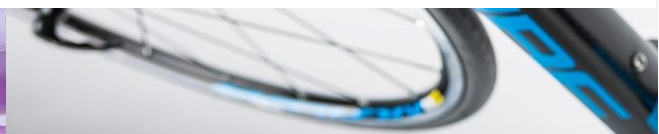


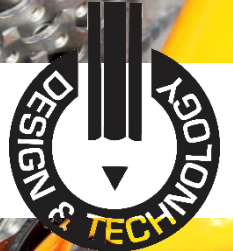
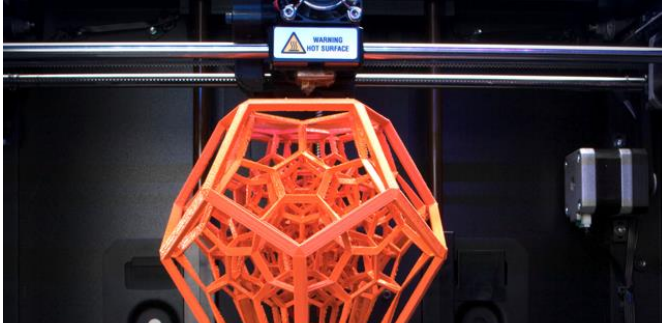
YR 10 Theory Booklet



Name:

Group:





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Polymers / CAD CAM

Section 2:

Sustainability

Section 3:

Smart Materials

Section 4:

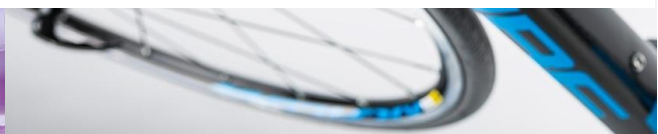
Materials Specialism

Section 5:

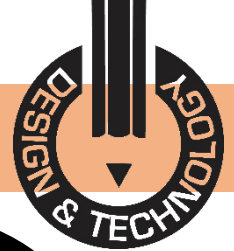
Exam Practice Nandos H/W's

Section 6:

Product Research H/W's

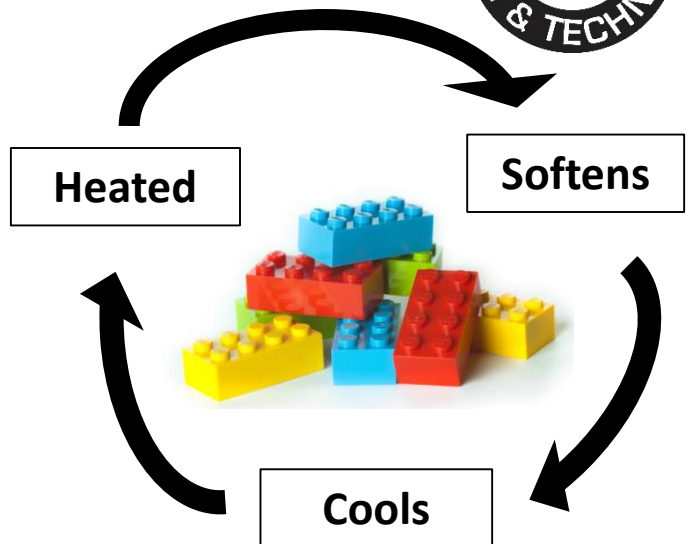



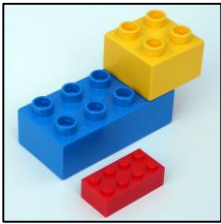

THERMOPLASTICS



Thermoplastics can be heated and shaped many times. Thermoplastics are formed when they are in their melted phase. This generally means that they are heated, formed, then cooled in their final shape.

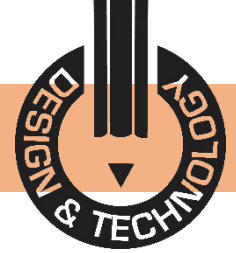
Thermoplastic components can be made in very high volume with high precision and low cost. Thermoplastics can replace metals with a considerable weight savings, providing proper care is taken in design.



Plastic	Picture	Properties	Uses
Acrylic		Stiff, hard, clear, durable outdoors, easily machined and polished, good range of colours, does scratch easily	Illuminated signs, aircraft canopies, perspex sheet, car rear-light clusters, school projects
ABS		Tough, high-impact strength, lightweight, scratch-resistant, chemical resistance, excellent appearance and finish. Good for injection moulding	Kitchenware, safety helmets, car parts, telephones, food mixers, toys
Low-density Polythene		Range of colours, tough, flexible, good electrical insulator and chemical resistance	Washing-up liquid, detergent and squeeze bottles, bin liners, carrier bags

Advantages of Thermoforming Plastics	Disadvantages of Thermoforming Plastics
Can be reheated many times due to their plastic memory.	Many thermoplastic materials, especially composites, tend to fracture rather than deform under high stress levels.
Wide ranging properties.	Thermoplastics melt. Some degrade in direct sunlight or under high U.V. light levels.
Can be widely recycled.	Generally more expensive than thermosetting plastics.

THERMOSETTING PLASTICS



Thermosetting plastics are synthetic materials that strengthen during being heated, but cannot be successfully remolded or reheated after their initial heat-forming. This is in contrast to thermoplastics, which soften when heated and harden and strengthen after cooling.

Thermosetting plastics can not usually be recycled and are also difficult to surface finish.



Heated






Softens



Cools



**Permanently
Hard**

Plastic	Picture	Properties	Uses
Urea-Formaldehyde		Stiff, hard, brittle, heat-resistant, good electrical insulator, range of colours	White electrical fittings, domestic appliance parts, wood glue
Epoxy resin		Good chemical and wear resistance, resists heat to 250°C, electrical insulator	Adhesives such as Araldite used to bond different materials such as wood, metal and porcelain
Polyester Resin		When laminated with glass fibre becomes tough, hard and strong, brittle without reinforcement	GRP boats, chair shells, car bodies

Advantages of Thermosetting Plastics	Disadvantages of Thermosetting Plastics
They are very resistant to heat.	They can only be formed into a shape once. They can not be reheated.
They strengthen during heating.	They burn if heated more than once.
Perfect for making permanent components ad large solid shapes.	Can not normally be recycled.

COMPUTER AIDED DESIGN / CAD



CAD software is used to create precision 2D or 3D drawings, models or technical illustrations. It is commonly used by designers, architects, engineers and artists.

Designers can use computer packages like 2D Design, Autocad, SketchUp to design, Model and Test ideas before they go into production. It is particularly useful because;

- Computers can be used to make changes to a design and edit it without having to redraw it.
- Computers can be used to produce very accurate drawings and dimension exactly to what is drawn.
- Computers can produce photorealistic models without having to make them
- You can see what it will look like in 3D – spin it around so you can see all angles
- Computers can show or simulate how a product will behave without having to undertake expensive testing.



AUTODESK®
AUTOCAD®







Advantages of CAD	Disadvantages of CAD
Designs can be created, saved and edited easily, saving time	CAD software is complex to learn
Designs or parts of designs can be easily copied or repeated	Software can be very expensive
Designs can be worked on by remote teams simultaneously	Compatibility issues with software
Designs can be rendered to look photo-realistic to gather public opinion in a range of finishes	Security issues - Risk of data being corrupted or hacked
CAD is very accurate	
CAD software can process complex stress testing	

COMPUTER AIDED MANUFACTURE / CAM



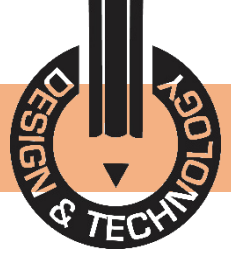
Computer-aided manufacturing (CAM) means using machines that are controlled by computers. CAM is widely used across all sectors of industry, not just electronics.

All machines in CAM use computer numerical control (CNC): strings of numbers control the machine. The numbers provide all the commands needed: eg which direction to move, how fast, etc. These are normally stored in the machine as a program.

3D Printer	Micro Router	Laser Cutter	Vinyl Cutter
The action or process of making a physical object from a three-dimensional digital model, typically by laying down many thin layers of a material in succession.	A computer-controlled cutting machine related to the hand held router used for cutting various hard materials, such as wood, composites, aluminium, steel, plastics, and foams.	By cutting at different speed rates, laser cutters can burn through or etch the surface of a material. They can cut complex shapes in a wide range of materials.	The computer controls the movement of a sharp blade. This blade is used to cut out shapes and letters from sheets of thin self-adhesive plastic (vinyl).
			

Advantages of CAM	Disadvantages of CAM
Computers do not make mistakes if programmed properly	CNC Machines can cost a lot of money, more than manual machines
Computers give reliable and consistently high standards of manufacture	Specialist knowledge is needed to programme computers
Computers achieve quicker production times	May lead to rise in unemployment (less workers needed)
Complex shapes and designs can be created easily	
Production can run 24 hours a day, 7 days a week, so more efficient	
Designs can be produced quickly to gather public opinion in a range of finishes	

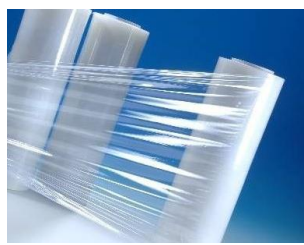
POLYMERS



Complete the names in the boxes for the standard forms that polymers come in:









Connect with the straight line, the property with the definition:

- | | |
|-----------------|---|
| 1: Hardness | Can be hammered, pressed into a shape |
| 2: Toughness | Can be stretched into wire |
| 3: Strength | Can withstand shocks such as hammering |
| 4: Elasticity | Can be pulled apart or stretched, crushed or compressed, twisted, sheared as a result of sideways force |
| 5: Flexibility | Can be stretched and then return to original length |
| 6: Ductility | Can bend but not break and return to original shape |
| 7: Durable | Can withstand bad weather conditions |
| 8: Malleability | Can resist cutting and indentations |

Put a **N** for Natural polymer or a **S** for Synthetic Polymer in the small box to the different polymers:

Nylon		Proteins	
Polyethelene		Cellulose	
Starch		Polyninyl Chloride	

THERMOPLASTICS & THERMOSETTING PLASTICS



Advantages of Thermoplastics	Advantages of Thermosetting Plastics



What plastic do you think the saucepan handle is made from?

Why do you think this?



Which plastic do you think the measuring jug is made from?

Why do you think this?



The plastic used for the thin rods needs to be flexible, name a thermoplastic suitable:

The plastic used for the outer shell of the headphones needs to be scratch resistant, name a thermoplastic suitable:

What is a disadvantage to these headphone components being made from thermoplastics instead of thermosetting plastics?

CAD WORKSHEET



Advantages of CAD	Disadvantages of CAD



Initial Sketches



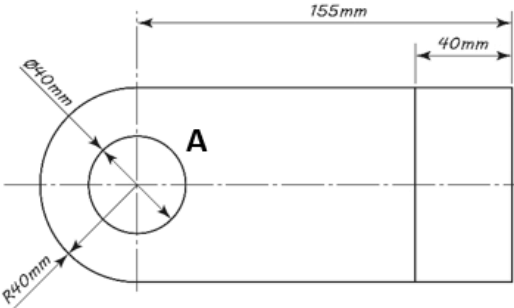
CAD Model



Final Manufactured Product

Explain how important using CAD is in the process of designing:

This is a component from the headphones. It has been drawn out using google sketch up. What are the advantages to using Sketch Up to draw this component?





CAM WORKSHEET





Advantages of CAM	Disadvantages of CAM

Write about the different machines and explain which would be better at cutting out the acrylic back to your keyring and why:

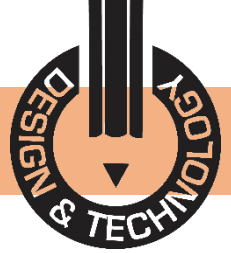
Laser Cutter	 VERSUS
Micro Router	
	

Discuss the different methods and the benefits of both when it comes to cutting out your vinyl sticker for the front of your keyring. Which would be best and why?

Vinyl Cutter	 VERSUS
Craft Knife	
	

What are the drawbacks to using CAM to an organisation and the staff working within the organisation?

CAM WORKSHEET



After watching the video about the future of 3D printing and learning of the dangers. Discuss in detail whether you think it is a good idea for everyone to have 3D printers in their home in the future:

After learning about the Laser Cutter and seeing it in action, why was this form of CAM best for creating your key ring? Why may this method have been better than making it by hand? What are the negatives of using this machine to make your key ring?

CAD DESIGN PAGE



Stick in the image of your CAD design below in the box. Remember, presentation is very important:

Evaluate the process of using 2D design to create your keyring. What difficulties did you encounter? What would you do differently if you were to do it again?

POLYMERS / CAD CAM



For this mini project you will be designing a keyring using CAD and CAM. You will use 2D design and then the laser cutter / Vinyl cutter. At the end of this section you will sit an exam. In the boxes below are the areas that will be covered in the exam. You need to think about some keywords that you can put into the second box, which remind you of the areas covered in the project. You must complete the confidence column before the exam; you must tick the face which best describes how you feel about the particular area. After the exam, your peer assessor will complete the question mark column and give two stars and a wish feedback, as well as put in the exam score. You must finally comment in purple pen whether you have re-attempted the questions you did not get full marks on.

CORE KNOWLEDGE AREA		KEYWORDS			CONFIDENCE		QUESTION MARK	RE-ATTEMPTED QUESTION
1	Polymers							
2	Properties							
3	Acrylic							
4	Frying Pan Handle							
5	Lego Brick							
6	CAD							
7	CAM							
8	Old CAM Machines							

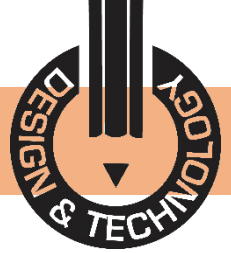
TOOLS & PROCESSES	
Tools used in project	
Processes (ways of doing things)	

PEER FEEDBACK



EXAM SCORE
/20

POLYMERS / CAD CAM EXAM



1) Polymers can be either Natural or? (1)

What are the two families of polymer? (2)

_____ / _____

Which type of polymer can be recycled? (1)

2) Name three different polymer properties: (3)

_____ / _____ / _____

3) Why do we use Acrylic at school? (2)

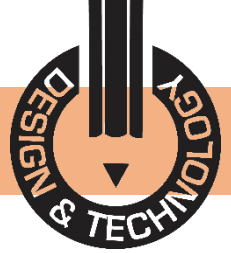
4) Name a polymer/plastic that would be used to make the handle of a frying pan: (1)

5) Name a polymer/plastic that would be used to make a Lego brick: (1)

6) What does CAD stand for? (1)

Name a CAD program that you use at school: (1)

POLYMERS / CAD CAM EXAM



Give four advantages of using CAD over traditional drawing techniques: (4)

Give three disadvantage to using CAD: (3)

7) What does CAM stand for? (1)

Name two CAM machines that we have at school: (2)

Give four advantages to using CAM over using hand tools: (4)

8) Explain why we don't use the micro router at school any more (3)
