GCSE D&T Knowledge Organiser

Briefs, Specifications, ideas and development

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Design Briefs

A Design Brief is the statement of how you will solve the Design Problem
It will often include:

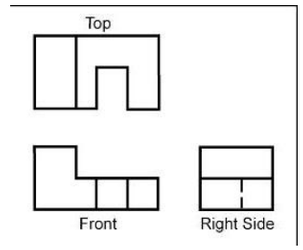
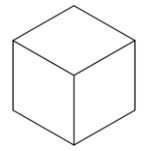
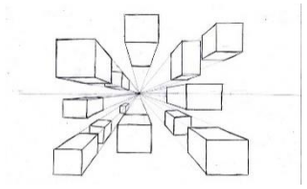
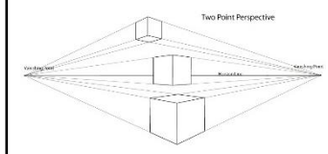
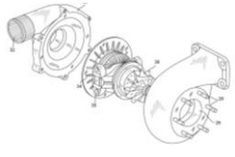
- Constraints/ limitations
- What the product is
- Materials/processes
- Any key information you know

Design Specifications

A Design Specification is a list of requirements your product has to meet in order to be successful

It is also useful for evaluation. If your product hasn't met the Spec then it gives you a starting point for improvements.

Aesthetics	What the product looks like? Style? Colour Scheme? Design Movement?
Customer	Who would buy it? (Age, gender, socio-economic, personality) How does the design appeal to them?
Cost	How much will it cost? (min-max) Why?
Environment	Where will it be used? Why? How will you make it suitable?
Safety	How is it safe? How will it be checked? Why must it be safe?
Size	What is the maximum or minimum size? Why?
Function	What does the product do? What features make it do that function well? How is it unique from similar products?
Materials	What is it made from? Why?
Manufacture	How might it be made? Why? What scale of production? Why?

Technique	Description/ notes	Diagram
Orthographic Projection/ Working Drawings	• Includes "Front", "Plan" and "End" 2D Views, and often an Isometric 3D View • Standardised method for scale, dimensions and line types • Great for manufacturing	
Isometric	• Common 3D sketching method • Can be drawn free-hand or using isometric paper and ruler • Angles are at 30 degrees • Great for seeing most of the products	
1-Point Perspective	• A 3D drawing method • Often used by interior designers and architects • Gives drawings depth • Only uses 1 vanishing point	
2-Point Perspective	• Used for 3D designs • Exaggerates the 3D effect • Objects can be drawn above of below the horizon line but must go to the 2 vanishing points	
Annotated Drawings/ Free and Sketches	• Quick and easy way of getting ideas down • Range of ideas can be seen • Annotation helps explain designs further	
Exploded View	• Helps see a final design of a product and all it's parts • Can see where all the parts fit • Great for manufacturers	

Modelling and Development

Modelling and development are key to testing and improving products
This can be done physically using materials like; card, foam, clay, man-made boards or virtually in **CAD**
Modelling helps the designer get feedback from the customer, check aesthetics, function, sizes and even materials and production methods and change them if needed

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Energy Generation and Storage

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Non-Renewable Energy Sources	This is when certain sources of energy will run out eventually
Fossil Fuels	• Coal, Oil and Gas • Burned to create steam, turned in turbines to create electricity. • Burning creates C02 which adds to **Global Warming**
Nuclear Power	• Nuclear Fission controls the reactor (that creates the electricity). This requires **Uranium** which is non-renewable • Accidents and waste can severely damage the environment and cause radiation poisoning • **Radiation poisoning** can be fatal and cause physical deformations • Nuclear waste has to be disposed of properly and is hazardous for thousands of years.

Storing Energy

Pneumatics: This is the production of energy using compressed gas or air. E.g. Pistons in an engine

Hydraulics: Like a Pneumatic system, but uses water or oil under pressure. E.g. Wheelchair lifts

Kinetic: Energy that is generated by movement. This is stored by items like springs in a "clickable" pen or balloons,

Batteries: Electrical power can be stored in batteries. Rechargeable batteries are becoming increasingly popular.

Renewable Energy Sources	This is when certain sources of energy will not run out.
Solar	• **Solar panels** are used to collect light and convert it into electricity • There is no waste and a consistent supply • However, the panels are not effective at night or in countries where there isn't a lot of sunlight
Wind	• **Turbines** harness wind energy • Not effective on non-windy days • Some people don't like turbines as they are noisy, and not attractive to look at
Hydro-Electrical	• This harnesses energy from water held behind a **dam** • Has to be created by flooding land – damaging wildlife habitats • **Tidal** energy comes from using energy from waves
Biomass	• This is fuel from natural sources e.g. crops, scrap woods and animal waste • Growing biomass crops produces oxygen and uses up C02 • However, is a very expensive method

Design Engineering (Electronics) Knowledge Organiser

Input Components

These devices form the crucial control needed for a product to operate. Most input components need to be bought but some can be manufactured especially for a project. For instance, a pressure sensor.

Light dependent resistors (LDRs) are a type of variable resistor whose resistance increases with light.

Push to make switches are simple input devices which allow electrical current to flow when pushed.

Time delay switches lengthen the time a product operates for.

Motion sensors use infrared to detect changes in the environment to activate the system.

Tilt switches use mercury to connect two electrodes when moved.

Thermistors are a type of variable resistor whose resistance changes when it becomes hot or cold.

Process Components

These devices are used in combinations to turn the signal from the input component into the signal to the output component. Careful designing and a good knowledge of the way circuits are designed is crucial.

Resistors limit current flow in an electronic circuit and have to be placed before some components to prevent damage.

Capacitors store charge in circuits and release charge when the circuit is off.

Transistors are semi-conductor electronic switches which allow current to flow through their third leg to a separate part of the circuit.

Diodes allow current to flow in one direction only, acting as a safety valve. They are a semi-conductor.

Integrated circuits (ICs) are manufactured for many different uses and functions. A tiny circuit is encased in silicone (a semi-conductor material). Although they look complex, they follow the same logic as simple circuits. Because of their reduced size, smaller products can be achieved as more technology can be made to fit into smaller spaces. The 555 timer is an example of a pre-programmed 8 pin IC. It can be used to produce time delays.

Microcontrollers are tiny integrated circuits used widely in automatically controlled devices such as engine management in cars. These can be combined with **drivers** to control devices such as motors. **Raspberry Pi** and **BBC micro:bit** computers are examples used in schools.

Process Components

The output is the end function of the product. In most cases, the output can be classed as light, sound, motion or a combination of two or more functions.

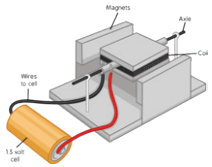
Light emitting diode (LED) come in different colours and levels of brightness. They have replaced the filament bulb in many everyday uses.

Light bulbs are not as widely used because of LEDs in an everyday context but mini-light bulbs do not require soldering, so can still be useful.

Buzzers use electric current to create their own sound. Used in alarm systems.

Speakers allow a sound signal from a circuit to be amplified.

Motors are magnetic devices and are behind nearly all moving parts in electronic systems.



Properties and Definitions in Electronics

Key Term	Definition
conductor	A material which allows heat or electricity to pass through it easily.
input	What has to happen to actuate the function of a circuit.
insulator	A material that does not conduct electricity and can therefore be used as a coating to components, circuit boards and wires.
heat sink	A conductive device, such as a crocodile clip, that allows heat to discharge from delicate components when soldering.
mono-filament	Single strand core found in some wire.
short-circuit	In a circuit, often as the result of a solder bridge, electricity will flow in the shortest path back to the battery.
resistance	How effective a conductor a material or component is.
semi-conductor	A component that allows current flow only under certain conditions, such as a transistor.

How to Read a Resistor

The fourth band tells you the tolerance % of the resistor. Gold is 5%. Silver is 10%. **Always on the right!**

The first band is a numerical value. Brown = 1

1 5 00 Ω ± 5%

The second band is a numerical value.

Green = 5

The third band is the multiplier- how many zeros the value has. Red = 2 (00)

0 1 2 3 4 5 6 7 8 9

Wasting in Electronics Design

Etching is a chemical process for PCB (printed circuit board) production that requires photo-sensitive copper board for best results. A design is produced and then 'photographed' onto the copper board before the board is placed in an acid bath. Only the circuit remains on the board. Effective for one-off high-quality PCBs.

Wasting using CAM in electronics.

Milling a PCBs is a quick and clean method of manufacture, ideal for batch production or one-offs. A CAD file is designed before being used to control a CAM milling machine to waste unwanted copper from a copper clad board.

Key Words

Printed Circuit Board (PCB) A hard-thermoset plastic board and copper circuit. Holes are drilled for components to be mounted on the reverse side.

Batch production manufacturing processes are planned so that a limited number of the same product can be manufactured.

Computer-Aided Design (CAD) Computer applications are used to support the design development of a product or component, such as PCB design.

Computer-Aided Manufacturing (CAM) A design file is used to control the machinery that creates a part or whole of the product.

Addition in Electronics Design

Electronic project 'bread-boards' are a practical method of creating functioning prototype circuits and developing them. Components push-fit into the board and are connected via a metal rail inside the casing. Extra boards can be joined using mono-filament wire for modular circuits.

Soldering is a permanent addition method for electronic components. Solder is a soft alloy usually made from copper and tin. An added substance, called flux, allows the solder to flow over the components to give a good join.

Soldering irons can be gas or electric. In schools, they are electric. Care must be taken to make sure the lead does not trail across the soldering area or off the desk.

A few components can be joined directly together, such as these LEDs in series. A heat-sink, such as a crocodile clip must be used.

Circuit boards can be created by adding adhesive copper strips to card or MDF. Components can then be surface mounted onto the copper with solder.

Veroboard (or stripboard) addition is suitable for one-off prototype circuits. Components are added on the blank side and soldered on the side which has copper 'rails'. The rails can be joined either by wire loops, components or a blob of solder. They can be 'broken' by removing part of the copper with a drill.

PCB component addition:

Once the holes for the component legs are drilled, the component is mounted on the blank side of the board and the legs are soldered in place on the printed circuit side.

Surface mount components:

Many commercial circuit boards have their components mounted directly onto the circuit side of the board. This method saves space as there are no holes to drill. Found in mobile phone technology.

Addition using CAM in electronics:

A CAD file can be quickly converted into a PCB using a cutter/plotter. Special adhesive-backed copper foil is loaded into the machine which then runs the program in exactly the same way as if it was on card or paper. It has to be very carefully transferred to card or a blank PCB. Holes can then be pierced or drilled for components to be mounted and soldered.

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Mechanical Systems

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Forces

Compression

Tension

Torsion

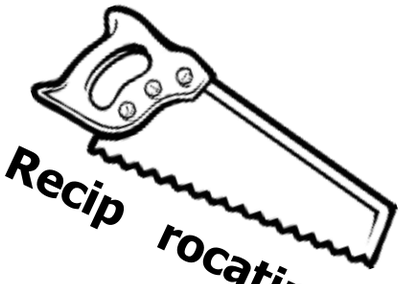
Shear

Motion

Linear

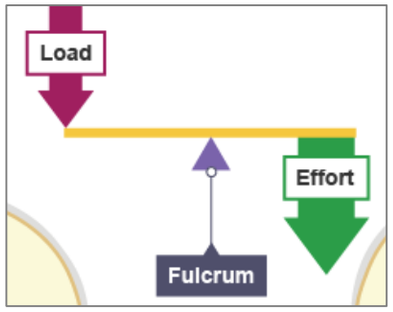
Rotation

Oscillating



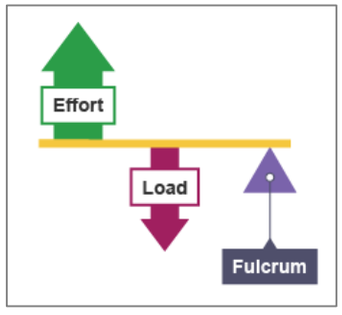
Reciprocating

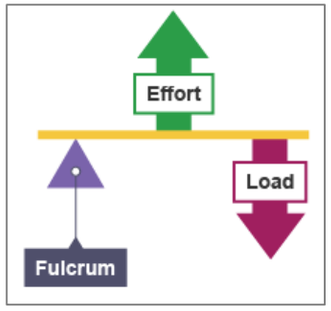
Levers



1st Class Lever:
Fulcrum in the centre
E.g. Scissors

2nd Class Lever:
Load in the centre
E.g. wheelbarrow





3rd Class Lever:
Force in the centre
E.g. Lifting a dumbbell

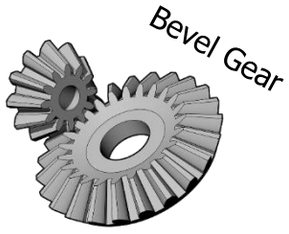
Gears and Pulleys

A Pulley is a grooved wheel, that has a belt running through it

This uses rotary motion and is often used to help with heavy loads, and transfer force from a motor to a tool in machines like drills, etc

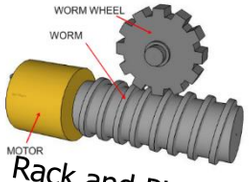
Gears have teeth that mesh together with each other (like teeth on a zip)

They mainly focus on rotary motion on tools and machinery e.g. car steering and pillar drills



Bevel Gear

Spur Gear



Rack and Pinion

Worm and Wheel

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Production Processes

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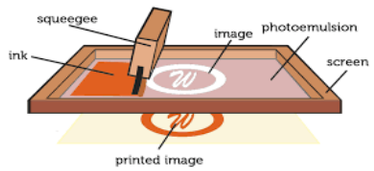
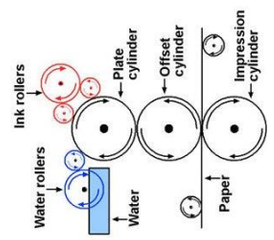
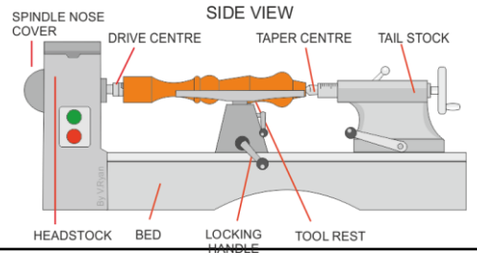
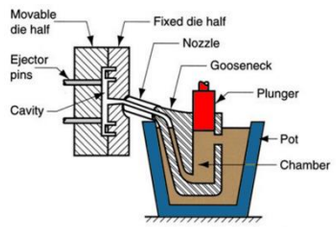
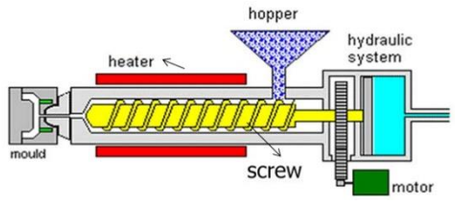
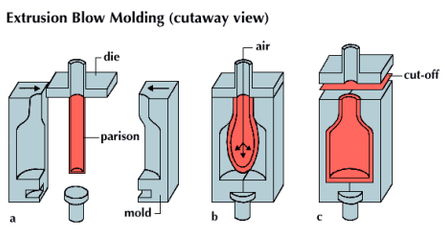
Name of Process	Diagram	Material	Products Made	Key info
Screen-printing		Papers and Textiles	Posters, signs and t-shirts	Screen printing places paint on top of a screen. The screen has a stencil embedded in it, so when the paint is passed across it the desired shape is printed underneath. Good process in one-off and batch production as often done by hand
Offset Lithography		Papers and card (thin, flexible plastics)	Posters, newspapers, plastics bags	Rollers containing the colours and water go onto the plate cylinder. The water stops the colours sticking to certain places, creating the shape. The shape is transferred between rollers and onto the material. Can be used at batch and mass production
Lathe Turning		Wood and metal	Chair legs, baseball bats)(cylindrical items)	Material is placed between the tail stock and the headstock and spun at high speed. The material is then cut using specialist tools (either by hand or my automated machinery) to the desired shape. Can be used in one-off and batch production
Die Casting		Metal	Car parts, engine components, etc	Molten metal is poured into a chamber and a plunger forces the metal through the nozzle into the mould. Unlike sand casting, the mould is reusable. Good process for both one-of and batch production
Injection Moulding		Plastics	Chairs, toys, etc	Plastic granules are poured into the hopper and onto the screw. The screw moves the material towards the heater where it turns into a liquid. The liquid is then forced into the mould, cooled and released. Great process for mass production as it makes 100s+ of products at once, to a identical standard.
Blow Moulding		Plastics	Plastic bottles	A Plastic parison is heated and put into the mould. The parison is then filled with air (like blowing up a balloon) and is forced to fit the mould shape. It is then cooled and then released. This is a great process for mass producing bottles.