they must be sealed before a final finish can be applied:
- **Sanding sealer** – seals grain, stops moisture, provides a colourless barrier (PVA glue could be used)
- **Varnish** – protection against weather & especially moisture, can be coloured. Can be gloss, satin or matt.
- **Paint** – changes the colour & protects from weather

CAD/CAM

- One of the most valuable tools for designers and manufacturers
- CAD software has now become easier to use, more powerful and the cost is dropping
- It has improved the quality of work at all stages of the design process
- It Is used from basic layout planning for a kitchen to detailed engineering drawings used for manufacturing
- Cad models can be used to simulate how products perform e.g. aerodynamic performance of a car
- CAD model simulations can save time, money and resources
- Cloud based technology is an emerging technology
- Cloud based technology has enabled collaborative working to become a lot easier
- Designers can share projects, work simultaneously whilst being on opposite sides of the planet

What are the advantages of CAD?

- Quality of presentation is higher
- 2d & 3D models can be created, amended & edited easily
- Textures and colours can be applied
- Can be securely stored, shared and collaborated on
- Ideas, concepts and models can be shown to clients and opinions gathered
- Can speed up the design process and reduce lead time (time taken to get a product to market

What are the disadvantages of CAD?

- Very powerful computers are necessary, especially for 3D modelling and rendering
- All users will require training to use any software to its full potential
- Requires a high level of expertise to use efficiently
- Can be slower to generate ideas than paper & pencil
- Software is continually updated, can be expensive
- Hardware such as printers can be expensive

- CAM machinery is used to produce products and components straight from CAD drawings
- A Cad drawing is converted into a code which can be interpreted by a CAM machine
- Most CAM machines use x, y and z axis and the code is a series of numerical commands
- As a result of the code used the machines are often referred to as Computer numerically controlled (cnc)
- CAM machines are frequently found in industry where large volumes are required of identical and consistent quality products
- Initial costs are expensive and workers need to be trained to operate them effectively
- They can run for long periods of time without a break so are more efficient than humans
- They do need ongoing maintenance and servicing

What are the advantages & disadvantages of CAM?

- CAM processes are generally faster
- High degree of accuracy is achievable
- Consistent and repeatable process achievable
- Less waste produced
- Allows for flexible manufacturing systems
- Cam machinery is expensive
- Cam machines need regular servicing and maintenance
- Skills & workforce are replaced due to increase in CAM
- The costs involved limit the processes to large scale production