Year 10 Knowledge Organiser Learning Cycle 1

Course outline
The course contains 3 elements

Engineering knowledge, understanding and skills (including practical skills) can and will be assessed throughout all 3 units. Many of the topics are covered in all 3 units, therefore, in each Learning Cycle you will be learning elements from all 3 units.

Unit 1: Manufacturing Engineering Products
Controlled assessment: 20 hours
40% of qualification

Unit 2: Designing Engineering Products
Controlled assessment: 10 hours
20% of qualification

Unit 3: Solving Engineering Problems
Written examination: time of exam - 1 hour 30 minutes
40% of qualification

An assignment brief will be provided by WJEC for both Units 1 and 2 (basically they tell you what to make and design). Unit 1 must be completed before Unit 2, as they are linked.

1

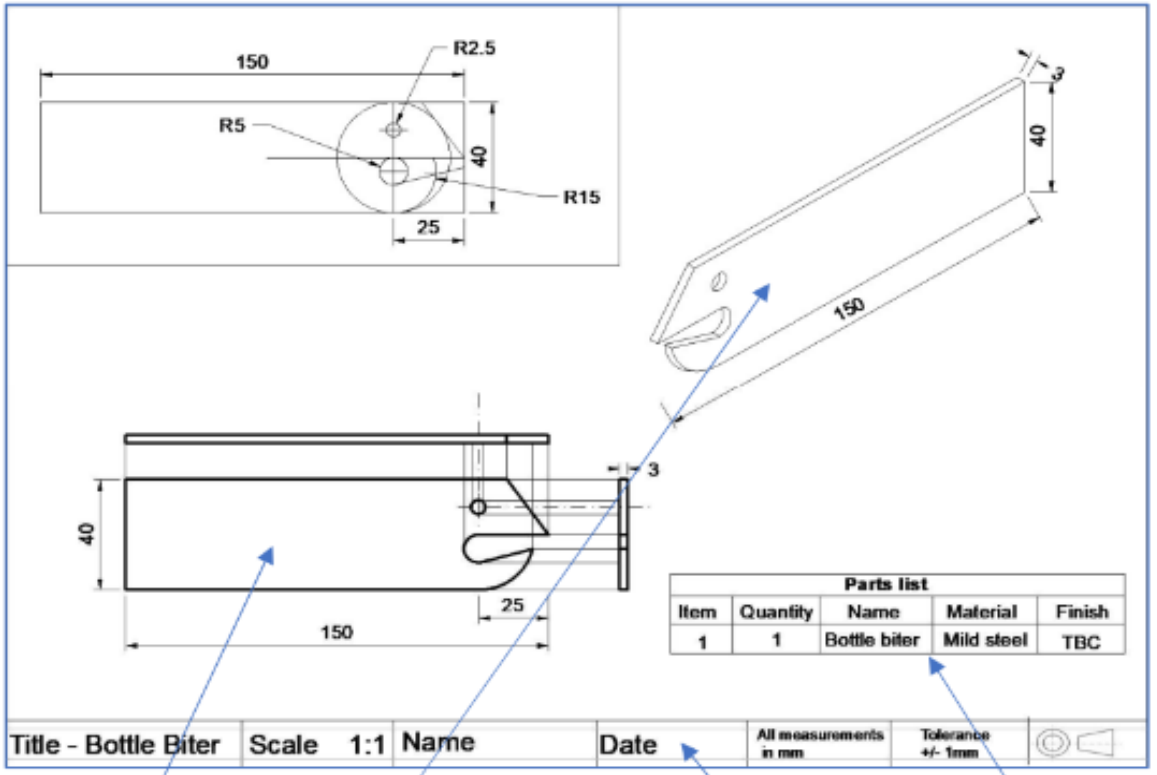
Interpret engineering drawings

Designers and engineers use engineering drawings to convey information and details about the product to be manufactured or constructed.

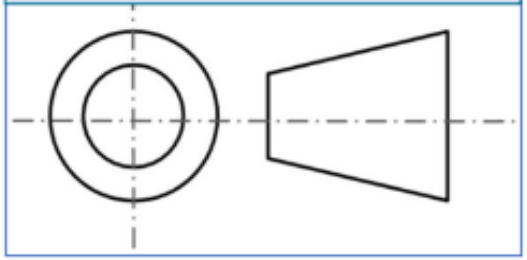
Engineering drawings include details such as:

- Sizes of parts or elements to be made
- Details on materials
- Information on finishes
- Various views of the product
- Tolerances
- Scale
- Details of complex parts.

Most information will be in the Title block/Parts list



Orthographic symbol – Third angle projection



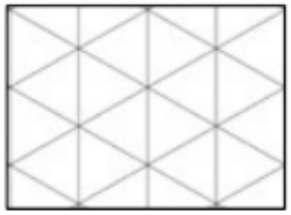
Orthographic views

3 views that line up
- Front
- Side
- Plan

British standards (BS8888) Conventions followed worldwide.

Isometric view

- Shown as 3D
- Lines at 30° degrees
- You can use a grid



Title block

This example has 7 pieces of information

Parts list

This gives more detail on the materials needed.

2

Planning manufacture

Before any manufacturing can take place, a plan is needed to determine each stage or step of the process.
The plan should include:

- The materials to be used to produce the engineered product
- What equipment will need to be used
- What tools will be needed
- The sequence (order) that manufacturing needs to take place in.

The sequences need to consider in what order parts are manufactured, as some parts require others to be made to ensure they join correctly, etc.
This is also known as **prioritising**.

Planning/Cutting list (AC1.1, 1.2, 2.1).

Part	Material	Sizes (mm)	Quantity	Tools/equipment needed	H&S / PPE
Base	5mm Acrylic	150 x 5 M4 (Countersunk)	1 (1 piece of acrylic)	2d design, Laser Cutter, File, Saw, Countersink Drill	Apron, Safety Goggles
Upright Bar	12.5mm Stock Round Aluminium Bar	295 x 12.5 M4 (Threaded)	2	Centre Lathe, Hacksaw, Tap	Apron, Safety Goggles
Top Plate	5mm Acrylic	55 x 30 x 5 4mm holes	1 (1 piece of acrylic)	2d design, Laser Cutter, File	Apron, Safety Goggles
Hinge Bracket	2mm Sheet Aluminium	41.5 x 15 x 2 4mm holes	2	Hacksaw, Pillar Drill, Folding Bar, File(s)	Apron, Safety Goggles
Support Arm					Apron, Safety Goggles
Counter Weight					Apron.
Central Lock Pivot					Apron.
Shade	3mm Acrylic	50 x 40 x 10 20 x 8 x 10 M4 (Threaded)	1 (2 pieces of acrylic) 1 (2 pieces of acrylic)	Solvent Cement	Apron, Safety Goggles
Bolt		M4 x 0.7 x 25	1	Bought In Component	Apron
Wing Nut		M4	1	Bought In Component	
Button Head Cap Screw		M4 x 0.7 x 8	6	Bought In Component	Apron
Button Head Cap Screw		M4 x 0.7 x 12	2	Bought In Component	Apron
Countersunk Head Screw		M4 x 0.7 x 12	2	Bought In Component	Apron
Plain Washers		M4	2	Bought In Component	Apron
LED Array	LED Array	N/A	1	Bought In Component Soldering Iron	Apron, Safety Goggles.

Example of a Cutting list, sometimes called a Job sheet.

Production plan - sequence in order AC2.2). To include all tasks.

Part	Material	Task including tools/equipment	Quality control checks
Base	Acrylic	Cut Out Shape - 2D Design, Laser Cutter 150mm	Ensure correct dimension and measurements.
		File The Edges – File, Wet and Dry	Make sure there's no rough edges
		Countersink Drilling – Countersink Drill M4 screw	Don't go all the way through
Top Plate	Acrylic	Cut Out Shape– 2D Design, Laser Cutter	Ensure correct dimension and measurements.
		File The Edges – File, Wet and Dry	Make sure there's no rough edges
Counter Weight	Acrylic	Cut Out Shape – 2D Design, Laser Cutter	Ensure correct dimension and measurements.
Central Lock Pivot	Acrylic	Cut Out Shape – 2D Design, Laser Cutter	Ensure correct dimension and measurements.
		Combine 2 Parts – 2nd Layer of Acrylic, Solvent Cement	Line up perfectly
Shade	Acrylic	Cut Out Shape – 2D Design, Laser Cutter	Ensure correct dimension and measurements.
		Combine All The Parts – Solvent Cement	Wear Goggles
		Thread The Holes – Tap M4	Make sure that the screws fit perfectly
		Smooth Edges – File, Wet and Dry	Remove cement line
All Parts		Combine Everything With Screws	Make sure it all fits into place accurately

Example of a Production plan

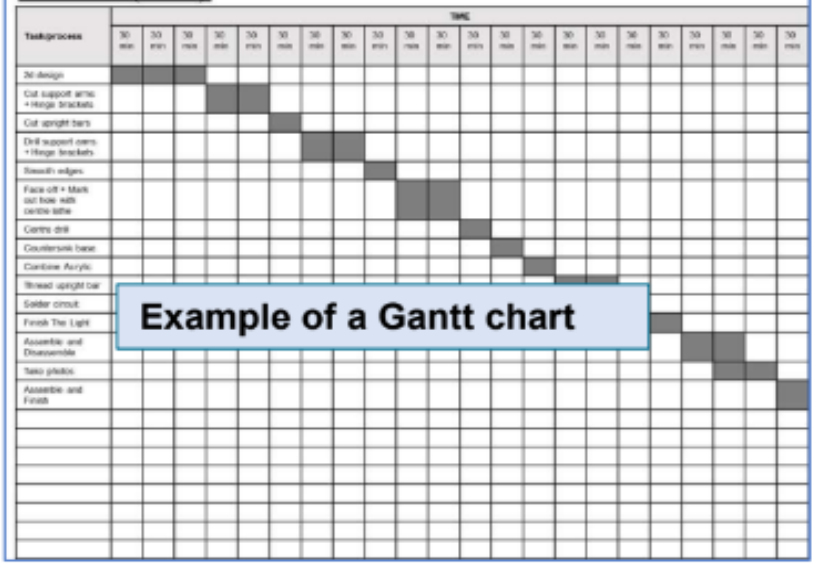
Contingency planning

Planning should also include ways to overcome any unforeseen problems.

Examples:

- Illness
- Broken machines
- Others using machines
- Material not available

Gannt chart (AC2.2).



Example of a Gantt chart

Understanding the physical properties of materials

Understanding that materials can be defined by a range of properties, for example:

- **Tensile strength** – the ability of a material to resist stretching or breaking when pulled
- **Compressive strength** – a materials ability to withstand loads without changing its shape
- **Hardness** – this is a materials ability to resist changing shape when impacted by another object
- **Toughness** – the ability of a material to absorb energy (impacts) before it starts to deform (change shape)
- **Malleability** – the materials ability to be repeatedly hammered, pressed, bent or rolled into thin sheets
- **Ductility** – the ability of a material to be drawn or plastically deformed without breaking
- **Conductivity** – a measure of how well the material conducts heat or electricity
- **Corrosive resistance** – how well the material can withstand damage caused by chemicals or oxidisation
- **Elasticity** – the ability of a material to limit distorting and return to its original shape and size
- **Environmental degradation** - how the physical environment is degraded, damaged or compromised through a range of situations such as air pollution, water contamination etc.

Know the names and the definitions

Understanding materials, their properties, and their selections for specific purposes

Properties and classifications of materials

Ferrous metals contain iron and are magnetic. They are also prone to rust and need a protective finish to prevent corrosion.

Cast iron is brittle if thin, can be cast in a mould, has strong compressive strength, good electrical and thermal conductivity, but has poor resistance to corrosion. It is used for products such as gates, manhole covers and drains.

High carbon steel is also known as **tool steel**. It is hard and brittle and is less malleable than mild steel. It is an effective electrical and thermal conductor. Uses include tools, screwdrivers, and chisels.

Low carbon steel is also known as **mild steel** and is ductile and tough, easy to shape, braze and weld. It is a good conductor of heat and electricity, but also corrodes easily. Commonly used for nuts and bolts, screws, bicycle frames and car parts.

There are many others.

Understanding materials, their properties, and their selections for specific purposes

Properties and classifications of materials

Non-ferrous metals do not contain iron and are not magnetic. They do not rust.

Aluminium is lightweight, malleable and strong. It is a good conductor of heat and electricity. It is used in drinks cans, cycle frames and saucepans.

Copper is very malleable and an excellent conductor of electricity and heat, which makes it perfect for plumbing and central heating applications. It is orange/brown when polished but will oxidise to a green colour.

There are many others.

How environmental issues affect engineering

How engineering applications and products have an environmental impact

Raw materials – how the landscape is affected? Transport and pollution? Cost of materials and production?

Recycling – all metals can and should be recycled. What affect does this have?

Understanding materials, their properties, and their selections for specific purposes

Properties and classifications of materials

Alloys - A mixture of two or more elements with the major part a metal.

They can be **Ferrous or Non-Ferrous** metals. Alloys were developed to **improve the properties** of existing metals. By heating, melting and mixing the elements, you can create new metals with new, different properties.

Brass a non-ferrous alloy 65% copper, 35% zinc. Easily cast into shapes and corrosion resistant. Hard, good conductor of heat and electricity. Used for handles, musical instruments and padlocks.

Stainless steel a ferrous alloy. Mainly iron with chromium and nickel (plus some others). Hard, tough, corrosion resistant, high tensile strength. Used for cutlery, saucepans and medical equipment.

Duralumin a non-ferrous aluminium based alloy. Lightweight and corrosion resistant. Other properties - hard, ductile, malleable, high strength to weight ratio. Used in the aircraft and car industries.

There are many others.

5

Implementing engineering processes

The physical making of a product (or part of) using a range of processes. PPE must be worn.

Marking out
- Engineers blue
- Scriber
- Steel rule
- Engineers square
- Dividers (straight calipers)
- Calipers – internal, external and odd leg
- Centre punch
- Ball pein hammer

Cutting/shaping
- Metal vice
- Hacksaw
- Junior hacksaw
- Files
- Pillar drill
- Drill bit
- Machine vice
- Cold chisel
- Reamer
- Deburring tool
- Emery cloth

Finishing
- Oven
- Gas hearth

Implementing engineering processes

Finishing is applied at the end stage of production. Ferrous metals need a finish to prevent corrosion. A range of **METAL** finishes are below:

- **Plastic dip coating**
  Mainly used on steel, heated metal covered in plastic power.

- **Galvanising**
  Steel covered with melted zinc to prevent corrosion.

- **Anodising**
  Best used on aluminium, an industrial process using acid, electricity and dyes.

- **Powder coating**
  Like Plastic Dip Coating but the plastic powder is sprayed on.

- **Blueing**
  Steel is heated up and dipped in oil.

- **Painting**
  Painting metal creates a protective barrier to prevent corrosion.

- **Enamelling**
  Enamelling involves melting powdered glass onto a metallic surface.

Health and safety

Assessing potential risks is a process that is undertaken prior starting manufacture. It should identify what potential hazards and risks may be present. This should include both the working environment and the actual items of equipment to be used.

Deciding on control measures should focus on stating how the identified risks and hazards can be mitigated (made safe). This should include detailing about guards on equipment and specific any hazards around the working environment.

Personal protective equipment should also be identified for manufacturing stages and should only include appropriate choices suitable for the individual task being undertaken.

Risk assessment: Five-step method

Step 1. Identify the hazard (what could happen)

Step 2. Who may be harmed and why?

Step 3. Evaluate the risk and choose precautionary control measures (how will you reduce the risk)

Step 4. Record (write down) your findings

Step 5. Review and update when needed

Sign	Meaning	Shape	Colour
	**Mandatory:** Specific instruction on behaviour	Round	White border, blue background, white pictogram
	**Warning sign:** Giving warning of hazards or danger	Triangular	Black border, yellow/orange background, black pictogram
	**Prohibition sign:** Prohibiting behaviour and/or actions	Round	Red border, white background, black pictogram
 First aid	**No danger:** Information on first aid, emergency exits, emergency stop, etc	Square or rectangular	White border, green background, white pictogram

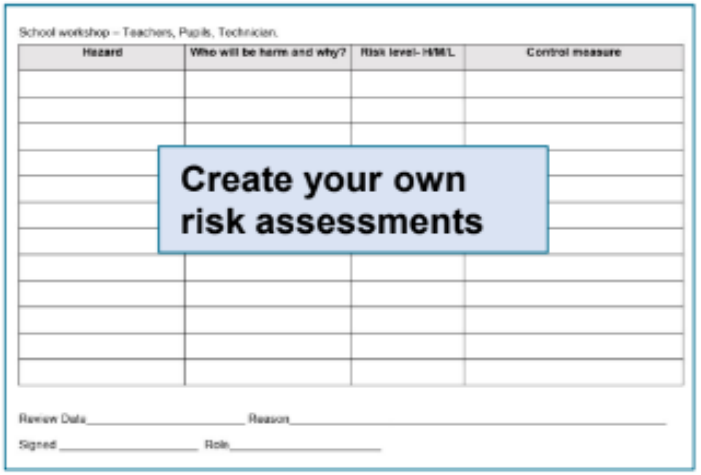
Signs and symbols

WOOD WORKING: PORTABLE POWER TOOLS - DRILLS

HAZARDS

RISK ASSESSMENT

CONTROL MEASURES



School workshop – Teachers, Pupils, Technician.

Hazard	Who will be harm and why?	Risk level- H/M/L	Control measure

Review Date_____ Reason_____

Signed _____ Role_____

Create your own risk assessments