Unit 1:

Portfolio of Creative Skills

Summary of expectations

1 What to expect

In this unit you have the opportunity to develop your creative, technical and practical skills through a series of product investigation, design and manufacturing activities. The unit is divided into three different sections: product investigation, product design and product manufacture. Each of these sections is separate and is not dependent on the other two, as opposed to one extended coursework project. All of the skills developed in this unit will be put to great use in the full design and make exercise in **Unit 4: Commercial Design at A2 level**.

This unit is set and marked by your teachers, then sent to Edexcel for moderation (sampling and checking of teachers' marks).

Product investigation

In this section you are free to choose any appropriate product(s) that interest you for your product investigation, so long as there is the opportunity to develop your skills in examining product performance, materials and components, product manufacture and quality issues. Alternatively, the choice of product(s) may be set by your teacher to ensure that a range of materials, techniques and processes are covered.

Product design

When working on the product design section of Unit 1 you are not limited by the manufacturing or materials constraints of your school or college workshop. There is no requirement for your designs to be carried forward into a manufactured product. Therefore, you can design as openly as you like, developing creative and adventurous design, modelling and communication skills. Modelling during the development stage should be photographed to provide evidence. The individual design briefs or needs can either be set by yourself or given to you as a design exercise by your teacher.

Product manufacture

In the product manufacture section you have the opportunity to develop many practical skills through making more than one product using a range of different materials. During product manufacture you do not need to design the product, as the focus is on gaining and developing practical abilities, plus those of planning for production and prototype testing.

Manufacturing briefs should be set by your teacher to ensure that you can target specific making skills and processes with a view to developing a broad set of skills and experiences in a variety of materials. Photographic records of all stages of manufacture are essential in providing evidence of advanced skills, level of difficulty and complexity so that you can access the marks you deserve.

2 What is a Graphic Product?

Graphic Products has two clearly defined pathways: either 'conceptual design' or 'the built environment'.

(i) **Conceptual design** incorporates a wide range of 3D products with associated graphics, for example:

- packaging design
- product/industrial design
- point-of-sale display
- vehicle design.

(ii) The built environment focuses on the surroundings that provide the setting for human activity, for example:

- architecture
- interior design
- exhibition design
- theatre sets
- garden design.

In this unit you can explore both pathways in order to evidence the assessment requirements for the **three** distinct sections.

3 How will it be assessed?

Unit 1 is divided into three main sections with several sub-sections to focus your work. Each of these separate sub-sections contains assessment criteria that are allocated a certain amount of marks. A breakdown of each assessment criterion will be outlined in the **'To be successful you will'** sections of this textbook.

The maximum number of marks available for each section is 30, with an overall mark out of 90.

Sections	Sub-sections	Marks
Product investigation	A. Performance analysis	6
	B. Materials and components	9
	C. Manufacture	9
	D. Quality	6
Product design	E. Design and development	18
	F. Communicate	12
Product manufacture	G. Production plan	6
	H. Making	18
	I. Testing	6
	Total marks:	**90**

4 Building a portfolio

You will submit **one** portfolio that contains evidence for all **three** distinct sections. Your portfolio should contain a variety of different pieces of work that covers a wide range of skills and demonstrates an in-depth knowledge and understanding of Graphic Products. Your portfolio can contain several separate investigating, designing and making tasks, or a few combined design and make tasks.

Example: separate investigating, designing and making tasks:

Product investigation	Product design	Product manufacture
Product investigation 1: Analysis of different perfume bottles and packaging.	**Design task 1:** (2D design) Design of a magazine cover using ICT.	**Making task 1:** Making a Styrofoam™ model of a games controller from a working drawing.
Product investigation 2: Disassembly of an mp3 player.	**Design task 2:** (3D design) Design of a hand-held games console.	**Making task 2:** Making an MDF block model of a hand-held games console (from Design task 2).
	Design task 3: (2D and 3D design) Design of a new ice-lolly and associated packaging.	**Making task 3:** Making a foam-board architectural model of a building and its interior based on your school/college site.

Example: combined design and make tasks:

Product investigation	Product design	Product manufacture
Product investigation 1: Research and analysis of perfume bottles and their packaging.	**Design task 1:** (2D and 3D design) Design of a new perfume bottle and associated packaging.	**Making task 1:** Making a model of a new perfume bottle and its packaging.
Product investigation 2: Research and analysis of mp3/CD players.	**Design task 2:** (3D design) Design of a 'next generation' portable music system.	**Making task 2:** Making an MDF model of the 'next generation' portable sound system.

5 How much is it worth?

The portfolio of creative skills is worth 60 per cent of your AS qualification. If you go on to complete the whole course, then this unit accounts for 30 per cent of the overall full Advanced GCE.

Unit 1	Weighting
AS level	60%
Full GCE	30%

Product investigation (30 marks)

Getting started!

In this section, you will analyse a range of existing commercial products using your knowledge and understanding of designing and making. You should take into consideration the intended function and performance of the product; the materials, components where appropriate and processes used during its manufacture; how it was produced and how its quality was assured.

FACTFILE:

When setting product investigation tasks you must take into account the following.

- Your chosen product must contain **more** than one material and process in order to access the full range of marks.
- You may investigate a range of different products over the course of your AS studies. However, for your portfolio, evidence of only **one** complete product investigation should be submitted. Evidence must **not** comprise the best aspects of a range of product investigations that you have undertaken.
- The submitted product can be chosen by you or by your teacher.

A Performance analysis (6 marks)

When analysing your chosen product, you should determine what it was that the designer set out to achieve and then produce a technical specification that covers several key headings.

The technical specification should include the following.

- **Form** – why is the product shaped/styled as it is?
- **Function** – what is the purpose of the product?
- **User requirements** – what qualities make the product attractive to potential users?
- **Performance requirements** – what are the technical considerations that must be achieved within the product?
- **Material and component requirements** – how should materials and components perform within the product?
- **Scale of production and cost** – how does the design allow for scale of production and what are the considerations in determining cost?

Your specification points should contain more than a single piece of information, so that each statement is fully justified by giving a reason for the initial point. For example, it is not sufficient to say 'the material used is polystyrene', as this is not justified until 'because it is tough and can be injection moulded' is added.

As part of this analysis, you should also look at one other existing similar product, using the same criteria identified in your technical specification. By finding out information on a similar product you can compare and contrast it with your own chosen product.

ACTIVITY:

Start your product investigation by carrying out a detailed physical study of your product. This will enable you to look at the product in closer detail and provide an opportunity to develop your communication skills.

1. Sketch a 3rd angle orthographic view of the product and, using Vernier callipers and/or a micrometer, accurately record the most important dimensions.
2. Construct an accurate 3rd angle orthographic drawing (to a suitable scale) of the product using a technical drawing board and equipment. Use British Standard dimensioning and labelling.
3. Draw the product in three dimensions using a pictorial drawing method such as isometric or two-point perspective. Use studio markers or coloured pencils to render the drawing to provide a realistic representation of the product.

Note: you could use suitable computer-aided design (CAD) software to perform tasks 2 and 3 in order to develop your ICT skills.

Performance analysis: perfume bottles			
			
PRODUCT 1: DKNY Red Delicious	**CRITERIA**	**PRODUCT 2:** Dali Kiss	**ANALYSIS**
The product is styled to resemble an apple – a play on the type of apple with the same name. The glass is coloured red to reflect the 'red delicious' brand. A 'red delicious' sticker is clearly visible to resemble the sticker on a real apple.	**Form**	The product is styled to resemble one of Salvador Dali's famous surrealist paintings and takes the form of a nose for the closure and lips for the bottle shape.	Both products use unusual forms to appeal to the consumer. Something out of the ordinary and not simply a normal bottle shape – individual and quirky.
The function of this product is to contain 100ml of fragrance securely by using a glass container, which is inert. The fragrance is dispensed by means of an atomiser that is activated by a push button on the top of the container.	**Function**	The function of this product is to contain 100ml of fragrance securely by using a glass container, which is inert. The fragrance is dispensed by means of an atomiser that is protected by a plastic closure for hygiene.	Both products have the same basic function but their form means that they operate in slightly different ways.
The size and shape makes it easy to hold in the hand and it is ergonomically sound so that it is easy to activate the push button to dispense the fragrance. The highly polished top surface complements the red glass and would look great on the customer's dressing table or bathroom shelf as a statement of their style.	**User requirements**	The width of the lips makes it slightly less comfortable to hold and dispense. The removable closure is another component that could be misplaced or damaged, which would detract from the overall style of the product.	Apart from the actual smell of the fragrance, the bottle shape is extremely important in attracting the attention of the consumer. Both would appeal to the consumer.
The atomiser must be activated when the button on the top of the container is pressed. Therefore, the internal mechanism must link this movement into a forward release of vapour. The highly polished component must fit perfectly on top of the glass container, which should be sealed to prevent liquid escaping.	**Performance requirements**	The glass container must be sealed with an appropriate atomiser system to enable the fragrance to be dispensed. The lid must fit securely over the atomiser to prevent it from coming loose.	Both products use fairly basic atomiser systems that enable the efficient and accurate dispensing of fragrance. Accurate production of components enables high-quality assemblies.
Glass is used because it is inert so it doesn't react with the fragrance. It is extremely tough and will not shatter easily, whilst glass gives a high-quality feel to the product, is crystal clear and can be coloured for effect. Polystyrene is used for the lid as it is tough and easily moulded. A highly polished silver effect is sprayed on to the grey plastic for visual appeal.	**Materials & components requirements**	Glass is used because it can be easily moulded into complex shapes and coloured and frosted for visual appeal. Frosted polystyrene is used for the lid as it can be easily moulded and will not shatter easily for this removable component.	Glass is the ideal material for containing perfumes. Visual appeal can be added by using plastic components. Both products use an atomiser system.
The glass container is produced using the automatic blow and blow process, which is ideal for large-batch and mass production, satisfying consumer demand. The lid is injection moulded for the same reasons as the container. The cost is £29.99 for 100ml, which is expensive due to the designer brand and not the actual cost of materials and production.	**Scale of production & cost**	The glass container and lid are manufactured in the same way as the DKNY product. The cost is £14.99 for 100ml as the brand is not as well developed.	Perfumes command a high price due to designer labels and consumer demand for luxury products.

Figure 1.1 *An example of performance analysis for the comparison of two perfume bottles.*

To be successful you will:

Assessment criteria: A. Performance analysis

Level of response	Mark range
Fully justify key technical specification points **(1 mark)** that relate to form, function, user requirements, performance requirements, materials and/or component requirements, scale of production and costs. **(1 mark)** Compare and contrast one other existing similar product using the technical specification. **(1 mark)**	4–6
Identify **(1 mark)** with some justification **(1 mark)** a range of realistic and relevant specification points that include reference to form, function and user requirements. **(1 mark)**	1–3

Marks are awarded in the following order: you must achieve all the marks from the lower section first (1–3) before being awarded marks from the higher section (4–6). This applies to all the assessment criteria.

B Materials and components (9 marks)

You will need to identify the materials and components used in your chosen product and apply your knowledge and understanding of their properties and qualities to suggest why in particular they have been selected for use. For example, cartonboards are used extensively in the retail packaging industry, where specific properties are required. These boards must be suitable for high-quality, high-speed printing and for cutting, creasing and gluing using very-high-speed automated packaging equipment.

Advantages of using cartonboard include:

- total graphic coverage and excellent print quality
- excellent protection in structural packaging nets
- relatively inexpensive to produce and process
- can be recycled.

LINKS TO:

Unit 2: Materials and components will provide you with the majority of information required to determine the choice of materials and components for a range of graphic products.

As with many products, your chosen product could have been made effectively in terms of quality and performance from other materials and components. Therefore, you should investigate suitable alternative materials and components and, using advantages and disadvantages, compare them with the materials and components actually used. For example, packaging can be made from a wide variety of materials, not just cartonboard as stated earlier. Companies may use metals, polymers or even woods to package their products, especially expensive gifts where they are trying to portray a sophisticated image.

ACTIVITY:

In groups of three, each select one different type of packaging used for the same kind of product. For example, fragile products such as biscuits can be packaged in card cartons, metal containers or plastic tubs – all with added internal packaging. Each person has to carry out an analysis of the materials and components used for their selected type of package.

Still in groups of three, each person has to explain why their type of package is better for containing the product. This mini debate should uncover the advantages and disadvantages of the materials used and you should be able to arrive at a joint decision as to the most suitable material overall.

Sustainability is an important aspect to consider with any product and you should be able to explain the environmental effects of using the materials identified in the product in relation to one or more of the following.

- **Extraction and processing of raw materials**– what is the financial and environmental cost of using a particular material in terms of energy use and pollution? Can less material be used? Can recycled materials be used or can the product be designed so that it is easily recyclable?
- **Production processes** – do they require lots of energy or produce lots of waste products? Can the product be simplified to reduce the amount of production processes?
- **Disposal of products after their useful lifespan** – does the product minimise waste production? (Reduce, re-use, recover and recycle.)

LINKS TO:

Unit 3: Sustainability looks at these issues in greater detail. Although it is an A2 unit, the information given will be extremely helpful to this section.

Materials and components analysis: DKNY 'Red Delicious' perfume bottle

Component	Why selected	Possible alternatives	Sustainability issues
Glass container	Glass is an inert material that will not react with the fragrance contained inside. Glass can be formed into complex and interesting shapes such as the apple form by the automatic blow and blow process, which also makes it suitable for large-batch or mass production. Glass has a high-quality appearance that is crystal clear and can be coloured red to fit with the 'red delicious' theme. Glass is impervious to water and air, which enables the container to be sealed for use with an atomiser dispensing system.	It is hard to suggest any real alternatives to glass for containing a fragrance due to its excellent functional, mechanical and aesthetic properties. Polymers can be used to provide decoration around a glass container as in the design of some perfume bottles.	Large amounts of energy are required to process glass from its raw materials through the automatic blow and blow process due to high temperatures needed to melt glass. Glass can be recovered and recycled after use. Alternatively, some recycled glass content could be used without degradation of overall quality. The glass container cannot be refilled due to the atomiser system.
Polystyrene lid	Polystyrene is a thermoplastic and can therefore be easily shaped using thermoforming techniques (injection moulding). Polystyrene has very good functional and mechanical properties including strength, toughness, durability and resistance to impact and water, which make it suitable for this application. The grey polystyrene (with some recycled content) can take a high-quality surface finish such as the chrome effect created by dip coating. Polystyrene is lightweight, so it does not add any significant weight to this glass container.	There are a couple of alternatives to polystyrene for this application including ABS and polycarbonate. However, as polystyrene possesses the majority of properties required and is the less expensive alternative, it is ideal for the lid of the perfume bottle.	As with most polymers, polystyrene can be recycled if the components can be separated easily for sorting. The separation of the lid from the glass container would be problematic, so a better design should be developed to enable this. The chrome effect would also prove problematic to remove even when separated. A silver polystyrene could be used but it wouldn't look as good. Polymers are derived from a finite resource – oil – and are not sustainable. They also take hundreds of years to degrade in landfill. A biodegradable polymer could be used but they are, at present, not sufficiently developed for this application.
Printed vinyl sticker	PVC film provides a thin yet durable substrate for adding surface graphics. PVC has excellent print quality to advertise DKNY brand in full colour. Shiny surface finish that creates a high-gloss effect, which fits with other reflective surfaces of chrome and glass.	A printed paper label could be used in place of the PVC one. However, the paper may become wet and peel off after prolonged use. PVC is water resistant.	PVC is quite polluting to the environment due to hydrochloric acid being produced when incinerated. However, PVC takes less energy to produce than other polymers. The printing inks used would most likely be solvent based, which cause volatile hydrocarbons to be released into the atmosphere. Water-based inks should be used instead.
Atomiser system	An atomiser system is utilised to dispense a measured amount of fragrance after each press of the button on the lid. The system provides a seal to the neck of the glass container that prevents any liquid from escaping and external contaminants from entering.	The perfume could be eau de toilette, which means it would not need an atomiser system. However, the design of the bottle would have to be developed so that the lid screwed off the glass container to gain access to the open neck.	An atomiser system does not use compressed gases as in the case of an aerosol, so no dangerous chlorofluorocarbons (CFCs) are released into the atmosphere. CFCs have been proven to contribute to the depletion of the ozone layer, which contributes to global warming.

Figure 1.2. *An example of the analysis of the materials and components used in a perfume bottle.*

To be successful you will:

Assessment criteria: B. Materials and components

Level of response	Mark range
Suggest, with reference to quality and performance, alternative materials and/or components that could have been used in the product. **(1 mark)** Evaluate, using advantages and disadvantages, the selection of the materials and/or components used. **(1 mark)** Describe the impact on the environment of using the materials and/or components identified. **(1 mark)**	7–9
Describe a range of useful properties that relate to the materials and/or components identified **(1 mark)** and justify their selection and use in the product. **(1 mark)** Identify alternative materials and/or components that could have been used in the product. **(1 mark)**	4–6
Identify a material or component used in the product. **(1 mark)** Describe a useful property of that material or component **(1 mark)** and justify its use. **(1 mark)**	1–3

C Manufacture (9 marks)

You need to be able to identify, describe and justify the processes involved in the manufacture of your chosen product. For example, the polymer casings for many electrical products are made using the injection moulding process. This is due to many reasons, including its suitability for mass production, its speed and accuracy and the ability to create complex and interesting shapes the consumer may find appealing.

It is important to consider that other methods of manufacture could have been used, so you should make clear **one** alternative method and compare and contrast it with the actual methods used. For example, the polymer casings for many mp3 players result in 'cheap'-looking products. Some companies, however, use anodised aluminium or polished stainless steel casings that add 'weight' and have a higher quality 'feel' to them. Obviously, injection moulding cannot be used for metals so alternative processes such as extrusion and press forming need to be employed.

LINKS TO:

Unit 2: Industrial and commercial practice will provide you with many manufacturing processes used to produce a range of graphic products.

ACTIVITY:

Study an example of the printed materials produced commercially for your school or college, i.e. brochure, prospectus, yearbook, etc. Determine what commercial printing processes, printing effects and binding methods have been used to produce these materials.

Now, think about alternative methods that could be used to produce those printed materials 'in-house' by you and your classmates. How could you produce identical copies using the printing and binding resources available to you, such as digital printing or colour photocopying, laminating or photo-glossy paper, thermal binding or spiral binding?

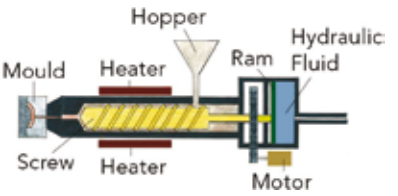
Again, you should also consider and describe the effects that using particular commercial processes in your product has on the environment. For example, the aim of many manufacturers is to reduce production costs by creating designs that use less material and less energy during manufacture and to reduce waste production. Controlling emmissions of harmful substances during production is also a serious consideration, e.g. carbon dioxide produced from the burning of fossil fuels for energy.

LINKS TO:

Unit 3: Sustainability looks at these issues in greater detail. Although it is an A2 unit, the information given will be extremely helpful to this section.

Manufacture analysis: Frijj milkshake bottle

Component 1: Closure (screw top lid)
Material: LDPE
Manufacture: Injection moulding



Justification:
- ideal for mass production – low unit cost for each moulding for high volumes
- precision moulding for screw thread and ribs on cap used for grip.

Possible alternative:
- blow moulding or vacuum forming could be used if the closure was a snap-on kind (did not require internal screw-thread).

Sustainability issues:
- process requires heating polymers so lots of energy use, although very little waste is produced.

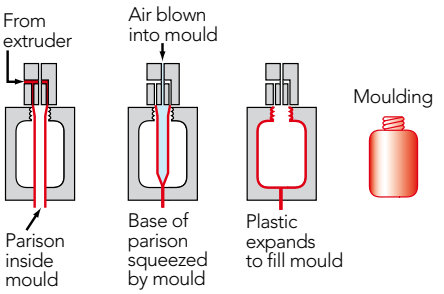
Component 2: Sleeve
Material: PVC
Manufacture: Shrink wrapping

Justification:
- high-quality decoration allows for full-body 360° labelling for high impact on shelf
- suited for tamper-evident seals (freshness seals/security seals)
- provides decoration on unusual shaped bottles using flexography and gravure printing.

Possible alternative:
- polypropylene shrink wrap
- printing directly onto bottle using rotary screen-printing process.

Sustainability issues:
- shrink wrapping requires PVC to be heated to 58 degrees, which requires a lot of energy in continuous production.

Component 3: Bottle
Material: HDPE
Manufacture: Blow moulding

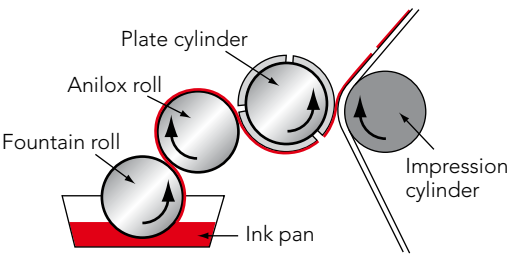


Justification:
- contoured shape of bottle can easily be formed
- hollow bottle shape with thin walls to reduce weight and material costs
- ideal for mass production – low unit cost for each moulding.

Possible alternative:
- none – blow moulding is the most efficient process for mass-producing a polymer bottle.

Sustainability issues:
- process requires heating polymers so lots of energy use although very little waste is produced.

Component 4: Printed graphics
Manufacture: Flexography



Justification:
- high-speed printing process suitable for continuous production
- fast-drying ink means high-quality printing produced
- relatively inexpensive to set up, therefore increased profits.

Possible alternative:
- Gravure – especially suitable if a perforated seal was required around the neck of the bottle instead of the snap-off polymer seal used
- digital UV flatbed printing only suitable for smaller runs.

Sustainability issues:
- solvent-based printing inks are used, which are not as 'green' as vegetable-based printing inks.

Figure 1.3 *An example of the analysis of the manufacturing processes used for a drinks bottle.*

To be successful you will:

Assessment criteria: C. Manufacture

Level of response	Mark range
Evaluate, using advantages and disadvantages, the selection of the manufacturing processes used in the product. **(1 mark)** Suggest one alternative method of production that could have been used in the manufacture of the product. **(1 mark)** Describe the impact on the environment of using the processes identified in the production of the product. **(1 mark)**	7–9
Describe: **(1 mark)** • a range of processes used in the manufacture of the product **(1 mark)** • and fully justify their use for the level of production of the product. **(1 mark)**	4–6
Identify, **(1 mark)** describe **(1 mark)** and justify the use of a manufacturing process used in the construction of the product. **(1 mark)**	1–3

D Quality (6 marks)

All products will have gone through a series of checks and tests to ensure they reach the consumer in the best possible condition in terms of quality and performance. You need to describe when and where quality control (QC) checks take place during the manufacture of your product, what the checks consist of and how they form part of a quality assurance (QA) system. For example, all printed materials will have undergone QC using printers' marks, including colour bars and registration. Many of these marks may still be visible on the products you investigate, e.g. some frozen food or cereal cartons contain colour bars and registration marks on their tabs. However, printers' marks are usually printed outside the margins of printed products and are subsequently cut off.

You also need to identify and describe some of the main external standards that must be met during product manufacture and how they influence production and the final product. For example, what British Standards need to be adhered to when producing your product? These can cover a wide range of topics including materials selection, individual component testing/overall product testing or standard of service and management. Some of these may result in the awarding of the British Standards Institute (BSI) 'Kitemark' or the European CE mark for quality assurance.

FACTFILE:

Quality assurance (QA) is the system used by the manufacturer to monitor the quality of a product from its design and development stage, through its manufacture, to its end-use and the degree of customer satisfaction. In other words, QA is an assurance that the end product fulfils all of its requirements for quality.

Quality control (QC) is part of the achievement of QA. It involves the actual inspection and testing activities used by a manufacturer to ensure a high-quality product is produced.

External quality standards are used when testing, inspecting and verifying the overall quality of materials, components, products and systems. These **formal standards** are produced through standards organisations for national (BS), European (EN) or international (ISO) use.

LINKS TO:

Unit 2: Quality will provide you with the necessary information on issues relating to QC and QA procedures used in the production of Graphic Products.

To be successful you will:

Assessment criteria: D. Quality

Level of response	Mark range
Describe a range of QC checks used during the manufacture of the product **(1 mark)** and explain how the main relevant standards influenced the manufacture of the product. **(1 mark)** Describe a QA system for the product. **(1 mark)**	4–6
Identify, **(1 mark)** describe **(1 mark)** and justify the use of one QC check during the manufacture of the product. **(1 mark)**	1–3

Quality control for electronic components.

- Electronic components would be bought-in from specialist electronics companies. Microsoft® engineers would monitor levels of quality at source and agree manufacturing specifications and tolerances suitable for this product.
- Sampling and testing of electronic components using bench tests to determine performance.
- Sampling and testing of circuit board assemblies looking for dry joints, which would prevent electrical current from flowing through circuit.
- Soak testing of final assemblies to determine performance, over-heating problems, etc.

Quality control for injection-moulded casing.

- Polystyrene pellets coming into factory would be checked against manufacturing specifications so that the correct grade and colour of material is being used.
- The injection mould would be visually inspected periodically for any damage or dirt/grit that would affect quality of casing. Computer analysis would be far more efficient at determining very small defects but mould would have to be taken out of machine (substituted).
- Sampling and testing of batches of injection-moulded components against agreed tolerances. Fine tuning of machinery if sampling chart shows tolerance creep.
- Sampling and testing of assembly of two halves of split casing to ensure that they accurately snap together.

Quality assurance for Xbox 360 games controller.

Preparation

- Raw materials such as polystyrene for casing, solder, etc., would all be sourced from reputable suppliers and quality checks made on a regular basis on batches of orders.
- Electronic components would be outsourced to specialist electronics companies who would have to meet Microsoft's tolerances for component manufacture.

Processing

- QC checks feature heavily in manufacture of electronic components and injection moulding of casing.
- QC checks on screen-printing of surface graphics.
- Sampling and testing of batches of components and casings against agreed tolerances.

Assembly

- Sampling and testing of sub-assemblies of circuit boards, split casings and button assemblies against agreed tolerances.
- Soak testing of batches of final assemblies to determine final quality of product – is it fit-for-purpose?

Finishing

- Packaging product/collating into corrugated board boxes/palletising – checking quantities for dispatch.

After-sales

- Guarantee assures customer that the games controller will be fit-for-purpose and will not break under normal conditions.

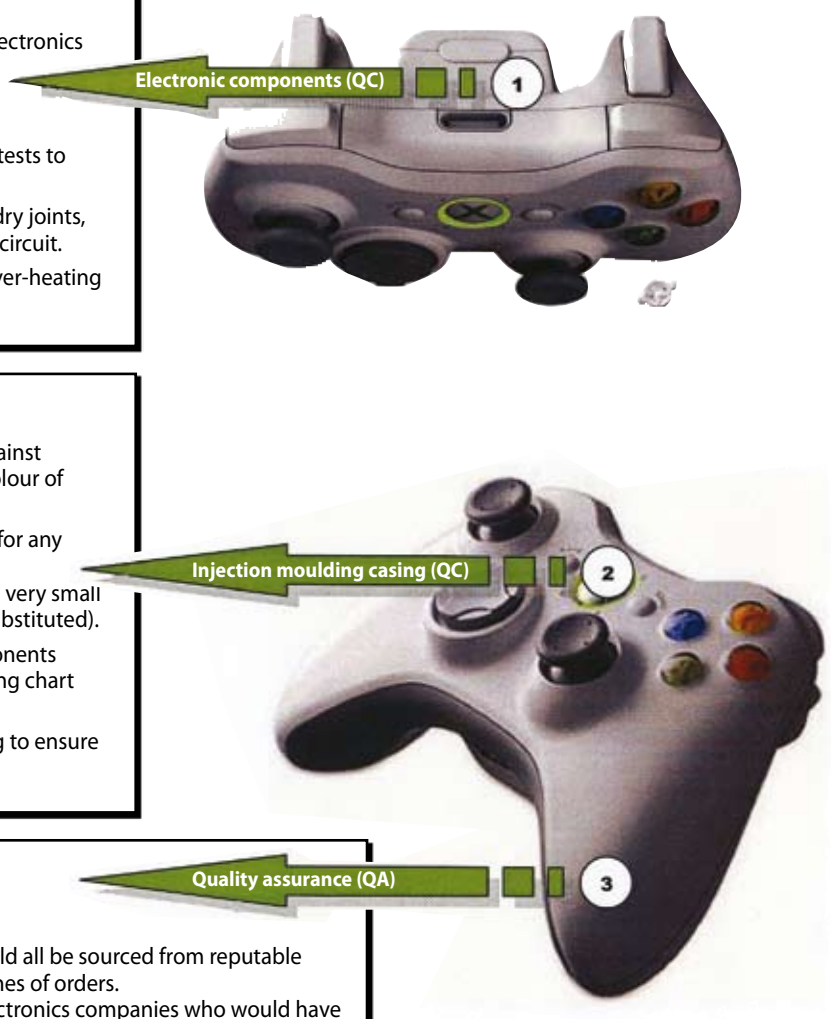


Figure 1.4 *An example of the analysis of quality issues related to a computer games controller.*

Product design (30 marks)

Getting started!

In this section, you will have the opportunity to demonstrate your creativity and flair by using your design skills, through the production of a range of alternative ideas that explore different approaches to a problem. Using the best aspects of your initial designs, you will develop and refine your ideas, with the aid of modelling, into a final workable design proposal that will satisfy a design brief or specific need.

Your designs do not have to be manufactured but the most viable products must be communicated to potential users. Any designer must sell their ideas by the use of presentation graphics or concept boards. Accurate working drawings and assembly drawings provide an audience with technical details of the product. Both forms of communication are invaluable in presenting an impression of the final product.

FACTFILE:

When setting product design tasks you must take into account the following:

- you can respond creatively and adventurously to one or more design briefs or needs
- design briefs or needs can be set either by you or by your teacher to produce solutions that are both fit for purpose and market viable
- design tasks can be explored in 3D products/environments and 2D 'graphic design' of printed materials but the portfolio must have evidence of both.

E Design and development (18 marks)

There are a number of possible starting points to this section. The design brief or need may be given to you by your teacher or you may define your own.
Two possible types of brief that you might want to use are:

- a focused design brief for a specific need or want
- a 'blue sky' project resulting in concepts using future technologies.

Design brief

Design a leaflet that challenges the stereotypical views of how the young perceive the older generation and how the old perceive the younger generation. The leaflet is to be delivered with a local newspaper and be backed by the local police force in order to promote 'safer neighbourhoods'.

The leaflet should be made from a single sheet of A4 paper, with two folds resulting in three columns to a side, i.e. tri-fold. The information communicated should challenge stereotypes in a humorous manner but not cause offence to either age group. The leaflet should be designed using desktop publishing (DTP) software and be full-colour printed.

Design brief

Design an interactive information kiosk for an airport departure lounge including interactive information screens.

Design specification

- The user should be able to access travel information, book hotels/hire cars with a credit card and enter secure areas of personal/business information using biometric security systems.
- The kiosk must look contemporary in order to fit into a modern airport departure lounge.
- The kiosk should be accessible to able and disabled users in wheelchairs.
- The kiosk should occupy a floor space of no more than 1m × 1m.

Outcomes

- A series of design sheets developing the 3D kiosk and 2D information screens.
- A 3D Styrofoam™ model of the kiosk made to an appropriate scale.
- A sample of three interactive information screens, including the main 'welcome' screen, using ICT.

Figure 1.5 *Examples of possible types of briefs.*

You are not required to write a detailed design specification for each design task. However, the design brief must contain a range of design criteria that your final design proposal must meet. Therefore, you need to consider the design problem set and produce a range of alternative design ideas that focus on the whole or parts of the problem. It is not necessary for you to produce a wide range of alternative ideas. It is better to produce high-quality focused work than lots of lower-quality work.

Throughout your work you should explore different design approaches, applying your knowledge of materials, components, processes and techniques to produce realistic design proposals that satisfy the design brief or need. Design ideas should be objectively evaluated against the criteria set out in the design brief or need, to ensure that your designs are realistic and viable. The use of detailed annotation is an important feature of design development and you should use it to explain details of design thinking and to offer thoughts on your design proposals.

It is important that you develop your own individual style when designing. Not everyone can produce beautifully presented and professional looking design sheets – the important thing is that you effectively communicate your design intentions. Experiment with a range of studio materials such as sketching with pencils, fine-liners, etc., on different types of papers, e.g. ballpoint pen on tracing paper or white pastel pencil on brown paper. Look at how professional designers present their design ideas and try to develop a more 'designerly' approach than your GCSE coursework projects.

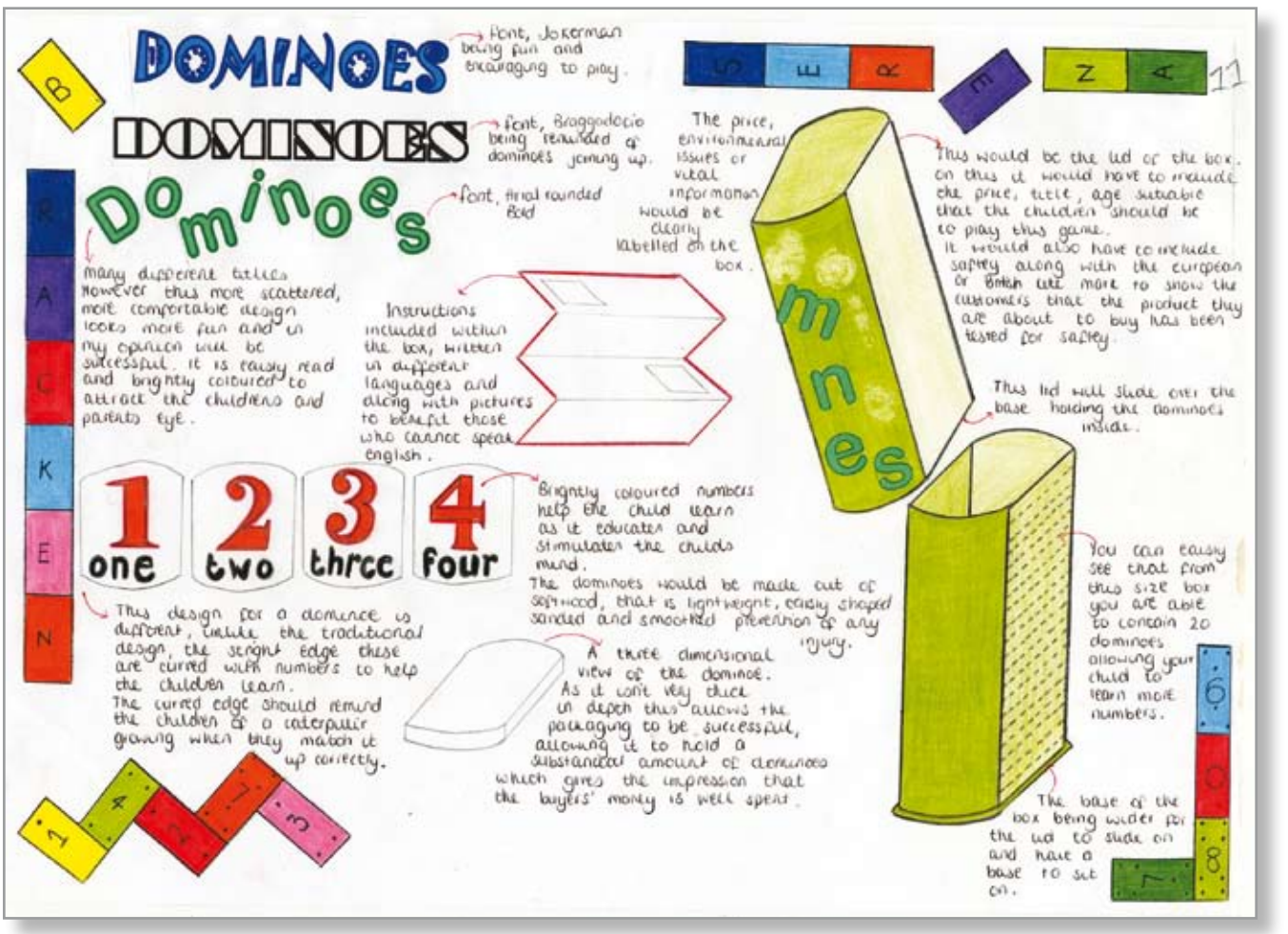


Figure 1.6 *This student's work for the design of a child's game is very structured and resembles GCSE work, although designs are communicated very well.*

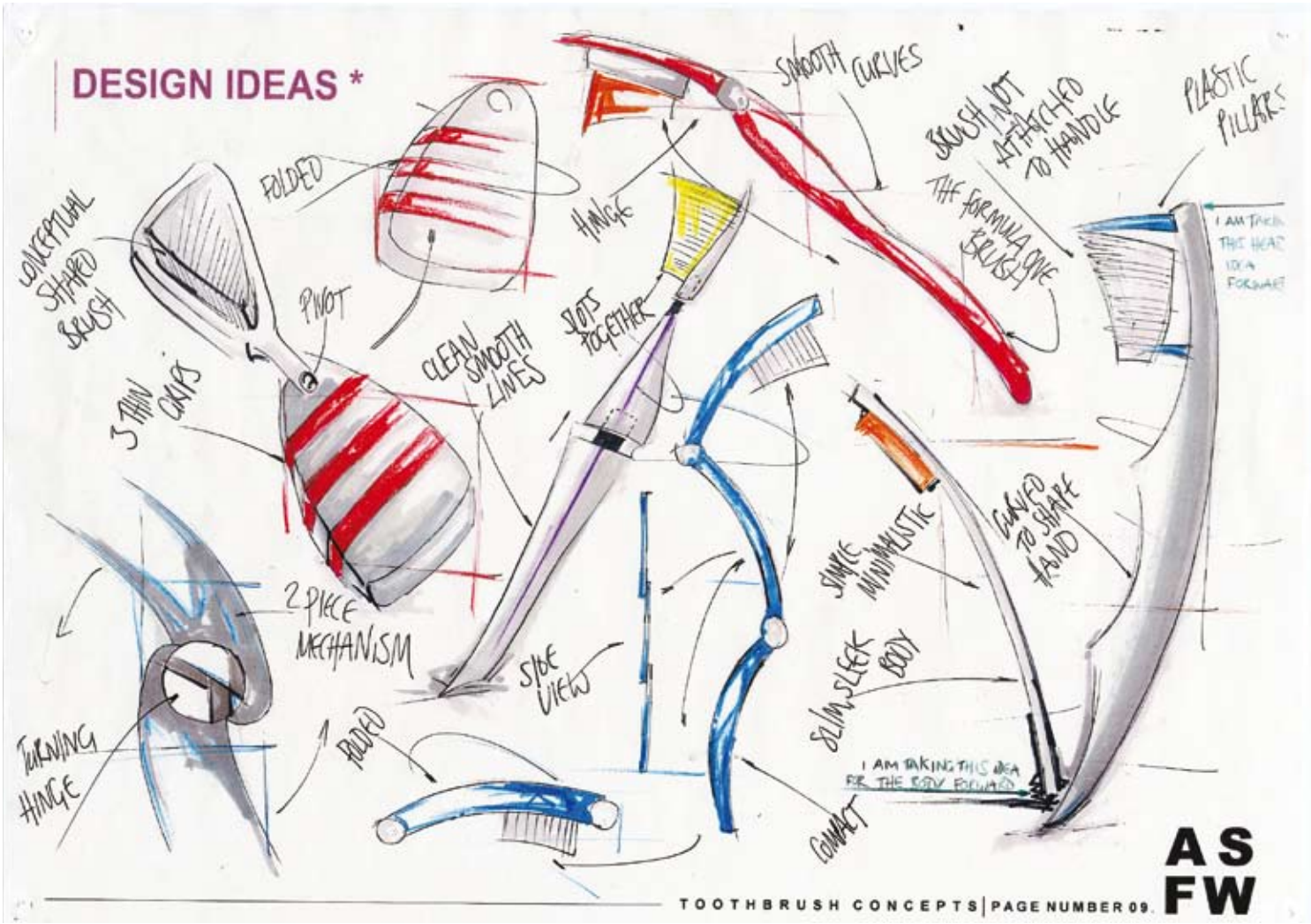
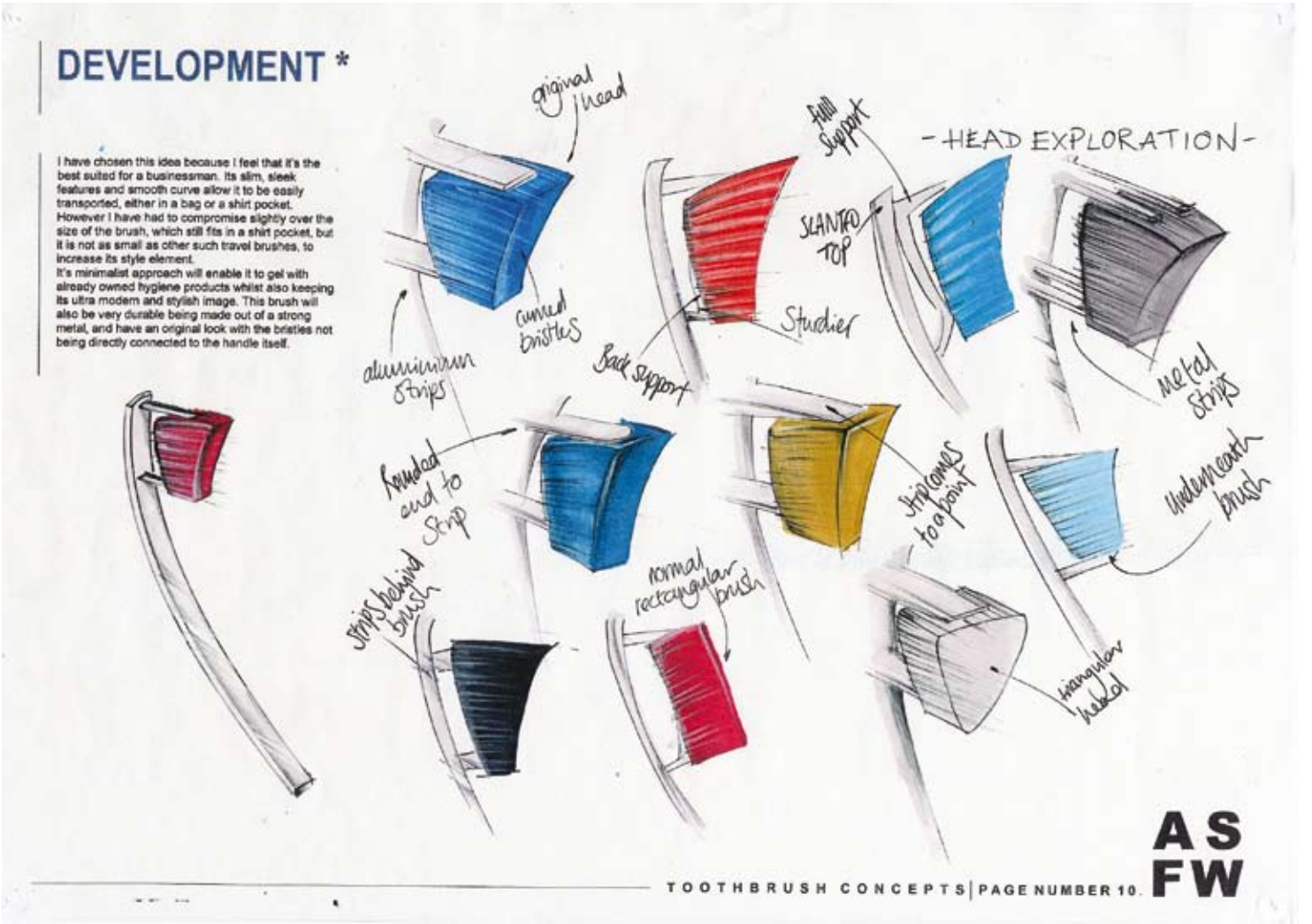


Figure 1.7 *This student's work for the design of a toothbrush adopts a more professional approach with 'busy' design sheets and highlighting using spirit-based markers.*

ACTIVITY:

To practise your designing skills, set yourself a few small and manageable design tasks. These tasks should be focused and limited to three hours of design time. For example:

- Design an in-car satellite navigation system that can be detached and used when walking. The product should be easily installed in a car and removed for use when walking, be easy to read and ergonomically sound to handle.
- Design the front cover of a new paperback book entitled *Terror at 30,000 Feet* using ICT. The cover must measure 17cm (width) × 23cm (height), include the title of the book, its author, J.R. Hartley, and present suitable imagery using a photo-composition to entice readers.



When developing your initial design ideas, the following design development cycle can be used. Development is an important part of the design process and should be used to refine an initial idea into a workable design solution.

Modelling should be used to test features such as proportions, scale, function, sub-systems, etc. Modelling can be achieved through the use of traditional materials or 2D and 3D computer simulations. Evidence of 3D modelling should be presented using clear, well-annotated photographs. Card mock-ups or rough layouts of 2D printed materials should be included in your portfolio with associated evaluative comments clearly labelled.

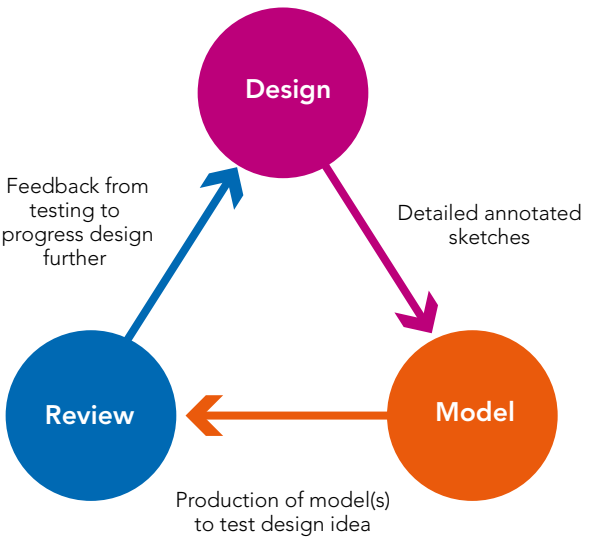


Figure 1.8 *Design development cycle.*

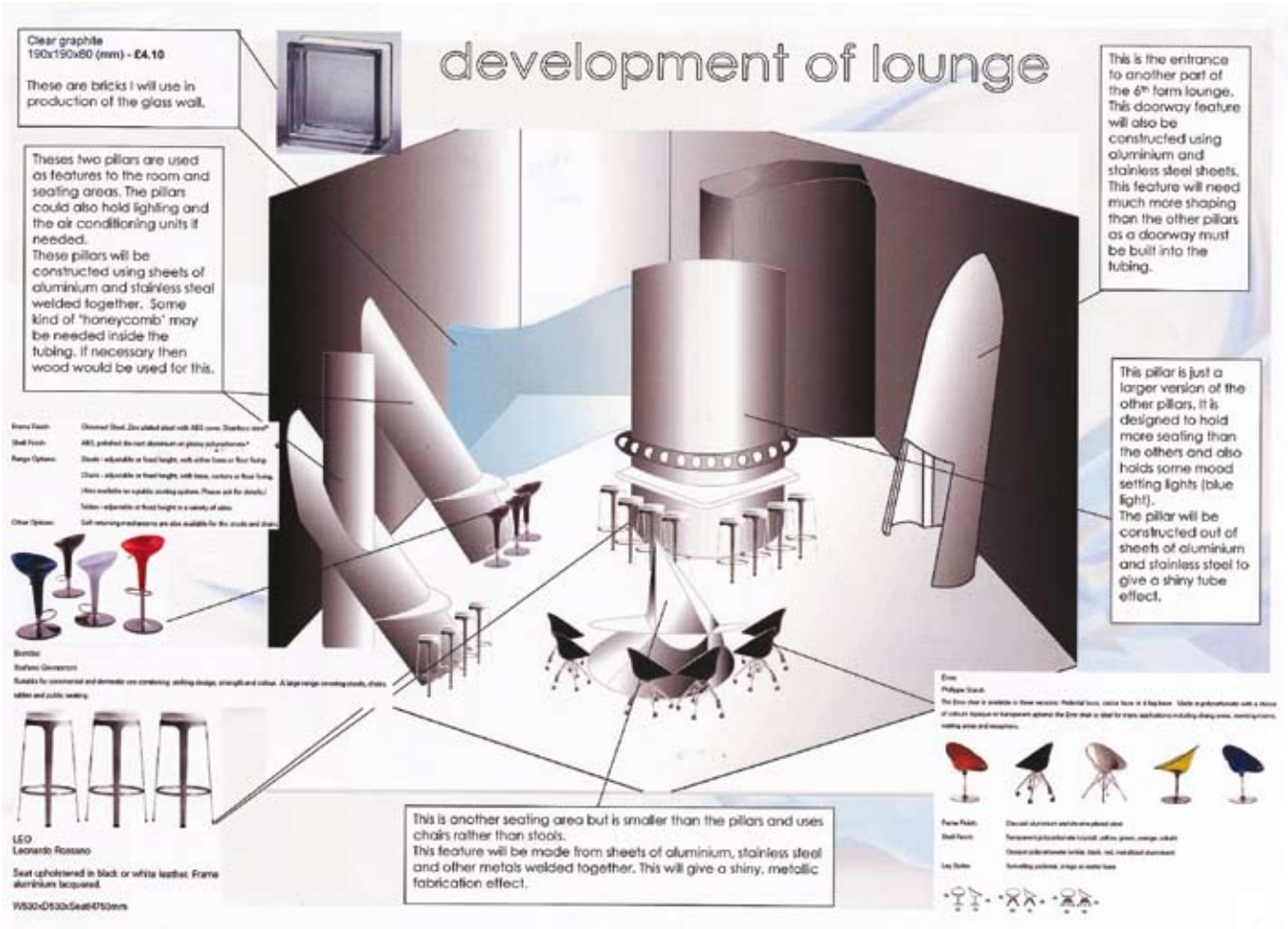
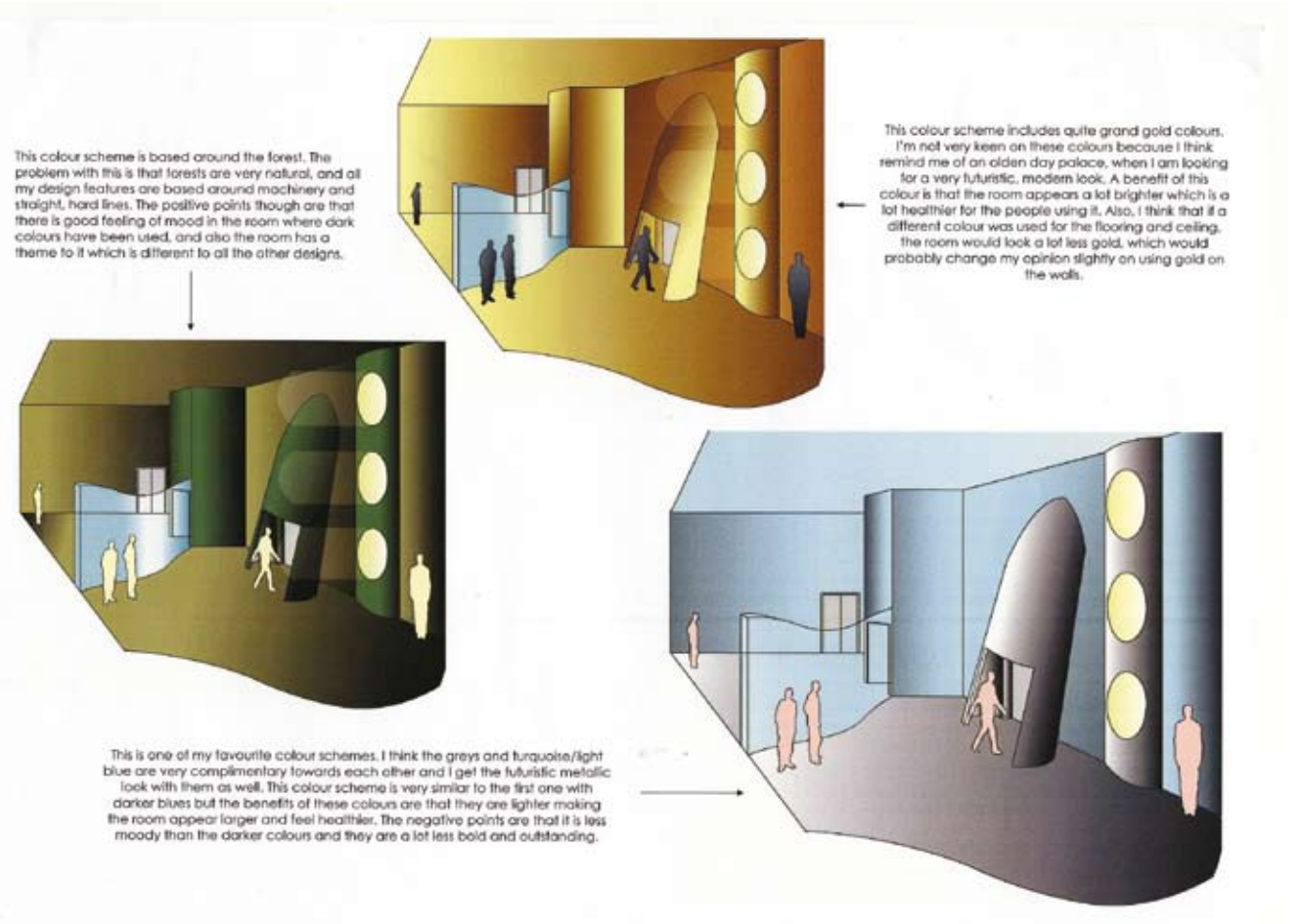


Figure 1.9 *A student's development of an interactive information kiosk involving Styrofoam™ modelling using an ergonome to test both form and function.*



To be successful you will:

Assessment criteria: E. Design and development

Level of response	Mark range
Present alternative ideas that are workable, realistic and detailed and that fully address the design criteria. **(1 mark)** Demonstrate detailed understanding of materials, processes and techniques in your ideas. **(1 mark)** Produce a final design proposal that is significantly different and improved compared with any previous alternative design ideas. **(1 mark)** Include technical details of materials and components, processes and techniques in the design proposal. **(1 mark)** Use modelling with traditional materials or 2D and/or 3D computer simulations to test important aspects of the final design proposal. **(1 mark)** Evaluate the final design proposal objectively against the design criteria in order to fully justify the design decisions taken. **(1 mark)**	13–18
Present realistic alternative design ideas. **(1 mark)** Present ideas that are detailed and address most design criteria. **(1 mark)** Use appropriate developments and use details from ideas to change, refine and improve the final design proposal. **(1 mark)** Present a final detailed design proposal. **(1 mark)** Use modelling to test some aspects of the final proposal against relevant design criteria. **(1 mark)** Objectively consider some aspects of the design brief/need in evaluative comments. **(1 mark)**	7–12
Present simplistic alternative design ideas. **(1 mark)** Present superficial ideas that address limited design criteria. **(1 mark)** Show developments that are minor and cosmetic. **(1 mark)** Present a basic final design proposal. **(1 mark)** Use basic modelling to test an aspect of the design proposal. **(1 mark)** Make evaluative comments that are subjective and superficial. **(1 mark)**	1–6

F Communicate (12 marks)

When presenting your design and development work, it is essential that you communicate your ideas effectively. Evidence for this section can be found throughout the following areas:

(i) Through your design and development work. You should show evidence of 'design thinking' using any form of effective communication that you feel is appropriate. However, you should try to use a range of skills that may include freehand sketching in 2D and 3D, cut and paste techniques and the use of ICT. It is important to demonstrate a high degree of graphical skill, which will be shown through the accuracy and precision of your work.

The development of ICT skills is essential to Graphic Products. You must be able to produce professional-looking printed materials such as items of packaging that closely replicate those available commercially. Therefore, graphic design using DTP, drawing/painting and image manipulation software should be explored. When using CAD, you should ensure that it is used appropriately, rather than for show. For example, specialist CAD software to produce 3D rendered images is likely to be more appropriately used as part of development or final presentation, rather than for initial ideas.

Figure 1.10 *A student's development of an ice-lolly wrapper using ICT.*

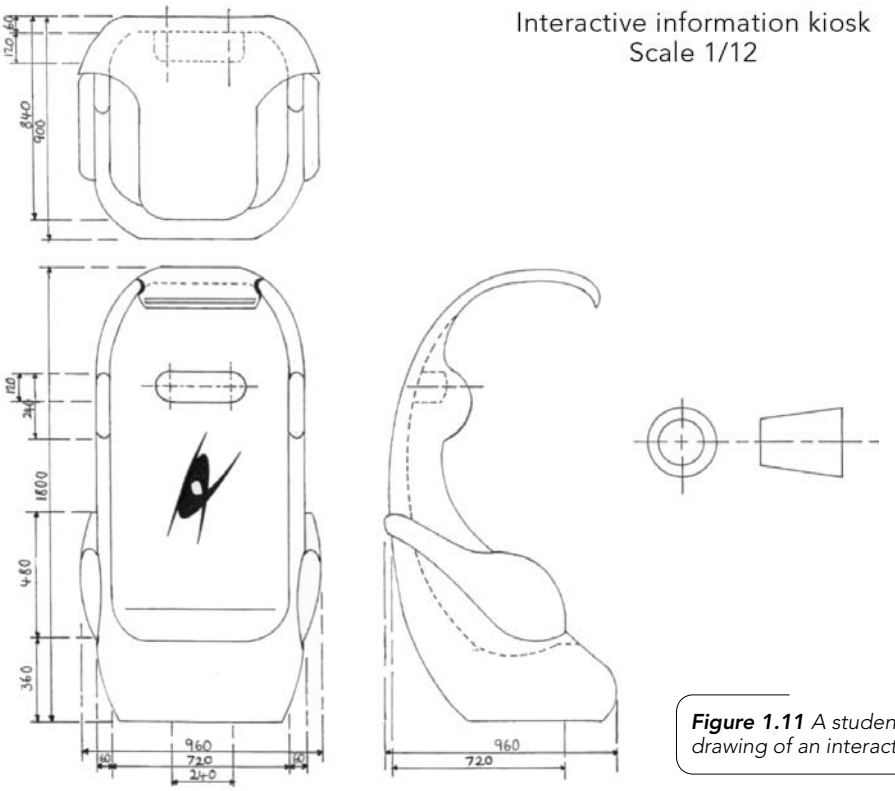


Figure 1.11 *A student's 3rd angle orthographic drawing of an interactive information kiosk proposal.*

(ii) Through your presentation graphics and technical drawings.

To effectively communicate final designs, a range of skills and drawing techniques should be demonstrated, which could include:

- **pictorial drawings** – isometric, planometric (axonometric), oblique and perspective drawings to convey a 3D representation of the product
- **working drawings** – 1st or 3rd angle orthographic, exploded assembly and sectional drawings to convey technical information
- **computer generated** – pictorial and working drawings, renderings, etc. using specialist software.

(iii) Through the quality of written communication.

Annotation should be used to explain design details and convey technical information. You should make sure that all information is presented in a logical order that is easily understood. Specialist technical vocabulary should be used consistently with precision.

To be successful you will:

Assessment criteria: F. Communicate

Level of response	Mark range
Use a range of communication techniques and media including ICT and CAD **(1 mark),** with precision and accuracy **(1 mark),** to convey enough detailed and comprehensive information to enable third-party manufacture of the final design proposal. **(1 mark)** Use annotation that provides explanation and most technical details of materials and processes with justification. **(1 mark)**	9–12
Use a range of communication techniques, including ICT **(1 mark)**, that are carried out with sufficient skill **(1 mark)** to convey an understanding of design and develop intentions and construction details of the final design proposal. **(1 mark)** Use annotation that provides explanation and most technical details of materials and process selection. **(1 mark)**	5–8
Use a limited range of communication techniques **(1 mark)** carried out with enough skill **(1 mark)** to convey some understanding of design and develop intentions. **(1 mark)** Use annotation that provides limited technical details of materials and processes. **(1 mark)**	1–4

Product manufacture (30 marks)

Getting started!

In this section, you will use your production planning skills and have the opportunity to develop your making skills through manufacturing **one or more** high-quality products to satisfy given design briefs or needs. You should use **a range** of materials, techniques and processes when manufacturing **a range** of products in order to build and develop a variety of skills and lay a foundation for more complex and challenging work in the future.

FACTFILE:

When setting product manufacture tasks you must take into account the following.

- You should produce **one or more** high-quality products that meet the requirements of the design briefs or needs.
- The design briefs or needs should contain requirements against which the final manufactured products can be measured.
- Some design briefs or needs may be set by your teacher to ensure a range of materials, techniques and processes are used.

There are a number of potential starting points to product manufacture.

- Making a product previously designed in the design and development section. This takes the combined design and make task approach to your portfolio.
- Making a product from a detailed working drawing and manufacturing specification provided by your teacher. Here your teacher will specifically target skills and materials that you need to evidence a wide range of techniques in your portfolio.
- The accurate replication or detailed modelling of an existing product or environment to a chosen scale. This could be linked to your product investigation task by accurately modelling the product you are studying.

ACTIVITY:

As an extension to the physical study task in the product investigation section, make a scale model of your chosen product from the information on your 3rd angle orthographic drawing.

Your model could be quickly made using Styrofoam™ as it is easy to cut and shape. However, for a more realistic model you could construct a block model using laminated medium-density fibreboard (MDF). This would enable you to apply a high-quality surface finish that might replicate the real thing.

Figure 1.12 *A student's Styrofoam™ model of the games controller used in the product investigation task.*

Figure 1.13 *A student's interior model of a music rehearsal space for a school.*

G Production plan (6 marks)

You need to produce a detailed production plan that explains the sequence of operations carried out during the manufacture of each product. A production plan should contain a work order or schedule, which could be presented in the form of a flow chart. The work order should include the order of assembly of parts or components and tools, equipment and processes to be used during manufacture.

QC points should also be identified throughout the production plan in order for you to produce a high-quality product. Specific quality checks should be described and not simply stated as 'quality control'. Information regarding important safety checks may also form part of detailed planning.

An important part of planning is the efficient use of time, so you should make sure that you consider realistic timings and deadlines. Where Gantt or time charts are used, you must make sure that they are detailed, cover all aspects of product manufacture and include achievable deadlines.

Consideration should be given to the scale of production of your products. Although you may be making one-off products, most products would be batch or mass produced, so you should consider the consequences of these scales in your planning, developing your awareness of commercial production.

LINKS TO:

Unit 3: Systems and control describes how flow charts are used to represent production processes.

To be successful you will:

Assessment criteria: G. Production plan

Level of response	Mark range
Produce a detailed production plan **(1 mark)** that considers stages of production in the correct sequence **(1 mark),** with realistic time scales and deadlines for the scale of production. **(1 mark)**	4–6
Produce a limited production plan **(1 mark)** that considers the main stages of manufacture **(1 mark),** with reference to time and scale of production. **(1 mark)**	1–3

H Making (18 marks)

You should produce **one or more** high-quality products that meet the requirements of the design briefs or needs you have been given or developed yourself. The design brief or need must contain requirements against which the final manufactured product can be measured, so it is important when setting design requirements that they can be tested. Requirements may include dimensional parameters, finishes, etc., which are all objectively measurable requirements that can be tested for success.

TASK		5 hours per week			
		Week 1	Week 2	Week 3	Week 4
1	Laminating MDF	Drying times			
2	Cutting out rough profiles	½ hour			
3	Rough shaping of block	4½ hours			
4	Fine shaping of curves		4 hours		
5	Sanding smooth ready for finishing		1 hour		
6	Sealing MDF			Drying times	
7	Priming model			Drying times	
8	Finishing by applying top coat			Drying times	
9	Making wheels				1 hour
10	Assembling wheels				1 hour
11	Assembling whole model				1 hour
12	Applying finishing details				2 hours

TOTAL:	20 hours over 4 weeks

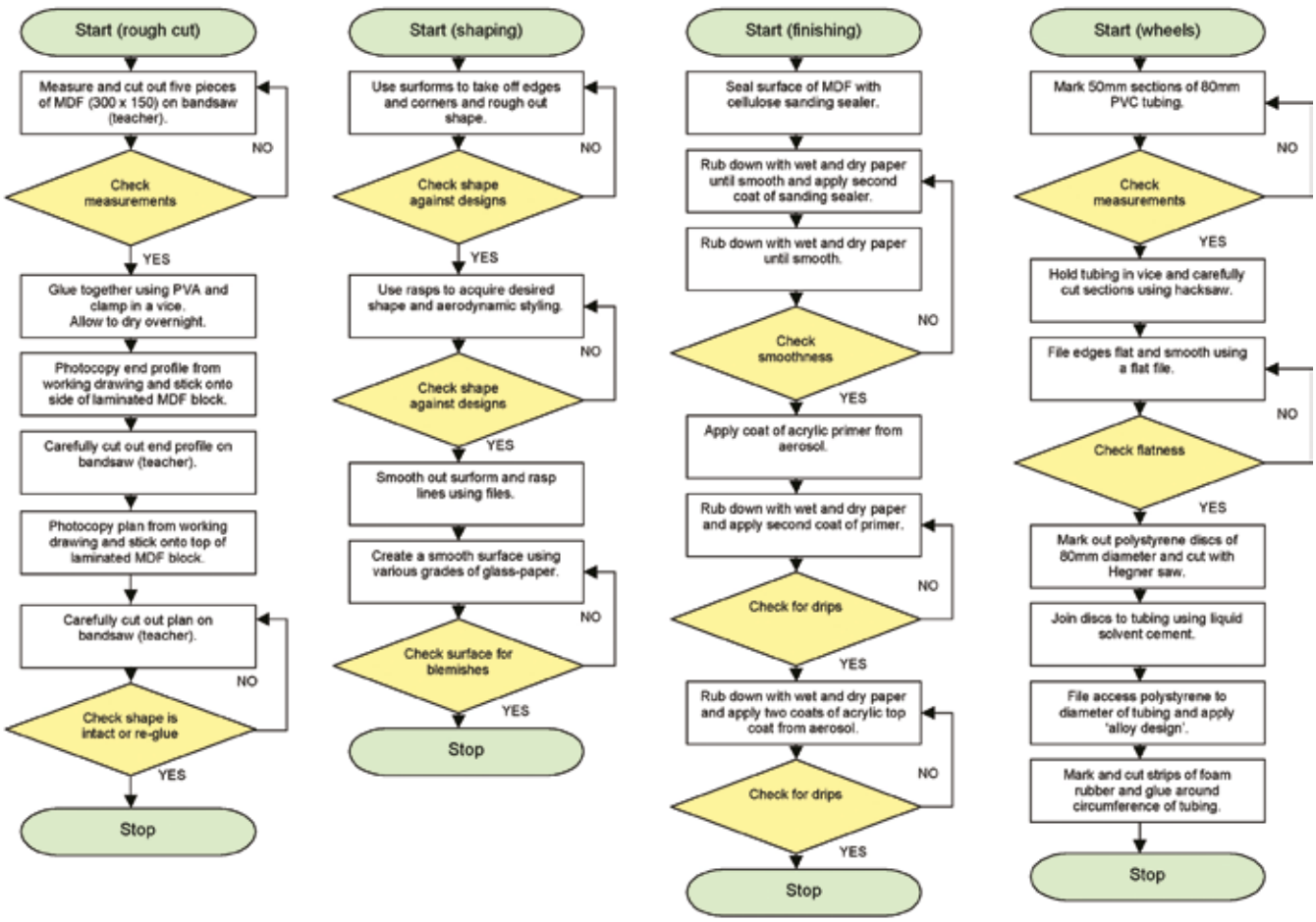


Figure 1.14 *An example of a production plan for an MDF block model.*

Design brief

You are required to make an accurate scale model of the Post-16 café that can be used to promote the school's Post-16 at careers fairs.

You are required to carry out a detailed site survey of the Post-16 café to determine dimensions and constructional details. The architectural plans for this building will be available to you to confirm measurements.

The model must be an accurate reproduction of the actual Post-16 café, including:

- a scale of 1:100
- a fully detailed exterior and interior
- a removable roof to view the interior layout.

Figure 1.15 *An example of an appropriate design brief for manufacturing a model.*

Throughout your making activities, you should demonstrate your knowledge and understanding of a range of materials, techniques and processes by selecting and using those that are appropriate to the requirements of the task. You should consider properties and working characteristics of materials and the processes used to manipulate them. In addition to this you should also be able to justify your selections by giving reasons for your choices.

In order to develop high-quality skills you must apply your knowledge and understanding of a range of materials, techniques and processes. It is likely that you will produce more than one practical outcome during this unit.

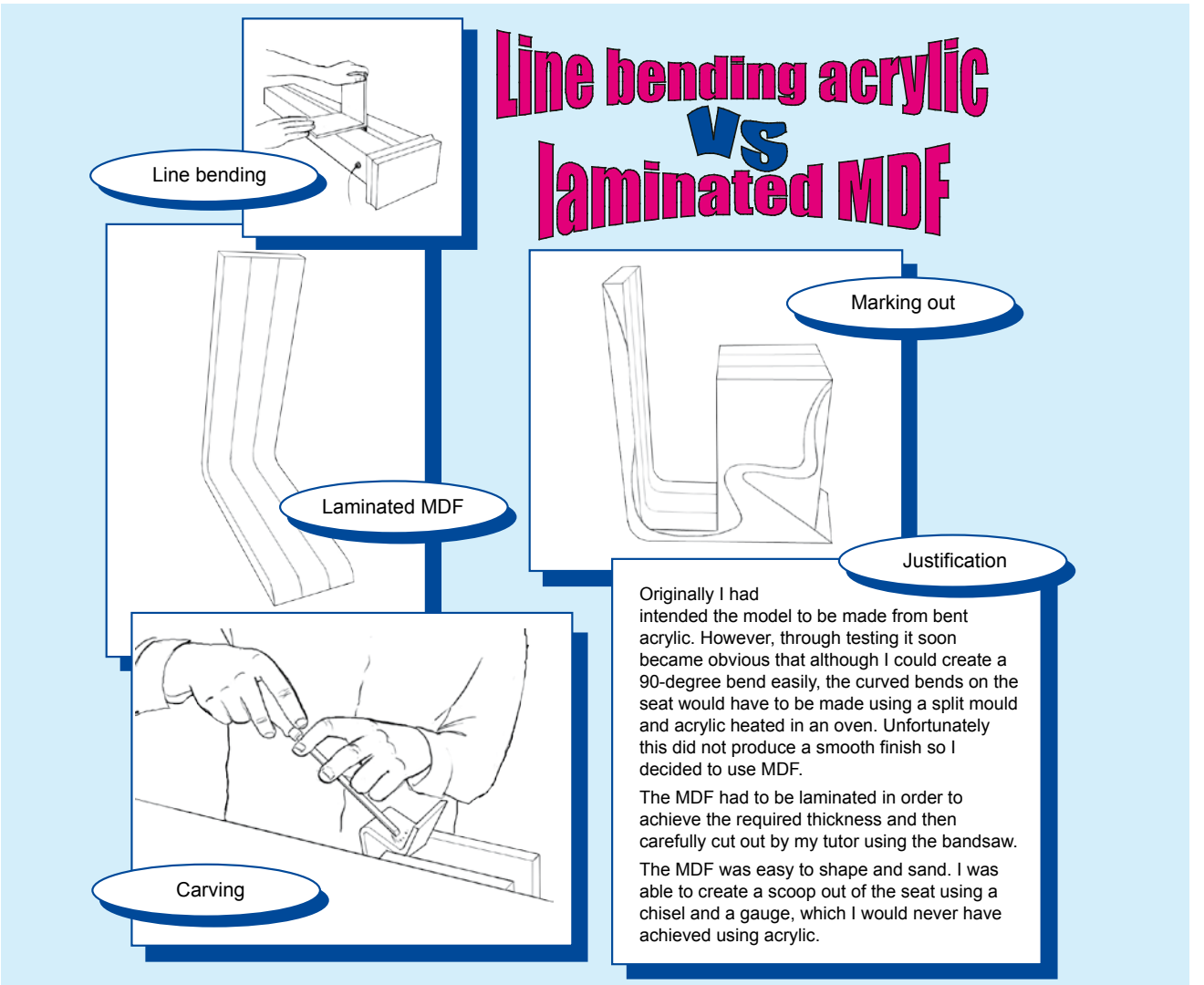


Figure 1.16 *Justification of materials and processes as part of a student's detailed evidence of a making activity.*

The table below gives you some examples of possible projects and the wide variety of materials, techniques and processes open to you in your studies.

Table 1.1 *Examples of projects including materials, techniques and processes covered.*

Project	Materials covered	Techniques and processes covered
Perfume bottle and packaging	Bottle: cast acrylic block Packaging: cartonboard	Bottle: shaping and finishing acrylic on lathe, high-gloss finish on buffer, etc. Packaging: CAD/CAM using plotter/cutter to produce net; digital colour printing
Concept car	Car body: MDF Wheels: PVC tubing and foam	Car body: machine cutting, shaping using surforms, rasps and files, finishing using glasspaper and aerosol paints Wheels: hand cutting, shaping and gluing
Architectural modelling	Foamboard, acrylic sheet, polypropylene (PP) sheet, etc.	Cutting using craft knife scalpel, hot melt gluing, bending acrylic on line bender, etc.
Yoghurt pot	Yoghurt pot: MDF mould and high-impact polystyrene (HIPS) shell Lid: foil	Yoghurt pot: cutting, shaping and finishing MDF, vacuum forming and finishing Lid: dye sublimation printing onto foil
Mobile phone	Scale 2:1 Styrofoam™ model	Cutting on vibrosaw, shaping and finishing using files and glasspaper; hand-painting using acrylic paints

In order to achieve high marks in this section, you must show demanding and high-level making skills. Therefore, it is important that manufacturing tasks set by your teacher provide enough complexity and challenge to allow you to demonstrate your skill levels to the full. It is important to keep in mind, too, that the manufacturing tasks set in this unit should be designed to develop skills that you can call upon in your A2 coursework project. A single manufacturing project that involves a range of materials, processes and techniques that you can learn from can be as valid as two or three shorter but equally demanding exercises. However, by setting different exercises, the use of a range of materials, processes and techniques can be assured.

You will need to use a variety of skills and processes during your making activities, which may include computer-aided manufacture (CAM). Where this is a feature of your work, you should make sure that there is plenty of opportunity within the tasks to demonstrate other skills and competencies that you have gained through other making activities. While the use of CAM is to be encouraged, you must not over-use CAM. It is okay for you to dedicate one manufacturing exercise to the use of CAM in order to explore its capabilities, but you must offer evidence of other skills and techniques in other manufacturing exercises. Whenever CAM is used you must provide evidence of programming the computer numerical control (CNC) equipment. Where a mixture of CAM and other skills and techniques is used in a manufacturing exercise, CAM should not exceed 50 per cent of the work.

Throughout your making, you should be aware of the risks involved in using specific tools, equipment and processes and should take appropriate precautions to minimise those risks. A risk assessment of all relevant equipment is an appropriate way of recording this awareness.

Table 1.2 *An example of a typical risk assessment for using a band facer in a school workshop.*

Hazard	Risk	People at risk	Control measure
Abrasion – belt	Cuts/abrasions to hands	Teacher/student	1. Sliding guard, where fitted to be <6mm above work. 2. Pupils queuing to use machine must stand behind yellow line. 3. Never leave machine running unattended. 4. Isolate machine after use. 5. Staff use only after recognised training. 6. Student use after training and at teacher's discretion.
Trapping – gap between belt and table	Trapping of fingers in gap between belt and table	Teacher	1. Adjustments to be made by competent staff. Post-16 students at teacher discretion. 2. Power to be isolated during repair/maintenance.
Projectile – dust and debris	Dust and debris being propelled into eyes	Teacher/student	Safety spectacles provided in boxes next to machine
Dust – respiratory irritant	Effects of prolonged dust inhalation	Teacher	1. Dust extraction fitted and operational. 2. Dust extraction system serviced every year.
Dust – skin irritant	Effect of prolonged contact with wood dust	Teacher	Barrier cream available

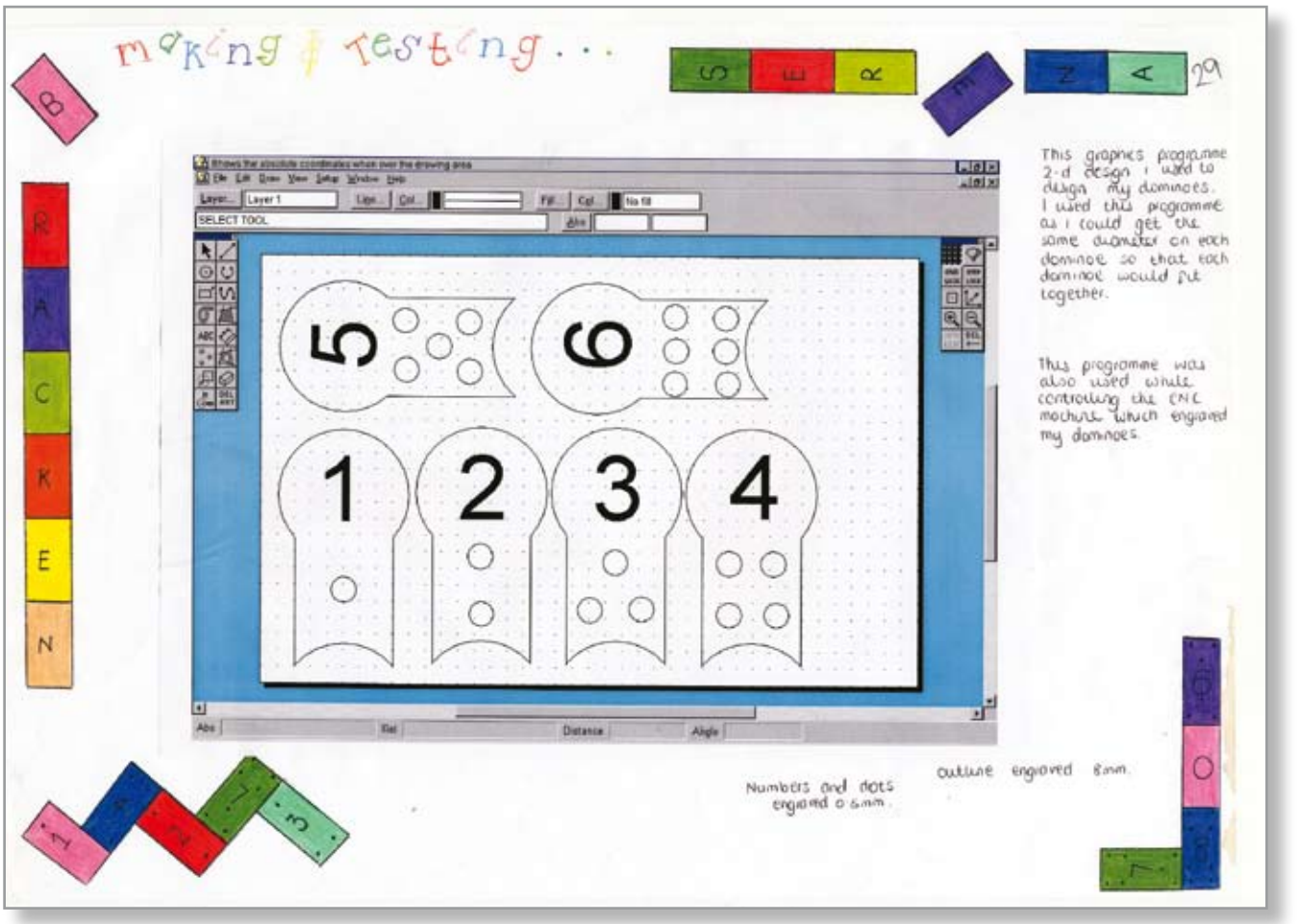


Figure 1.17 *CAM can be used to produce some components in a product. Here, the student has used CAM to produce multiple pieces for a young children's game.*

You will not be expected to produce a risk assessment for every piece of equipment you use. Annotated photographs of your making process should indicate where health and safety issues have arisen. For example, when using a band-facer your photograph should clearly show you with your safety goggles on with your hair tied back.

LINKS TO:

Unit 2: Health and safety describes the procedures for carrying out a risk assessment according to the Health and Safety Executive (HSE).

As proof of the quality of your making skills (and the level of demand of your work), photographs of your work must be evidenced to show that the product is complete, expertly made, well finished, etc. These photographs must clearly show any details of advanced skills, technical content, levels of difficulty and complexity of construction, so that you can achieve the marks you deserve. It is unlikely that a single photograph for each product will be enough to communicate all of the information required, so it will be better to take a series of photographs over a period of time during making. These should highlight the processes used and provide examples of precision and attention to detail that may not be otherwise noticed.

Figure 1.18 *Part of a student's detailed photographic evidence of the making process.*

To be successful you will:

Assessment criteria: H. Making

Level of response	Mark range
Demonstrate a detailed understanding and justified selection of a range **(1 mark)** of appropriate materials **(1 mark)** and processes. **(1 mark)** Demonstrate demanding and high-quality making skills and techniques. **(1 mark)** Show accuracy and precision when working with a variety of materials, processes and techniques. **(1 mark)** Show high-level safety awareness that is evident throughout all aspects of manufacture. **(1 mark)**	13–18
Demonstrate a good understanding and selection of an appropriate range **(1 mark)** of materials **(1 mark)** and processes. **(1 mark)** Demonstrate competent making skills and techniques appropriate to a variety of materials and processes. **(1 mark)** Show attention to detail and some precision. **(1 mark)** Demonstrate an awareness of safe working practices for most specific skills and processes. **(1 mark)**	7–12
Demonstrate a limited understanding and selection of a narrow range **(1 mark)** of materials **(1 mark)** and processes. **(1 mark)** Use limited making skills and techniques. **(1 mark)** Demonstrate little attention to detail. **(1 mark)** Demonstrate an awareness of specific safe working practices during product manufacture. **(1 mark)**	1–6

I Testing (6 marks)

After making each product, you should then carry out tests to check their fitness for purpose against the set design requirements. Your finished product, as far as possible, should be tested under realistic conditions to determine its success and to check its performance and quality. You should describe in detail any testing carried out and justify this by stating what aspects you are testing and why you are doing so. Tests should be carried out objectively, and it would be beneficial to involve potential users so that you can receive reliable and unbiased third-party feedback. Well-annotated photographic evidence is a very good tool to use when describing the testing process.

To be successful you will:

Assessment criteria: I. Testing

Level of response	Mark range
Describe and justify a range of tests carried out to check the performance or quality of the product(s). **(1 mark)** Objectively reference relevant, measurable points of the design brief(s)/need(s). **(1 mark)** Use third-party testing. **(1 mark)**	4–6
Carry out one or more simple tests to check the performance or quality of the final product(s). **(1 mark)** Reference superficially some points of the design brief(s)/need(s). **(1 mark)** Record test results that are subjective. **(1 mark)**	1–3

Presentation of portfolio

Your portfolio of creative skills must be organised into **three** distinct sections clearly headed: product investigation, product design and product manufacture. It is important that each individual piece of work provided for assessment is evidenced in the appropriate section. This will allow your teacher to easily mark your work and provide the Edexcel moderator with a clear indication of your skills and ability.

While there is no defined limit to the number of pages you should include, it is envisaged that all requirements of this unit can be achieved within 25–30 A3-size pages. You may choose to produce your product investigation in A3 or A4 format. You can also submit your work electronically for moderation provided it is saved in a format that can be easily opened and read on any computer system, i.e. a PDF document.

Authentication

It is extremely important that you sign the authentication statement in your Candidate Assessment Booklet (CAB) before your work is marked. If you do not authenticate your work Edexcel will give you zero credit for this unit.

Testing: third-party feedback

The box can be carried and dispensed very easily.

Joe found this box of dominoes very eye catching.
The colours are vivid and bold, which meets the most important point in my specification that the packaging advertises and appeals to the customers through the use of bright colours.

While Joe was playing with these dominoes he was thinking about getting it right.
This helps teach children how to count, which again meets my specification.

Joe enjoyed playing with the dominoes very much.
Asking his mother questions helps me to understand what the parents of young children want to buy. She commented upon the colours – in her opinion each number could be a different colour as this would be more interesting and develop colour visualisation.

Figure 1.19 *Part of this student's testing involved third-party feedback provided by a member of the target market group (TMG).*