



KS4 Knowledge Organiser
Subject: Engineering WJEC
Term 1

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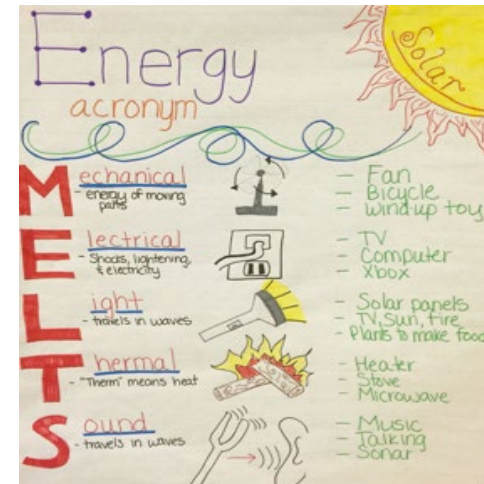
How to use the Knowledge Organiser:

- Your teacher will direct you to what topics to revise for each week
- You will be expected to revise for at least 30 minutes each evening
- Ask someone to quiz you on the key information
- Remember to APPLY the information using the tasks included in each Knowledge Organiser

Also, please remember, you should spend 20 minutes on the following apps and websites:

- GCSE Pod
- PIXL Lit
- PIXL Maths App
- Tassomai
- BBC Bitesize
- Onmaths
- Corbett Maths
- English Instagram @greenacreenglish
- Quizlit

If you would like support with any of the apps, please email
akehr005@sflt.org.uk



- Give yourself a nice space to work in - have a nice, organised study space with lots of stationary to help you make quality notes/highlight.
- Make a plan - schedule dedicated study time into your daily schedule. Be organised with your time. Stick to your plan. Sacrifice some of your social time for study time. No pain, no gain!
- Start your revision early - start now, if you have not already done so, not days before your exam.
- Do small chunks of revision. Your brain is not capable of mass storing information in a short space of time. Digesting small chunks of information, over a longer period of time, means you are more likely to remember it

Click on the QR code below which will take you to the revision support page on our website:



What is a centre lathe used for?

A centre lathe is used to manufacture mainly cylindrical products/ objects. Lathe can be operated both manually (in the workshop) or using CNC in industry.

Fitting tools

The workpiece (material) on a lathe is held in place using a chuck. This uses 3 or 4 jaws to **self-centre** the workpiece as they come together.

A **chuck key** is used to tighten the jaws of the



Spring loaded chuck key

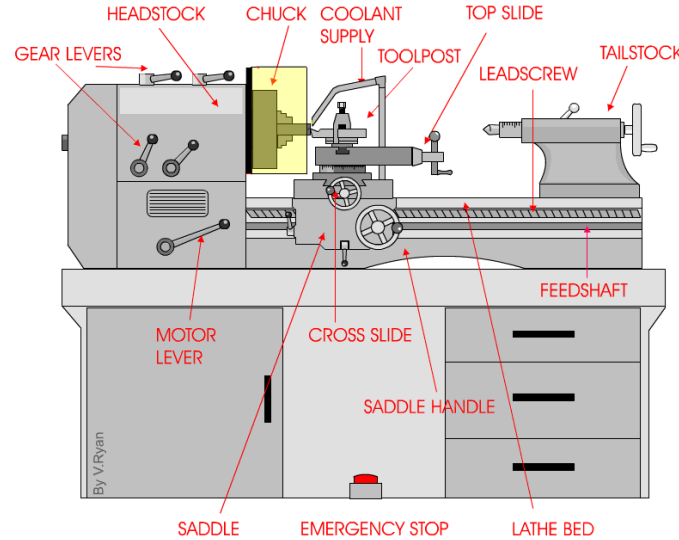
This has a spring so that it cannot be left in the chuck and cause injury to the user.



4-jaw
centre lathe
chuck

Useful websites:

[Technology student: centre lathe](#)
[BBC bitesize](#)
[DT online: centre lathe](#)



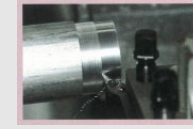
Safety precautions

- A **risk assessment** must be completed before using this machine.
- Safety goggles and apron must be worn.
- Long hair must be tied back
- Limited persons around the machine e.g. user plus instructor only.
- Workpiece must be securely closed in the chuck.
- Machine guard must be set to the correct position.
- Tools must be sharpened and set up correctly.
- Correct machine speed must be selected.

Common phrases:

Turning:

Reducing the diameter of a cylindrical object.



Facing off:

Ensuring that the **end** of a cylindrical object is flat (perpendicular to its sides)



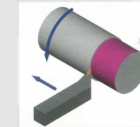
Parting off:

Cutting the workpiece to a specific length with a specific cutting tool (parting tool)



Taper turning:

Creating a **taper** down the length of the workpiece (think cone-shaped)



Knurling:

Creating a **textured surface** on your workpiece



Grooving/ face grooving:

Creating a **groove** on the **external diameter** or **face**



Boring:

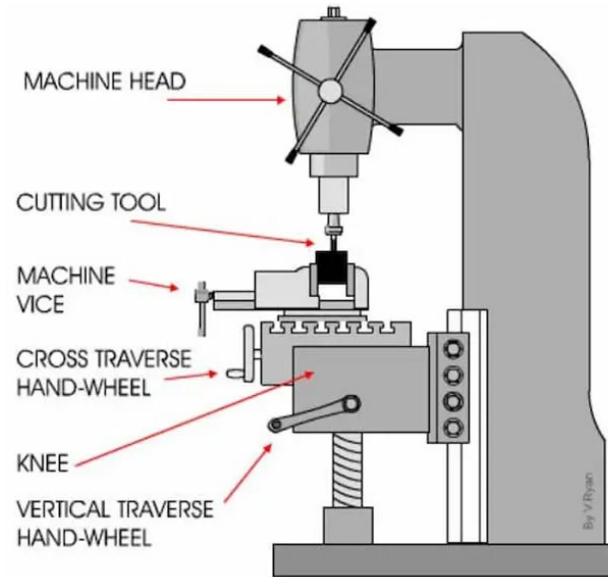
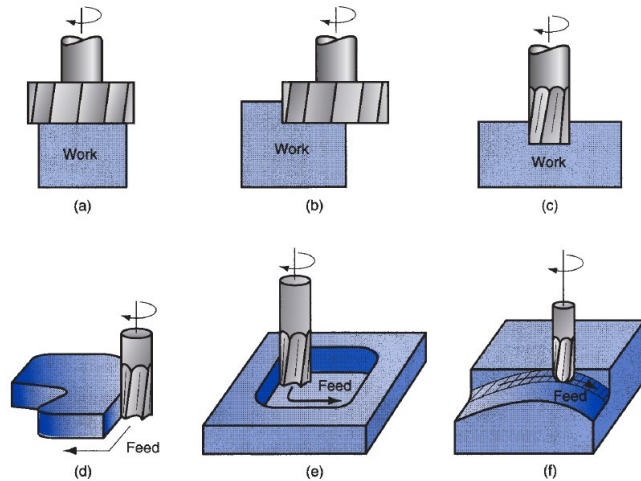
Enlarging an existing hole in a workpiece using cutting tools or a 'boring bar'



What is a vertical milling machine used for?

This machine uses a rotating cutting tool to produce machined surfaces by progressively removing material from a work piece.

The machine vice is controlled using handles to allow it to accurately move along 3 axis. More advance machine can be partly or fully automated.



Different sizes and shapes cutting tools are used to remove material as needed. By controlling the X,Y & Z axis, the machine can be used to accurately cut out areas such as slots.

Useful websites:

- [Technology student: vertical miller](#)
- [BBC bitesize](#)
- [DT online: vertical milling machine](#)

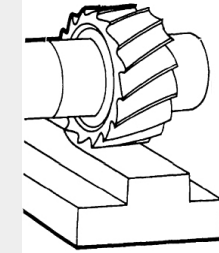
Safety precautions

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- Limited persons around the machine e.g. user plus instructor only.
- Workpiece must be securely closed in the chuck.
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- Correct machine speed must be selected.

Common operations:

- **Plain milling/ surface milling:**

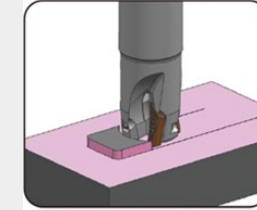
(this the the most common operation) this is performed to the flat, horizontal surface, parallel to the cutter.



Face Milling

- **Face milling**

Removing material from the top face of the workpiece



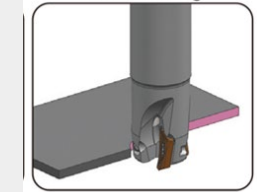
- **Side milling**

Removing material from the side of the workpiece

Side Milling

- **Shoulder milling**

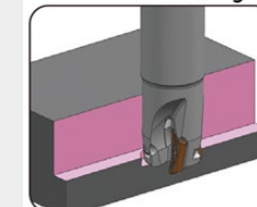
Removing material from the side of a workpiece



Shoulder Milling

- **Boring/ hole expansion drilling**

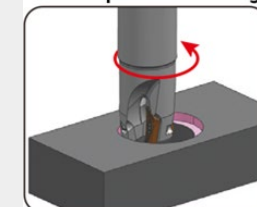
Enlarging an existing drilled hole

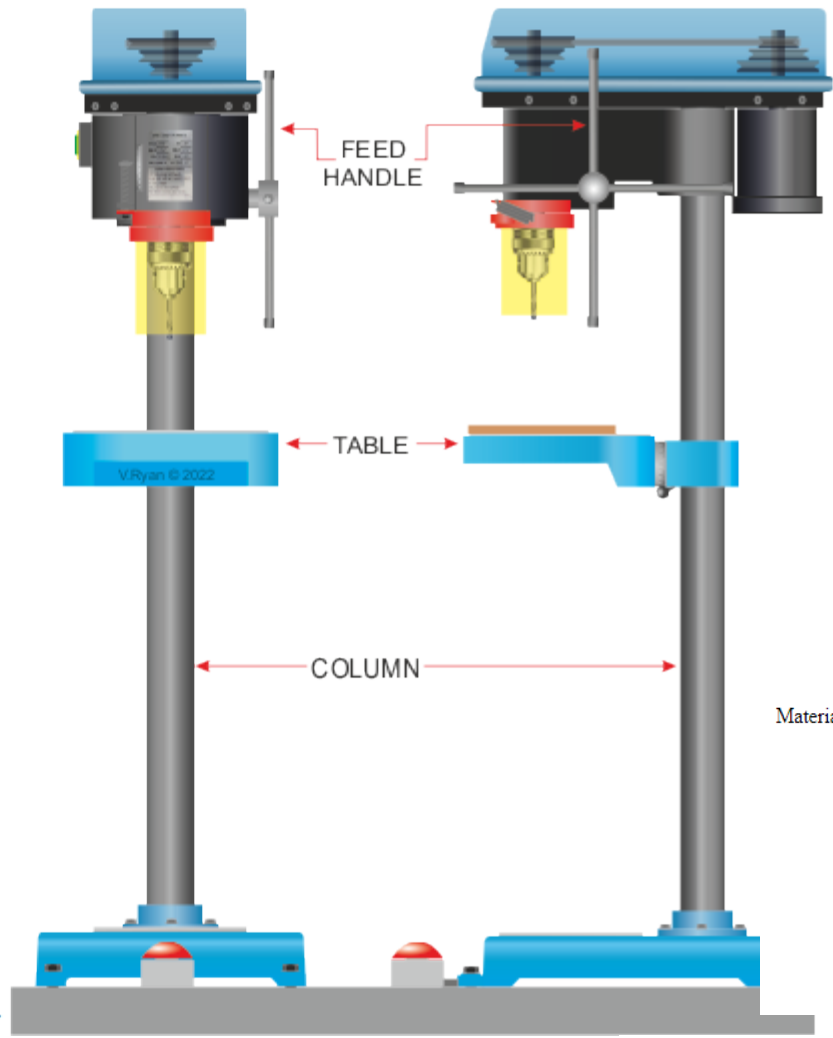
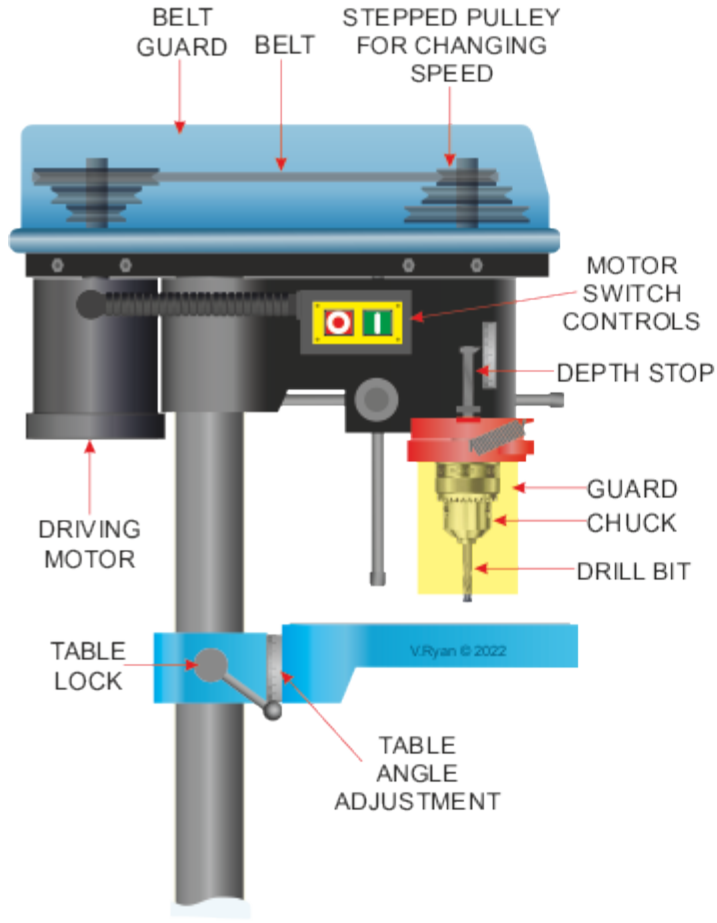


Hole Expansion Drilling

- **Tapping**

adding a screw thread to a pre-drilled hole





EXAMPLES OF BITS USED WITH DRILLING MACHINES



Twist Drill

Used for drilling holes. A normal drill set will include sizes from 1mm to 14mm.



Forstner Bit

Used for larger diameter holes. When using this bit the hole is drilled very slowly so that the bit does not 'jam' in the wood.

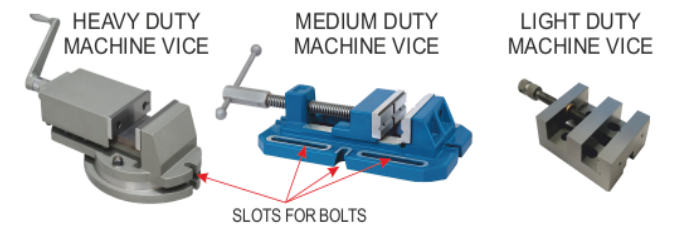


Hole Saw

For large diameters a 'hole saw' can be used. The advantage of this type of drill bit is that the blade can be changed to give different sizes of diameter

HOLDING MATERIAL SAFELY WHEN DRILLING

Material should never be held directly in the hand, when it is being drilled on a drilling machine. A selection of vices are shown below. These are ideal for securing the material.



SETTING THE HEIGHT OF THE TABLE

The height of the table is set by adjusting the table handle (see below). When drilling, the table should be moved quite close to the drill bit, so that the distance from the drill bit to the material is small.

Some machine drills have a rack and pinion system that allows height adjustment. The rack and pinion table adjustment, allows the user to lower or higher the machine table with ease. Simply rotate the handle to move the machine table up or down. *Rotating the handle, rotates the worm gear. The worm gear meshes with the pinion gear, which rotates. The pinion gear meshes with the rack, moving the machine table either up or down.* The machine table is then locked in position.

The guard should always be used. This is the first line of defence if the material being drilled breaks or shatters. Wearing

SAFETY

Always follow the instructions given by your teacher. (only use the machine if you have permission and have trained to use it).

2. Clamp the work down, do not hold the work in your hand.
3. Use the guard.
4. Wear safety clothing and footwear.
5. Tie back long hair or use a hair net.
6. Only one person at a time, to use the drilling machine.
7. Do not distract the person operating the drill

Vocabulary	Wider Research	Apply
<p>Oxidation</p> <p>Fabricate</p> <p>Extract</p> <p>Refine</p> <p>Corrosion</p> <p>Tarnish</p> <p>Galvanise</p>	<p>https://technologystudent.com/joints/matprop1.htm</p> <p>https://technologystudent.com/designpro/matintro1.htm</p> <p>https://www.bbc.co.uk/bitesize/guides/zcxmfcw/revision/1</p> <p>https://learning-center.homesciencetools.com/article/metals-101/</p> <p>https://www.vedantu.com/chemistry/properties-of-metals-and-nonmetals</p> <p>https://www.morecambemetals.co.uk/different-metals-and-their-properties/</p>	<ol style="list-style-type: none"> 1. Your practical product is made from mild steel. Explain why it is a suitable material to make it from. Justify using Topic 1. 2. Pick 3 everyday items that are made using a milling machine and centre lathe. 3. Modern technology has made the modern road sign safer for road users. Describe two ways this has been achieved. 4. Classify these materials – Mild steel, Aluminium, Brass, Stainless Steel, Cast Iron and Duralumin. 5. Explain how to face off on a centre lathe. 6. Give 3 examples of metals that can be combined with another to form a common alloy. 7. What properties are relevant when describing a centre punch? 8. Define Low and high density. 9. What is oxidation and what group of metals does it affect? Explain. 10. How is tarnish different to corrosion? Justify fully.



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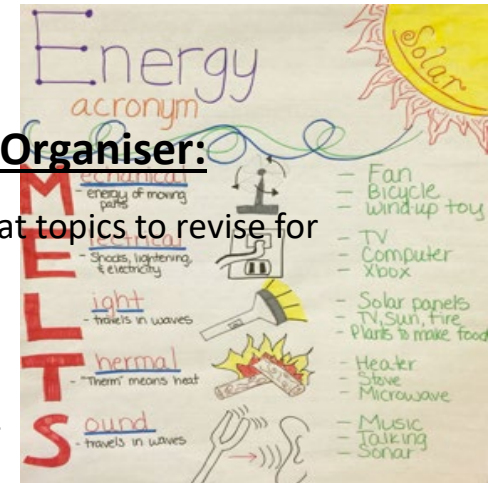
each week

- You will be expected to revise for at least 30 minutes each evening
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Revision techniques and strategies

How to use the Knowledge Organiser:

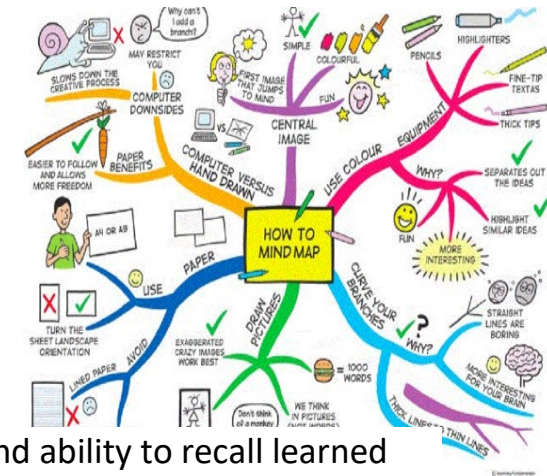
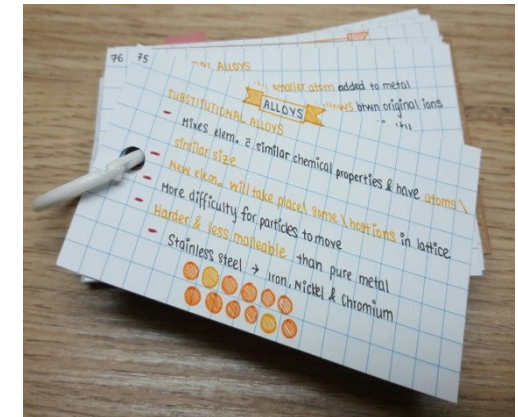
- Your teacher will direct you to what topics to revise for



1. Turn your huge amount of revision notes into small and easy to handle
2. Put a question on the front of your flash cards and write the answer on the reverse – then ask someone to quiz you
3. Mind map – what is the topic and what are the key points you need to remember? You could use different colours for different ideas/characters
4. A question a day – complete an exam question, under timed conditions, each day
5. Record yourself reading your notes and listen back to yourself
6. BUG the question – write out exam questions, examine the key words and plan an answer
7. Use of post-it notes – place post-it notes in key places so you are constantly reading key information
8. Make lists of important facts and figures
9. Draw diagrams to help you visually remember your notes
10. 'Look, cover, say, write, check' – use this method to make sure that you are remembering key information

Revision tips

- Make sure you get some sleep – cognition (acquiring and understanding information) and ability to recall learned facts is limited when you are sleep deprived.
- Eat a healthy, balanced diet - lots of fruit and veg, meats for protein, limit sugary fatty foods.
- Switch off social media/distractions - ignore your phone for a few hours! It will help you keep focused. Social networking, while it's fun, is a big distraction from your revision.
- Give yourself a nice space to work in - have a nice, organised study space with lots of stationary to help you make quality notes/highlight.



- Make a plan - schedule dedicated study time into your daily schedule. Be organised with your time. Stick to your plan. Sacrifice some of your social time for study time. No pain, no gain!
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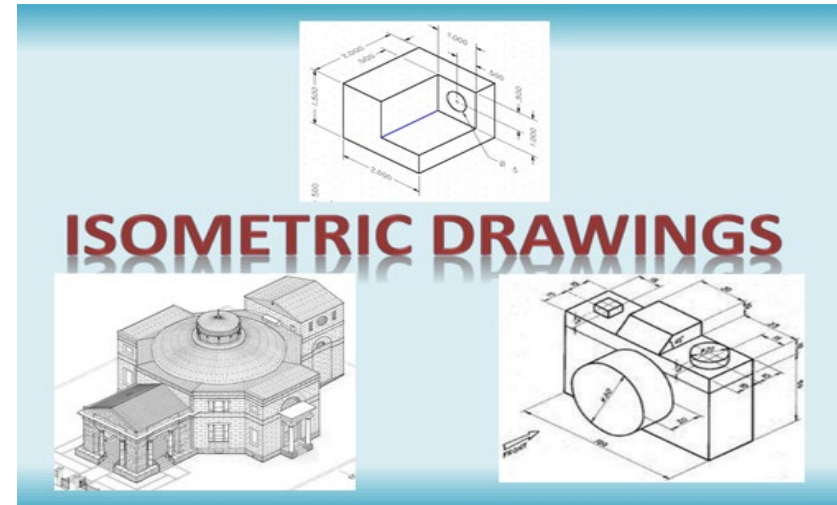
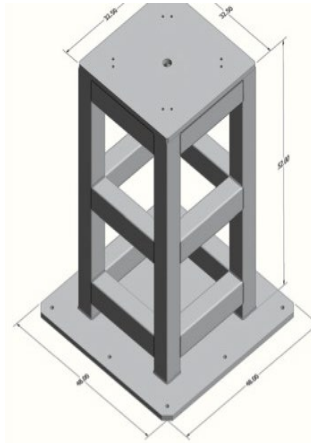
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Topic 1: Isometric Drawing

Isometric drawing

Isometric drawing is a British Standard method of drawing; it is recognised in many different places of work. For example, Engineers who make products will need to look at Isometric drawings produced by the designer so that they are able to make the product.



Isometric drawings are a good method of presenting your design ideas in 3D. In Engineering, you will need to show ideas for your assignments and in your exam. You have been drawing 3D design ideas for your speaker box.

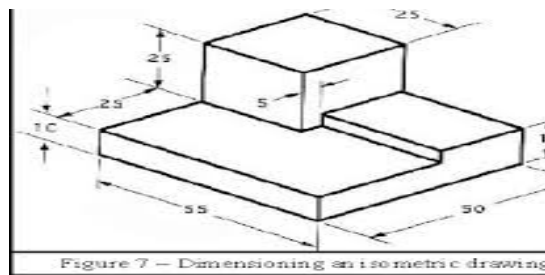


Figure 7 – Dimensioning an isometric drawing

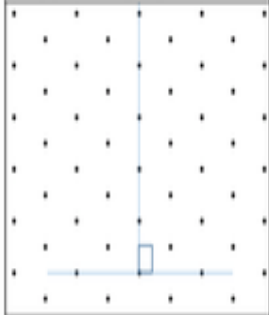
Isometric drawings allow people at work such as Engineers, Kitchen fitters, Builders, Interior designs, Carpenters and many other professions to see what the finished product / project will look like.

Isometric drawings keep all vertical lines at 90 degrees. Horizontal lines are drawn at 30 degrees to the vertical line.

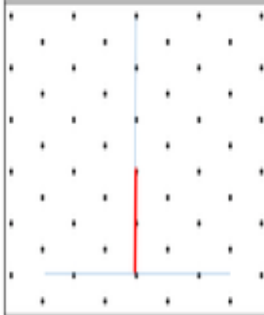
Isometric Projection

Key words: parallel right angle vertical horizontal diagonal equal isometric edge

1. Draw a guide line vertical down the page centre of the page and horizontal across the page to form a right angle.



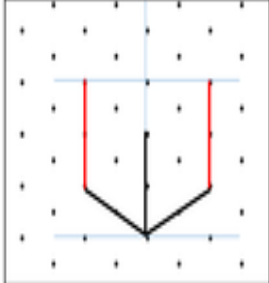
2. Draw the first vertical line of the cube on the centre guide to the length required.



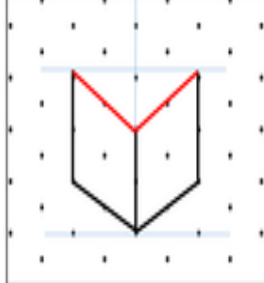
3. Add in the base lines of the cube at 30° angles to the horizontal guide line.



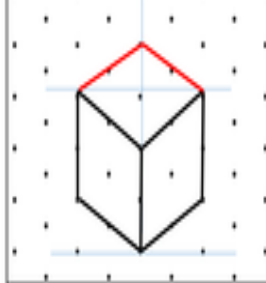
4. Create the side of the cube by drawing two vertical lines the same length as your centre line and parallel to the centre guide line.
5. Add in a new guide line across the top of the two new lines.



6. To make the top front of the cube, draw two lines parallel to the two base line at 30° by connecting the centre line to the two sides.



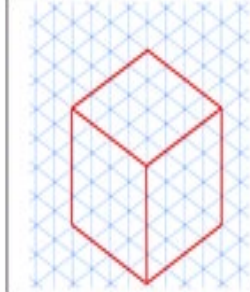
7. Add in the top back edges of the cube at 30° angles to the horizontal guide line.



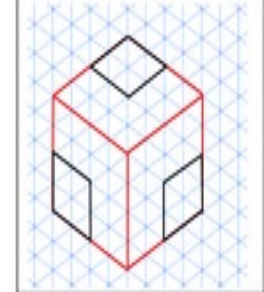
Isometric crofting

Key words: depth height width vertical horizontal diagonal equal isometric

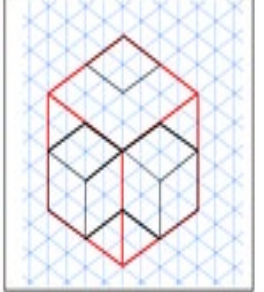
1. Draw a crate to fit the width, depth and height of the object you want to draw.



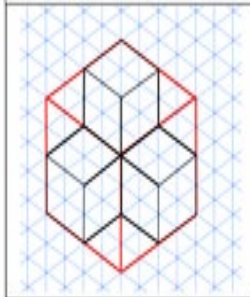
2. Draw the ends of your shape, using the grid as a guide.



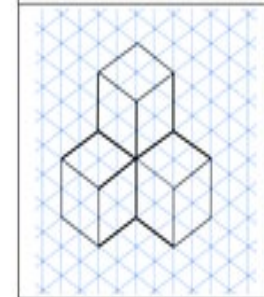
3. Add in the base lines of the cube at 30° angles.



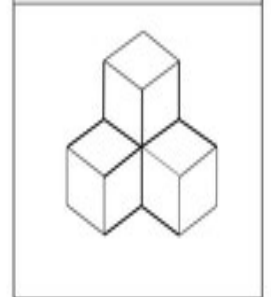
4. Create the sides of the cube by drawing the vertical lines.



5. The crate can be removed to leave the final shape.



6. Show form by rendering the shape.



Topic 2: Third Angle Orthographic Projection

Orthographic drawings are British Standard drawings (ISO, BSI) that contain all the relevant details and information needed for a part / product to be made by a third party. For example a designer will design a car engine and produce Orthographic drawings of the different parts for the Engineers in the factory to use to make the parts to the correct sizes, from the correct materials etc.

Many products are designed by Designers and Engineers in the UK. The drawings can then be sent to manufacturing companies in countries such as China who have the factories and equipment to manufacture the product.

These drawings therefore need to be very accurate with all the necessary details communicated clearly and effectively. Any errors in the drawing would lead to a product that would be faulty.

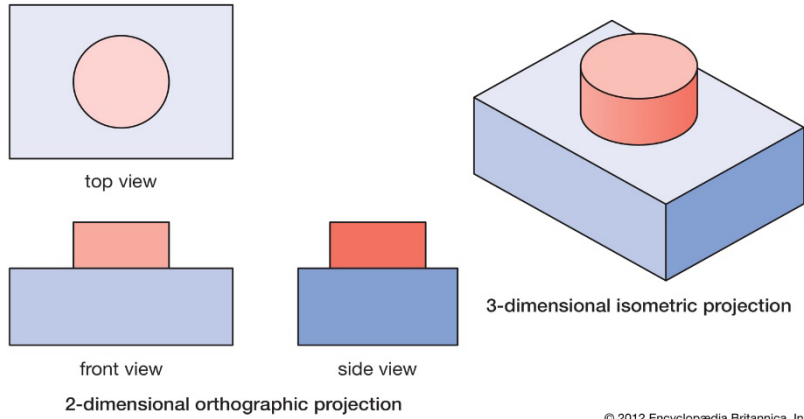
This is why orthographic drawings are standardised using the same format and symbols. Anyone should be able to read and understand the drawing as they must conform to **ISO and BSI**.

Orthographic drawings can be referred to as Technical Drawings, Working Drawings or Engineering Drawings.

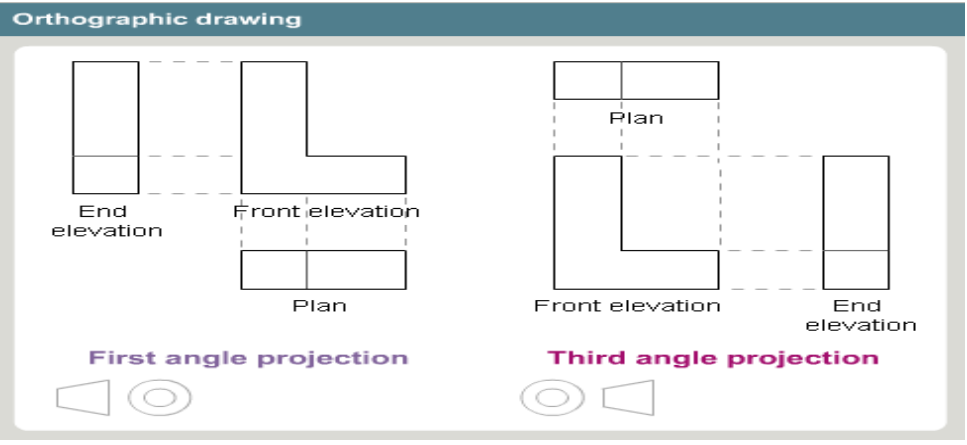
The following conventions must be shown on the drawing so that the person making the product knows what they are doing when making it. For example, all sizes and dimensions would be shown as would the material to be used.

- **Different views**
- **Dimensions**
- **Scale**
- **Materials**
- **Hidden detail**
- **Centre lines**
- **Finishes**
- **Section views**
- **Date the drawing was produced**
- **Engineers/Designers name**
- **Angle Symbol**
- **Title**
- **Parts List**
- **Manufacturing processes**

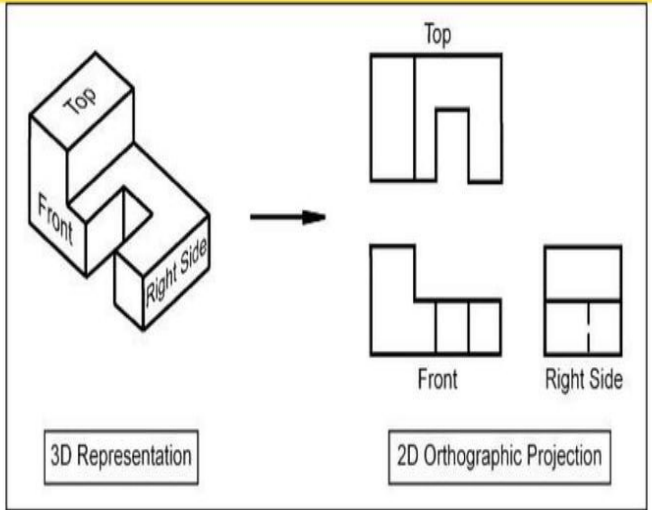
Orthographic and isometric projections of an object



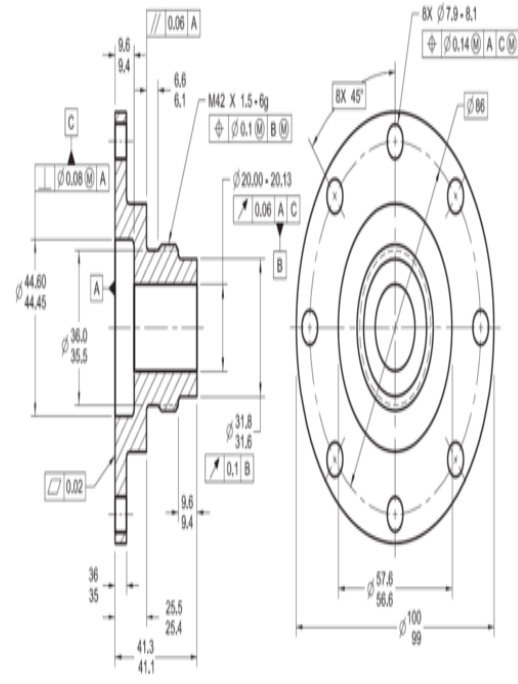
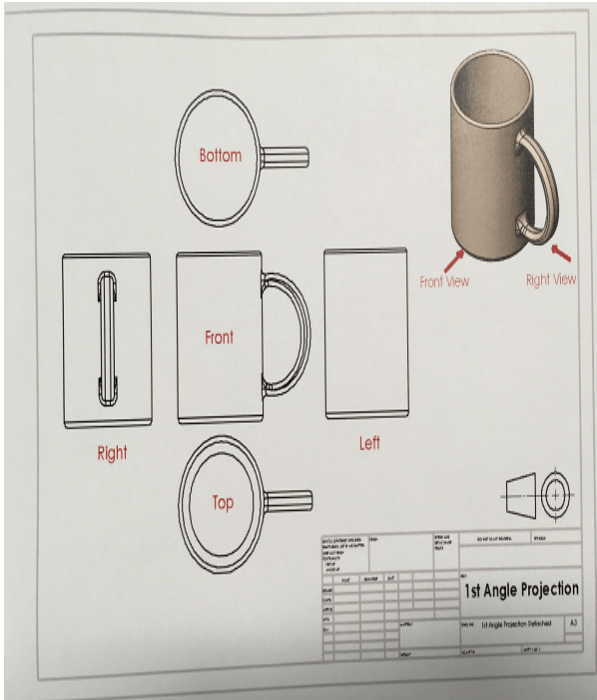
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ORTHOGRAPHIC PROJECTION.





x



Topic 3: Engineering Drawing Dimensions / Line type

Engineering drawings have certain standard conventions, so that any worker that is using the drawing to make something can read it.

First angle and Third angle drawing should have a symbol on the drawing to show you which of the two types of Orthographic drawing has been used in the drawing.

Projection	Symbol
First angle	
Third angle	

Dimension lines on an Orthographic drawing are very important as the person making or building the product uses the dimensions when cutting material to size or positioning features on the product they are making.

All dimensions should be kept to a minimum, so that the page is not covered in too many dimensions that will confuse the person reading it

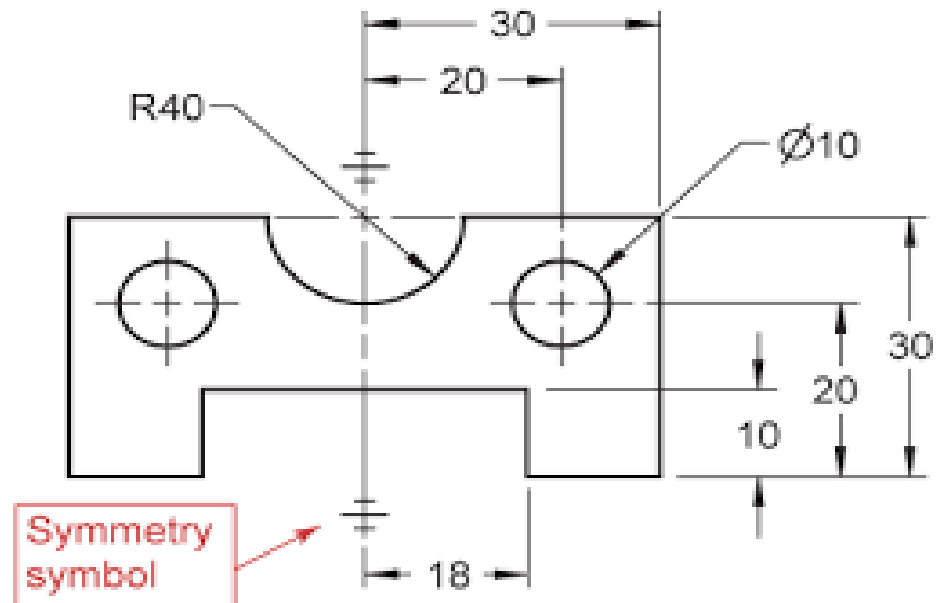
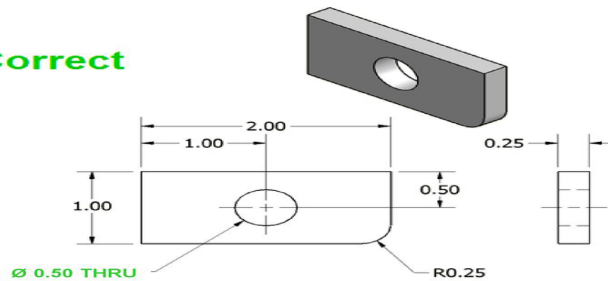
All horizontal dimensions should be show be on the left or right.

Dimension should be above or below the dimension line.

Arrowheads must be a solid block.

11. Avoid crossing dimension or extension lines with leader lines.

Correct



Different types of line used in Engineering drawings

There are many are many different types of line that are used in Engineering drawings.

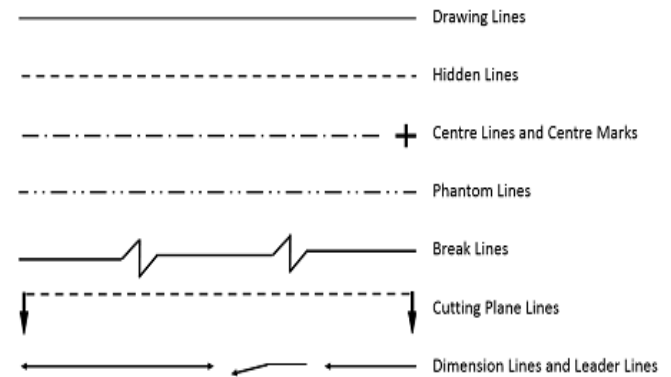
Specific lines are used to show specific things in Engineering drawings.

Due to the sheer amount and variety of lines used.

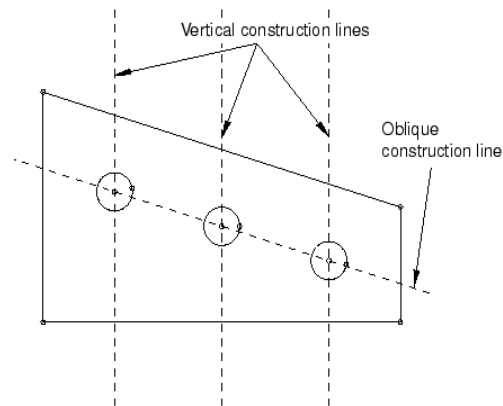
Specific lines have been created to show specific things or have a specific job.

To the right are some lines that conform to BSI 8888:2017

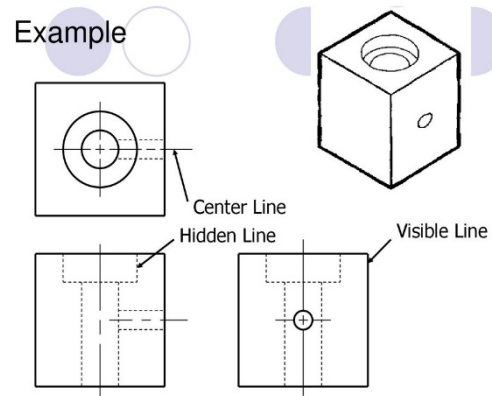
Types of Line



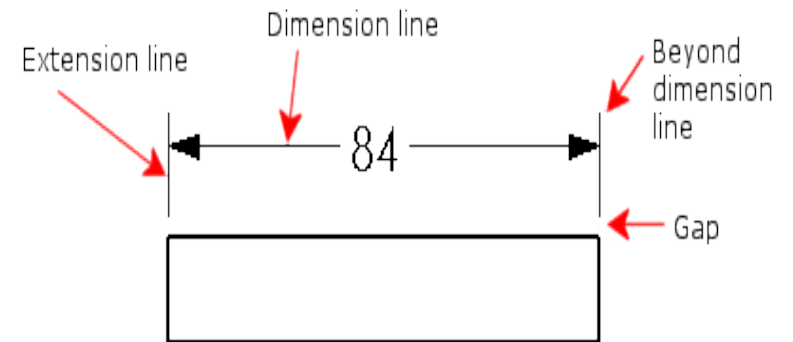
Construction Line Example



Hidden Detail Line Example



Extension Dimension lines



Vocabulary	Wider Research	Apply
<ol style="list-style-type: none"> 1. Isometric drawing 2. Three dimensional 3. British standards 4. International standards 5. Formal drawing 6. 30 degrees 7. Horizontal line 8. Vertical line 9. Isometric grid paper 10. Orthographic drawing 11. Third angle drawing 12. First angle drawing 13. Front view 14. Plan view 15. Side view 16. End view 17. 3rd angle symbol 18. 1st angle symbol 19. Dimension 20. Dimension line 21. Radius 22. Diameter 23. Engineering drawing 24. Construction line 25. Weighted line 26. Centre line 27. Hidden detail line 28. Section line 29. Extension line 	<p data-bbox="566 276 1171 339">https://www.technologystudent.com/despro_fish/graphics_iso1.html</p> <p data-bbox="566 387 1171 451">https://www.technologystudent.com/despro_fish/graphics_ortho1.html</p> <p data-bbox="566 499 1171 563">https://www.technologystudent.com/despro_fish/graphics_main2.html</p> <p data-bbox="566 611 1171 675">http://www.design-technology.info/IndProd/drawings/</p> <p data-bbox="566 722 1171 786">hop.bsigroup.com/products/technical-product-documentation-and-specification-3/standard</p> <p data-bbox="566 834 1171 898">https://www.iso.org/ics/01.100.20/x/</p>	<ol style="list-style-type: none"> 1. Draw a cube using the Isometric drawing method make sure that your horizontal lines are at 30 degrees. 2. Draw and every day product such as a television or an item of furniture using the Isometric drawing method. 3. Draw your mobile phone in 3rd Angle Orthographic Projection. 4. Drawing your phone in 1st Angle Orthographic Projection. 5. Draw the symbol for First angle projection. 6. Draw the symbol for Third angle projection. 7. Using the ISO standards add dimension lines to the drawing of your phone. 8. Draw a Centre line. On your mobile phone drawings. 9. Draw an Orthographic front view of your school bag. 10. Add hidden detail lines to show what is inside your school bag.

Year 11 Engineering Mock Revision List

1. Thermoplastics
2. Thermo setting plastics
3. Ferrous Metals
4. Non ferrous metals
5. Non Destructive tests
6. Destructive tests
7. Temporary fixings
8. Permanent fixings
9. How to cut a external thread
10. How to cut a internal thread
11. Simple electronic component symbols
12. Smart developments in technology
13. What is a LED? What are the benefits of LEDS
14. Health and Safety when using machines
15. Electronic tools for making PCD boards
16. Third Angle orthographic drawing.
17. How to calculate volumes of a cylinder

WJEC Engineering – Unit THREE

The table below shows the different areas which will need to be covered. You HAVE to have evidence on every page to be able to pass this unit

LO	Page	Assessment Criteria	Content
LO1 know how engineered products meet requirements	Page 1 Product Investigation	AC1.1 identify features that contribute to the primary function of engineered products AC1.2 identify features of engineered products that meet requirements of a brief AC1.3 describe how engineered products function	Page one should be a primary investigation. You should be looking at existing products and taking it apart to investigate the product. The content should include the ergonomics, the materials, manufacture of the product and any internal components; Electrical or mechanical. You will need to take plenty of photos to evidence your investigation For a L2 Distinction you will need to 'Accurately describe in detail how a range of engineered products function' This could mean you will need a wide analysis of the product with photos and evidence from the internet of what to components are inside!
	Page 2 Product Analysis	AC1.2 identify features of engineered products that meet requirements of a brief AC1.3 describe how engineered products function	Your product analysis should include 4 existing products. Ideally these can be from a secondary resource such as the internet or a parts catalogue. Use ACCESSFMM to focus on all areas of the products.
LO2 be able to communicate design solutions	Page 3 Communicating Design Ideas	AC2.1 draw engineering design solutions AC2.2 communicate design ideas	In this area you will need to evidence your drawing techniques. A range of styles will be needed. Iso, 3 rd Angle This will be split into two sections 1. Design ideas which will be ONE PAGE of designs with a creative approach 2. Technical Drawings Ideas that have been developed need to show creativity. This means you have developed you idea into a few different variations. There is clear evidence of exploration of ideas with links between other engineered products and ideas demonstrated. This means grab some ideas off the internet and show how you have adapted them onto your designs L2 Distinction Drawings will be fully dimensioned, in proportion and will use the appropriate conventions. Evidence is balanced in terms of isometric and 3 rd angle orthographic.
LO3 be able to propose design solutions	Page 4 Technical Drawings	AC3.1 develop creative ideas for engineered products	Technical Drawings blend in from the previous area. Your Teacher will have taught you how to lay out a drawing to include the following areas which must all be present! 3 rd angle orthographic projection, Isometric , Dimensions and associated symbols, Diameter, circumference, radius, height, depth, width, Conventions , Title block, Dimension lines, Extension lines, Centre lines, Metric units of measurement, Hidden detail, Scale
	Page 5 Evaluation of Designs	AC3.2 evaluate options for design solutions	In your evaluation you must take your specification that you have written and match the areas up to your sketches and drawings. Do they meet the criteria you have written? If they do explain why, if they do not also explain why. You will need to have written your specification before you will be able to evaluate the designs. L2 Distinction Options are evaluated against a range of relevant criteria. Conclusions are clear with detailed reasoning
	Page 6 Design Specifications	AC3.3 produce design specifications	Your design specifications must take priority. Complete these early on and can even be written before your designs. Use ACCESSFMM again to write your design spec against the Design Brief L2 Merit Design specifications are produced with accuracy and clarity

WJEC Engineering – Unit Three

**The table below shows the different areas which could appear on your exam; Revise the areas below to further your understanding of the topics below.
Produce a mind map or revision card for each topic area. Tick when the topic is complete or covered**

Tick	Topic	Content	100% Understand	Not Quite Sure	Need more work!	Link/Resource	Parent Sign
	Engineering Environments and Industry	Structural Mechanical Electronic					
	Environmental issues	Fair Trade, product miles, carbon footprint, disposal, 6 R's. Reduce , reuse, recycle, repair, rethink and refuse Environmentally friendly products and ' Green design'				http://practicalaction.org/6rs http://www.slideshare.net/harrietcarpenter/year-10-introduction-to-the-6-rs	
	Material Properties	Tensile strength Hardness Toughness Malleability Ductility Conductivity Corrosive resistance Environmental degradation Elasticity				http://www.technologystudent.com/joints/joindex.htm http://www.technologystudent.com/joints/matprop1.htm http://www.technologystudent.com/designproj/matintro1.htm	
	Explain how materials are tested for properties	Destructive Tests Non Destructive Rockwell Hardness Test				https://www.youtube.com/watch?v=G2JGNllvNC4 https://www.youtube.com/watch?v=c366-CFb_LE	
	Materials and Components	Metals Ferrous, Non Ferrous, Alloys- Types of Finishes Heat treatment Sheet, Rod, bar and tube				http://www.technologystudent.com/joints/joindex.htm	
		Plastics Thermoplastics and Thermosetting plastics- names of Forming processes – Vacuum Forming, Injection moulding, line bending, compression moulding, extrusion Sheet, rod, powder, granules, foam				http://www.technologystudent.com/joints/joindex.htm	

WJEC Engineering – Unit Three

**The table below shows the different areas which could appear on your exam; Revise the areas below to further your understanding of the topics below.
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Tick	Topic	Content	100% Understand	Not Quite Sure	Need more work!	Link/Resource	Parent Sign
	Materials and Components	Woods Hard Woods, Softwood, Manmade woods- Names of woods				http://www.technologystudent.com/joints/joindex.htm	
	New and Smart Materials	Smart materials and properties Precious Metal Clays (PMC) Corn starch polymers (Packaging) Thermochromic inks Shape memory alloys Nanomaterials				http://www.technologystudent.com/joints/joindex.htm www.designandtech.com/graphics	
	Know and Describe Engineering Processes	Marking out Cutting Finishing Preparing Shaping Drilling Turning Brazing Joining o Permanent o Temporary fixings Filing Soldering				Practical work throughout the year Folder Work and photos taken	
	Material Shaping Heat Treatment	Material removal For shaping and manipulation For joining and assembly For heat and chemical treatment				https://www.youtube.com/watch?v=TcrQ1_fYU0	
	Quality Control + Manufacturing	CE, BS EN ISO 9000, BSI Kitemark Testing of products CAD CAM – Manufacturing techniques Computer Manufacture, Computer Design				https://www.bsigroup.com/en-GB/standards/british-standards-online-database/bsol-academic/	
	Mathematical techniques for solving engineering problems	Use of formulae Ohms law Areas and volumes of geometric shapes Calculation, Measuring, Estimation, Mean, Units of measurement o Metric o Metres, millimetres o Pounds, pence				https://www.bbc.com/bitesize/subjects/z6vg9j6	
	Orthographic + Technical Drawings	Isometric Drawing 3 rd angle orthographic projection, Isometric , Dimensions and associated symbols, Diameter, circumference, radius, height, depth, width, Conventions , Title block, Dimension lines, Extension lines, Centre lines, Metric units of measurement, Hidden detail, Scale					