CLEETHORPES ACADEMY HOME LEARNING

Year 10: Engineering

We Are ***CARING*** We Are ***CURIOUS*** We Are ***CREATIVE***

SELF QUIZZING

OUR EXPECTATIONS

- The act of self-quizzing supports retrieval. Retrieval is important because the more we revisit knowledge and ideas, the more likely we are to remember it. The more we remember, the greater sense we can make of our learning.
- You should spend a minimum of *30 minutes a night* focusing on a specific subject's retrieval activity.
- You should bring your completed work to form, every Tuesday, where your work will be checked and additional retrieval activities will be completed to support your retention of the information studied at home.
- Failure to complete the activities each week, will result in further sanctions.

WHAT YOU SHOULD DO

- Each night, select a subject to focus on.
- Read the subject's information really trying hard to remember what you have read. You might want to highlight and add your own notes to the information you have been given.
- Once you are confident that you can recall the information without having to recheck, use the following blank page to write down everything you can remember, using a black or blue pen. Don't worry if you can't remember everything
- In form time, your tutor will ask you to check through your work and use a green pen to "gap fill" any information you may have missed.
- Your tutor will also ask further questions in relation to the information you have read each week, to further support your retention of new knowledge.
- You will be rewarded with carrot points for your efforts each week.

WEEK 1

Material properties

Physical Properties (Before a material is used)

Property	Simple Meaning	Easy Example
Absorbency	Soaks up water, light or heat	Cotton and paper absorb well; acrylic does not
Density	How heavy/solid something is for its size	Lead is very dense (heavy for its size)
Fusibility	Can melt and join to another material when cooled	Webbing that irons onto fabric
Electrical Conductivity	Lets electricity pass through	Copper wires conduct electricity
Thermal Conductivity	Lets heat pass through	Steel conducts heat; pine wood does not

Working Properties (How a material behaves when used or changed)

Property	Simple Meaning	Easy Example
Strength	Can resist being pulled, squashed or twisted	Wool is stronger than cotton when pulled
Hardness	Resists scratches, dents or impacts	Oak is harder than pine
Toughness	Hard to break or snap; absorbs shock	Kevlar in bulletproof vests
Malleability	Can be bent or shaped easily	Sheet steel or silver can be hammered into shape
Ductility	Can be stretched without breaking	Copper can be pulled into thin wire
Elasticity	Stretches and returns to its original shape	Elastane in swimming costumes

Material Categories

Material Type	Examples / Notes
Papers and Boards	Card, cartridge paper
Timbers	Pine, oak, beech
Metals	Steel, copper, aluminium
Polymers	Acrylic, polystyrene, nylon
Fibres and Fabrics	Cotton, wool, polyester

WEEK 2

Hardwood

Hardwoods come from *deciduous* *trees, which have large flat leaves that fall in the autumn. Hardwoods take longer to grow, are not easily sourced and are expensive to buy.*

Hardwood	Physical properties	Working properties
Birch	Creamy white or yellow colour	Well worked by machines, can be steam bent and is resistant to preservatives, used in joinery and plywood
Beech	Slight pink tint, close grain	Tough, durable and smooth to finish, used on high-quality furniture
Teak	Coarse uneven texture with oily feel, usually straight grained	Produces own natural oils, can be cut well and glues well, used on outdoor furniture and boats
Oak	Moderate-brown colour with unique and attractive grain markings	Tough and durable, polishes well, used for quality furniture
Balsa	Pale and wide-spaced grain due to it being a fast-growing hardwood	Very soft and easy to form, often used to make models

Softwood

Softwoods come from *coniferous* *trees. These often have pines or needles, and they stay evergreen all year round - they do not lose leaves in the autumn. They are faster growing than hardwoods, making them cheaper to buy, and are considered a* *sustainable* *material.*

Softwood	Physical properties	Working properties
Cedar	Reddish brown in colour, straight grain and coarse texture	Easily worked with tools and machines, glues and finishes well, used in joinery and cladding
Pine	Pale coloured with aesthetically pleasing grain	Lightweight, easy to form, used for construction and decking
Spruce	Pale cream with an even grain	Easy to form, takes stain colour well, used for construction and furniture

WEEK 3

Manufactured board

Manufactured boards are usually made from timber waste and *adhesive. To make them more aesthetically pleasing they are often veneered. They are cheap to buy.*

Manufactured board	Physical properties	Working properties
Medium-density fibreboard (MDF)	Smooth, light brown, can be veneered	Smooth and easy to finish, absorbs moisture so not suitable for outdoor use, used for kitchens and flat pack furniture
Plywood	Odd number of layers of veneer glued at 90 degree angles for strength, aesthetically pleasing outer layer	Easy to cut and finish, can be stained or painted, used for shelving, construction and toys
Chipboard	Compacted wood chips, laminated with a variety of coverings, end cuts are difficult to finish	Strong but absorbent to water, used for veneered worktops and flooring
Blockboard	Blocks of wood that are 'sandwiched' between two thin outer layers of wood	Strong and durable, not used outside but instead for interior use on shelves, doors and panelling

General Advantages of Manufactured Boards

- Available in **large sheet sizes**
- **More stable** than natural timber (less warping/twisting)
- Often **cheaper** than solid wood
- Uses **waste wood** → more **sustainable**

General Disadvantages

- Some boards contain **adhesives** which may give off fumes
- Edges can be **weak** and need covering
- Some boards (e.g., chipboard, MDF) **absorb moisture** easily unless treated

WEEK 4

Thermoforming polymers

Thermoforming polymers can be heated and formed repeatedly. They are *pliable and recyclable*.

Thermoforming polymer	Physical properties	Working properties
Acrylic (PMMA)	Hard, brittle, shiny, available in a wide range of colours	Resists weather well, can be cut, folded and polished well, scratches easily, used for car headlights, visors and baths
Polystyrene (PS)	Rigid, cheap, available in a lot of colours	Can be cut and vacuum formed easily, food safe but toxic when burned, used for CD cases and yoghurt pots
High density polyethylene (HDPE)	Stiff, strong, lightweight	Lightweight and flexible, can be recycled well, used for washing baskets, pipes and chairs
Polypropylene (PP)	Easily coloured, available in sheets	Tough and flexible, used for plastic chairs and casings
Polyvinyl chloride (PVC)	Cheap, can be matt or high gloss	Brittle but durable, can be extruded or in flat sheets, used in blister packs and window frames
Polyethylene terephthalate (PET)	Clear, smooth finish	Light, strong and tough, used for clothing and drinks bottles
Low density polyethylene (LDPE)	Low cost, processed through all common manufacturing processes.	Resistant to moisture and chemicals. Used in bottles, containers and packaging
Acrylonitrile butadiene styrene (ABS)	Strong, tough and lightweight, good surface finish	Durable material, resistant to chemicals and water, ideal for injection moulding, used on keyboards, toy bricks and casings of products such as drills
Thermoplastic elastomer (TPE)	Properties of natural rubber but processed like other plastics, flexible and stretchy	Excellent weather resistance and shock absorption, long-lasting, used on wires, grips on handles and seals

WEEK5

Drawing Type	What It Is	Key Features (Simple)
Working Drawings	Drawings sent from the designer to the manufacturer to help them make the product	– Shows accurate sizes (dimensions) – Used in manufacturing – Clear, detailed views
Exploded Diagrams	A drawing that shows all the parts of a product separated but arranged in order	– Shows how parts fit together – Dotted lines show where pieces go – Used instead of written instructions (e.g., flat-pack furniture)
Elevations	Flat views of each side of an object, such as front, side or plan (top)	– Shows each side separately – Allows detailed measurements – Plan = top view
Orthographic Projections	2D drawings showing different views of a 3D object (front, side, plan)	– No perspective (not 3D looking) – Used for accurate technical drawings – Drawn to scale with dimensions
First & Third Angle Projections	The two different ways orthographic drawings can be arranged	– First angle: right-side view drawn on the left – Third angle: right-side view drawn on the right – Special symbols show which one is used
Isometric Drawings	A 3D-looking drawing used to show shape and size clearly	– Horizontal lines at 30° – Vertical lines straight up – Parallel edges stay parallel – Shows accurate 3D shapes
Freehand Sketches	Quick drawings used to record ideas before they are forgotten	– Drawn without ruler or tools – Fast and simple – Used for early design ideas

WEEK 6

CAD

Topic	Simple Explanation	Key Points for KS4
What CAD Means	CAD = *Computer-Aided Design*. It is design work done on a computer instead of on paper.	– Used on computers – Makes drawing quicker and easier
Why CAD Is Important	It helps engineers design products accurately and quickly.	– Saves time – Reduces mistakes – Easy to edit and improve designs
Accuracy	CAD allows **precise measurements** and perfect shapes.	– Exact sizes (millimetre accurate) – No hand-drawing errors
Easy to Change Designs	Designs can be edited without starting again.	– Simple to fix mistakes – Try new ideas quickly
3D Modelling	CAD can show a product in **3D**, allowing engineers to see what it will look like before it is made.	– Helps visualise the design – Rotate and view from all angles
Testing and Simulation	CAD can test how strong or safe a design is before it's built.	– Helps avoid faults – Saves money on prototypes
Sharing and Collaboration	CAD files can be sent to others easily.	– Engineers can work together – Used worldwide
Links to CAM (Computer-Aided Manufacturing)	CAD designs can be sent straight to machines like laser cutters or CNC machines.	– Fast production – Very accurate making – Reduces human error
Use in Engineering	CAD is used to design cars, machines, buildings, tools, electronics, and more.	– Used in most engineering careers – Important skill for the future
Saving Cost and Time	CAD reduces time spent drawing and reduces waste in manufacturing.	– Uses fewer materials – Makes production cheaper

WEEK 7

Sketchup Support

Navigation (Moving Around the Model)

Task	How to Do It (Easy Instructions)
Orbit	Hold the **scroll wheel** and move mouse
Zoom	Roll the **scroll wheel**
Pan (move view sideways)	Hold **Shift + scroll wheel**

Drawing Tools

Task	How to Do It
Draw a line to a set length	Type the **length** → press **Enter**
Undo the last part of a line	Press **Esc**
Lock the direction (straight line)	Hold **Shift** while drawing
Change circle/polygon sides	Type **number + s** → press **Enter**
Draw circle with a set radius	Type the **radius** → press **Enter**

Select Tool

Task	How to Do It
Add/remove items from selection	Hold **Shift**
Select everything	**Ctrl + A**
Select items completely inside box	Drag **left → right**
Select items touched by box	Drag **right → left**
Select all faces with same material	Right-click → **Select → All with Same Material**

Move Tool

Task	How to Do It
Move set distance	Type the **distance** → press **Enter**
Force Auto-Fold	Press **Alt**
Lock movement up/down (blue axis)	Press **Up/Down arrow**

WEEK 8

Sketchup Support

Eraser Tool

Task	How to Do It
Hide something	Hold **Shift** + click
Smooth something	**Ctrl** + click
Unsmooth	**Shift** + **Ctrl** + click

Scale Tool

Task	How to Do It
Scale from the centre	Hold **Ctrl**
Scale evenly (not stretched)	Hold **Shift**
Scale by a number	Type the **number** → Enter
Set exact size	Type **size** + **units** → Enter

Quick Time-Saving Tips

Task	How to Do It
Divide an edge into equal segments	Right-click edge → **Divide** → type number
Resize whole model from one measurement	Tape Measure → measure → type real size → **Enter** → Yes
Set your own keyboard shortcuts	Window → **Preferences** → **Shortcuts**

Useful SketchUp Keyboard Shortcuts

Tool	Shortcut	Tool	Shortcut
Line	**L**	Arc	**A**
Eraser	**E**	Rectangle	**R**
Select	**Spacebar**	Push/Pull	**P**
Move	**M**	Offset	**O**
Circle	**C**	Rotate	**Q**
Arc	**A**	Scale	**S**
Rectangle	**R**	Zoom Extents	**Shift + Z**
Push/Pull	**P**	Paint Bucket	**B**

WEEK 9 and 10

Orthographic Drawings

A 2D technical drawing that shows different views of a 3D object that shows front, side and plan (top) views. There is no perspective or 3D depth, and it is used to show accurate information for manufacturing. An orthographic drawing helps manufacturers understand the exact size and shape of a product as it shows all necessary measurements. It also helps avoid mistakes when making the product this is a standard method in engineering and design.

Feature	Explanation	Key Points for KS4
Views	Usually **Front View**, **Side View**, and **Plan (Top View)**	– Views line up using construction lines – Each view must match the others accurately – Shows the object from all angles
First Angle Projection	The object is placed between the viewer and the plane. Views appear on the opposite side.	– Right-side view is drawn on the **left** – Plan view appears **below** the front view – Used mostly in Europe – Uses the *first angle symbol*
Third Angle Projection	The drawing plane is placed between the viewer and the object. Views appear on the same side.	– Right-side view is drawn on the **right** – Plan view appears **above** the front view – Commonly used in the UK & USA – Uses the *third angle symbol*
Symbols Used	Special symbols show whether first or third angle projection is used	– Ensures the manufacturer reads the drawing correctly – Prevents mistakes in production
Scale	Drawings are created to scale so they match real sizes	– Shows the product smaller or larger but in correct proportions – Must be labelled clearly (e.g., 1:2, 1:5)
Dimensions	Measurements added to show the exact size of each part	– Must be clear and easy to read – Use standard dimension lines and arrows – Avoid placing dimensions inside the object unless needed
Line Types	Uses standard lines to show edges, hidden parts, centres, etc.	– Solid lines = visible edges – Dashed lines = hidden edges – Chain lines = centre lines – Construction lines = light guiding lines
Accuracy	Orthographic drawings require careful measuring and layout	– Views must align exactly – Lines must be straight and neat – Uses precise drawing tools (ruler, set square, compass)
Use	Engineers, manufacturers, architects, designers	– Needed before anything is built – Helps communicate technical information clearly

WEEK 11

Exploded View Drawing

A drawing that shows all the parts of a product pulled apart, but in the correct order and position. An exploded view shows each part separately and the parts are spaced out (exploded).

Link to Isometric Drawings

Exploded views are often drawn in **isometric** so you can see the parts in 3D as Isometric drawings show. 3D shapes clearly. Isometric drawings use 30° angles for horizontal edges in addition to vertical lines; this helps you see how parts fit together.

Topic	Simple Explanation	Key Features for KS4
Importance	They help people understand **how to assemble** a product	– Used in flat-pack furniture instructions (e.g. IKEA) – Can replace long written instructions – Easy to understand in any language
Showing How Parts Fit Together	Exploded drawings show where each part goes and how it connects	– Dotted lines often show where parts slide or screw into place – Hidden parts (inside) can be seen – Good for showing complex assemblies
Use in Manufacturing & Design	Designers and manufacturers use these drawings to plan and explain products	– Helps workers assemble products correctly – Used in manuals and technical drawings – Useful in quality control and repair guides
Advantages for the User	Makes building and understanding a product easier	– Clear visual steps – Reduces mistakes – Good for visual learners and low reading ability
Key Features of Exploded Isometric Drawings	Combination of **exploded view** and **isometric style**	– 3D effect (isometric) – Parts separated but aligned – Labels or numbers can show each component

Advanced Specification

WEEK 12

Function:	What job(s) does the product have to do in order to be successful? The product may have more than 1 function.
Appearance:	What should the design look like? Try to explain the way the design should appear. This can involve the shape, proportions as well as colours used and the texture.
Quality:	How do you intend to get a well made product? Are you going to listen to instructions, consider other peoples' opinion and work safely? What methods will you use to try and get a quality result? Will you model first, measure, test print/ plot or use a jig?
Deadline:	How long you do you have to do the set work? Consider here how long you have to do the whole project including folder work or just the making. This could be explained in the number of weeks available or the number of lessons
Materials:	What do you intend to use in making the consider woods, metals, plastics, paper, card, fabric, raw ingredients? Also here you could clarify if they need to be sheet materials, rod, tube, board etc.
Target user:	Who is the intended user of the particular product? For a designer the user could be specific person or group so the design is developed to suit his/her, their needs
Cost	How much would you expect to pay for the finished product?What price limit would you set to buy the materials for you to make it?
Size	In simple terms, how big the design could be. What maximum and minimum limits can you work to? Think of this in Length, Width and Depth restrictions.
Safety	What factors will you consider to make sure the product is not dangerous to use? Are there any health and safety guidance to follow when designing?
Maintenance	How do you intend to look after the product? This could involve cleaning, charging up, changing the battery. Consider the Life-span of the product.
Lifespan	How long do you intend for the product to be used for? This can be the product shelf life. Try to explain it in a time-frame e.g. a month, a season, a year or longer term.
Weight	How heavy is the product likely to be? How many people will it take to carry it? Will it be one or two people, will it be a child or an adult as different restrictions can be applied.
Anthropometrics	Human Measurements-Use these to help you design a product that will be comfortable for the Target Consumer to use? Which dimensions are important for you to use in your designing?
Environmental	What will be the impact of the product on the environment during manufacture, after use? Will the product be suitable for recycling? Are the materials/power supply sustainable?