1.1 Exploring the context of a design solution

1. Any three from:
   - The purpose of the product
   - The features and functions of the product
   - The materials the product is made from
   - The cost of the product
   - The construction methods used
   - The safety of the product
   - The product’s maintenance requirements.

2. Any four from: designer, manufacturer, retailer, marketing team, repairer/mechanic/tailor, recycling organisation, maintenance department, supplier of components, supplier of energy, regulatory body, standards organisation, governmental agency.

3. User requirements for a garden table:
   - Is it suitable for external use?
   - Is it made of weather-resistant materials?
   - Does it have an easy-to-clean surface?
   - Is it made of hard material?
   - Is it aesthetically appealing?
   - Is it suitable for four or more people?

4. User requirements for a ski jacket:
   - Does it have a high wicking surface?
   - Is it water resistant/waterproof?
   - Is it easy to use with gloves and other apparel?
   - Does it have internal armour?
   - Is it resistant to abrasion?
   - Is it warm?
   - Is it ventilated?
   - Does it include a storage bag?

5. User requirements for a heavy-duty sack truck:
   - Can it be stored easily?
   - Is it foldable?
   - Is it strong enough to carry 100 kg+?
   - Is it stable and easy to manoeuvre?
   - Is it corrosion and scratch resistant?
   - Is it suitable for internal and external use?

1.2 Stakeholder analysis

1. Any three from:
   - The designer avoids working in isolation.
   - The designer understands how the user interacts with the product.
   - The designer can identify gaps in their knowledge about the product’s use.
   - It can identify the views and opinions of stakeholders on the proposed product.
   - It can ascertain whether a market exists for the product.
   - It can ascertain how and where the product will be used.
   - It can ascertain whether users would purchase the product rather than other options.
   - It can identify the stakeholders’ key requirements.
   - It can identify what aspects users would see as desirable but inessential.
   - It can ascertain how users would interact with the product and what they would need to understand.

2. Appropriate focus group activities include:
   - Direct questioning and discussions about the jacket
   - Interaction with jacket or wearer trials
   - Discussion of possible improvements to the jacket.

3. Qualitative data describe products in terms of appearance, size or perceived value, in adjectives like ‘small in size and cheap to buy’. Quantitative data describe products in terms of numerical quantity such as size, weight or capacity in numbers such as 5 kg in weight or dimensions of 100 mm × 150 mm × 400 mm.

4. Any three from: questionnaires or surveys, interviews, focus groups, product analysis, ergonomic data.

5. As the weather warms up, shoppers will look to buy new summer clothes to match current fashion trends, any requirements for keeping cool or for going on holiday. The high-street clothing company will seek to:
   - Determine what stock levels will meet demand
   - Account for national differences in buying habits or weather
   - Buy only enough stock to meet demand
   - React quickly to unseasonal weather such as long cold or wet spells
   - Take into account local events or attractions which may alter buying habits, such as a large music festival or carnival.
### 1.3 Considering usability when designing prototypes

#### Answers could include:

1. A TV remote control with good affordance should be easy to use. The layout of the buttons and their appearance and feel should make it obvious which one to press to carry out a particular function such as finding the menu or pausing a programme.

2. Standard TV remote controls often compress a large number of buttons into a small space, which can make it difficult for users to find the ones they need.

3. A TV remote control with good affordance usually has raised volume control and channel up/down rocker switches, which make it straightforward to recognise the position of the buttons and know when they have been pressed.

4. Standard TV remote controls often include a range of controls for additional items such as DVD players, which can be confusing, and the use of colour text and symbols is not always as helpful as it might be.

5. Anthropometrics is the measurement of humans to provide data such as sizes and grip strength. The data collected help in the more effective design of products with which humans interact and is an important element of ergonomics. Ergonomics is the interaction between humans and their environment, including the products they use and the activities they carry out.

#### Inclusivity involves the design of products that are accessible to the largest possible range of people without the need for the product to be adapted in some way. Inclusive design would cater for the needs of those who have physical disabilities or who are at the extremes in terms of anthropometric data, and would also bear in mind issues such as gender and cultural differences.

#### Appropriate colours make designs more usable as the instinctive reactions that they generate mean that it is often unnecessary to think about how to use them. For example, green and red are essential for safety in traffic lights and warning systems. Blue and red make the design of taps and temperature controls more user-friendly.

#### Answers could include:

- Utility furniture was a government initiative led by Gordon Russell to provide simple, functional furniture for those who desperately needed it in the Second World War.
- The inventor Trevor Baylis responded to the lack of radio batteries in parts of Africa by developing the first wind-up radio.

#### Bauhaus designers such as Marcel Breuer believed in the concept of ‘Form follows function’, whereas post-modern designers such as Peter Shire of the Memphis group adopted an approach where functionality is of low priority and products are often show pieces rather than practical ones.

#### 2.1 Analysing and evaluating products

1. Penetration pricing is where the price is set artificially low to gain market share. Once achieved, the price is increased.

2. Price skimming is where the price is set at a high level when the product has a competitive edge. This will fall with increased supply.

3. The Art Deco period spanned the years 1925–1939.

4. Social media.

5. Possible advertising mediums could include local radio or magazines and social media. These would be appropriate because:
   - They could be targeted at the surfing demographic found in a coastal town.
   - They are low cost so suitable for start-up firms with a small budget.
   - They can be used to advertise directly to members of surf clubs.
   - The company’s marketing strategy and branding can increase their impact, for example with celebrity endorsements.

#### 2.2 Technological developments in product design

1. **3D printing.**

2. **Any three from:** thermoplastics, metals, ceramics, foofstuffs, construction materials.

3. **To provide training that would otherwise be impossible, for example practising emergency routines in dangerous or unlikely scenarios such as crash events.**

4. **Biometric such as iris, face or fingerprint are unique to each user and cannot be easily replicated.** Products that can identify these factors are more secure from attack than those that use passwords or pattern codes that can be stolen or replicated.

5. **Jobs that require hand skills or human interaction may be replaced with technology.** This may reduce the number of available jobs and may have serious social impacts.

### 2.3 Past and present developments in product design

#### Answers could include:

- In the early 20th century, washing machines made use of the electricity supplied to homes to power a simple electric motor-driven agitator.

- More sophisticated control systems were introduced with the invention of the transistor in the 1940s.

- In the 1960s the ‘Keymatic’ key card control system allowed different washing sequences for a variety of types of laundry through a relatively crude logic input system to recognise the sequence required.

- Microprocessor control was introduced in the 1990s, further improving reliability as even fewer switches and other controls were needed.

- Temperature reduction, water reduction and other energy-saving measures have been introduced, often in tandem with advances in detergents, to make machines more environmentally friendly.

- Some of the latest washing machines use ‘fuzzy logic’ which optimises the machine’s operation by analysing a large range of inputs, such as water temperature, size of load, detergent level, clothing type, etc.

#### Reasons include:

- Aspirational consumers who have a high level of disposable income might buy the Juicy Salif as a ‘display piece.’

- Phillipe Starck designs have a ‘cult following’ due to his often controversial and outlandish designs, and some people like to collect as many of his designs as possible.

#### Now test yourself answers

- Biometric such as iris, face or fingerprint are unique to each user and cannot be easily replicated. Products that can identify these factors are more secure from attack than those that use passwords or pattern codes that can be stolen or replicated.

- **Bel Air Chair by Peter Shire (1982)**
  - Asymmetrical, abstract design with random shapes and forms
  - Quirky, ball-shaped leg

- **Form not prioritised**

- Colourful cotton upholstery and painted wood construction

- More like a sculpture

- Colourful cotton upholstery and painted wood construction

- More like a sculpture
4.5 Product design and manufacture: \[\text{DFM = Design for Manufacture}\]

- It is an attractive, sculptural, aesthetic design, combining the appearance of a rocket and some kind of creature, which goes well with the appearance of many modern houses. A range of special editions, with finishes ranging from gold and bronze to white ceramic, has extended its aesthetic appeal.

5. Any two from:
- Apple iPod inspired by Dieter Rams’ Braun radio
  Jony Ive, Apple’s chief designer, admits to being highly influenced by the work of Dieter Rams, who shared his minimalist approach to design. The similarities in the way this approach may have inspired Ive’s designing can be seen in this side-by-side comparison.

- Richard Sapper’s whistling kettle inspired by steamboat whistles
  When Richard Sapper was designing his kettle for Alessi he wanted to design something that appealed to the senses as much as possible. His childhood memories of seeing and hearing the whistles of steamboats on the Rhine inspired his idea for this kettle. The whistle is made of brass to further reflect his inspiration and it has the same pleasing dual note.

- Velcro inspired by nature
  George de Mestral was inspired to design Velcro after seeing how hooks present in burrs (shown in the sketch below) attached themselves to the fur of his dog. After studying this natural hook, he developed a way to replicate it commercially. Many other designs have come about due to designers using this ‘biomimetic’ (copying nature) approach.

- James Dyson’s vacuum design inspired by a sawmill extraction system
  James Dyson saw the way extraction systems worked in sawmills and decided to try to implement a similar principle in a domestic vacuum cleaner. The development of his dual cyclone system came about after making thousands of prototypes in the search for a way of achieving a bagless cyclone system that would work. The basic principle of how the air flows through the dual cyclone system is shown in the sketch below.

- Velcro inspired by nature
  George de Mestral was inspired to design Velcro after seeing how hooks present in burrs (shown in the sketch below) attached themselves to the fur of his dog. After studying this natural hook, he developed a way to replicate it commercially. Many other designs have come about due to designers using this ‘biomimetic’ (copying nature) approach.

2.4 Lifecycles of products

1. Introduction, growth, maturity, decline.
2. Market penetration involves increasing the market share of an existing product, or promoting a new product by using a variety of marketing and advertising strategies.
3. Any two from: pop-up ads on social media, magazine and newspaper adverts, radio and television adverts, product endorsements, direct mail leaflets.
4. Social media marketing is a form of internet marketing that utilises social networking websites as a marketing tool.
5. In the growth stage:
   - Advertising helps to increase the popularity of product.
   - Product sales steadily grow.
   - Rival products emerge on the market.

3.1 Factors to consider when investigating design possibilities

1. Any four from: wood, metals, cotton, wool, silk, stone, glass, clay, porcelain.
2. Advantages: there are no pollutants or waste, the costs of pumping are low, only a small infrastructure is required. Disadvantages: there are few suitable locations, there is a possibility of gas emissions.
3. Examples include: light bulbs, refrigerators, washing machines, cars.
4. The disadvantages of high initial set-up costs and the destruction of local habitats involved with hydroelectric power may outweigh the less costly disadvantages associated with wind power.
5. Our social footprint refers to the impact we have on other people.

3.2 Factors to consider when developing design solutions for manufacture

1. Carbon dioxide, methane, nitrogen oxide.
2. Cracking or fractionation.
3. DFM = Design for Manufacture. Its purpose is to reduce waste at every stage of the manufacturing process.
4. Symmetrical parts are not sided and can be placed in either orientation during fitting. This reduces time and errors.
5. Possible negative impacts include: human rights violations, forced labour, child labour, exposing domestic companies that have become inefficient or complacent.

3.3 Factors to consider when manufacturing products

1. Any five from: reliability, performance, packaging including size and shape, cost, manufacturing and assembly, regulatory directives, intellectual property, sustainability.
2. Designers tend to choose standard stock sizes or forms instead for ease of availability and to reduce costs for components, processing and transport. Savings can be made by buying in bulk to reduce unit price and transportation costs.
3. Any four from:
   - What the product or component must do
   - The product’s environment of use
   - The maintenance requirements for the product
   - The specific aesthetics of the product
   - Sustainability issues.

3.4 Factors to consider when distributing products to markets

1. The trademark must be unique and distinct, fair and accurate, morally acceptable.
2. Trademark rights.
3. Tracking cookies.
4. Direct distribution removes wholesalers and retailers from the distribution chain and companies can save money by using their own staff and premises for distribution.
5. Any four from:
   - Reducing energy use and costs by using a centralised distribution centre
   - Using less impactful transportation such as rail and water rather than road or air
   - Using fuel-efficient transport options
   - Using intelligent transport management systems
   - Using local suppliers
   - Outsourcing storage and distribution to specialist companies which will reduce the number of journeys made by delivering for numerous companies
   - Optimising packaging materials and design.
3.5 How skills and knowledge from other subject areas inform decisions

1 Networking with experts and specialists from a wide range of subject areas can lead to new solutions to product design problems. Experts and specialists often have a better knowledge and understanding of the human body, new theories, and technological developments in materials of manufacturing.

2 Technical specifications and size data sheets.

3 It would allow for the identification of problems, features and the environmental context of use.

4.1 Annotated 2D and 3D sketching and digital tools

1 A detailed orthographic engineering drawing would be required. This type of drawing enables the communication of exact shapes, dimensions and tolerances, with additional information regarding manufacturing requirements such as materials and parts, as well as showing areas for finishing by grinding or where welds are to be positioned. The drawings would be produced in accordance with existing standards such as BS888 to ensure that there is no possibility of any misunderstanding of any element of the drawing, such as symbols. Hidden detail, sectional and exploded views can be included to give more detailed information about parts of the design that can’t be seen clearly in a conventional view. Particularly complex parts of the design can be shown in additional orthographic views drawn at a larger scale to clarify the details of the required design.

2 In this situation a designer would be likely to use some form of sketch model. This is a relatively fast method of modelling that is intended to give an indication of the form of a design. If the design was for a hairdryer, for example, foam would be used, carved and sanded into the form of the new design and this would make it possible to get a preliminary idea of its aesthetic and ergonomic merits, as well as providing a basis for trialling the position of switches, vents and other important features. These features could be quickly modelled in materials such as card and wire.

5 Fences are usually built using sawn timber which has a rough surface and may have some bowing and twisting due to imperfections in the seasoning process. The tolerances will need to be relatively large therefore to take this into account and it will be acceptable to cut lengths with a tolerance of about 5 mm so that pieces align reasonably well. A smaller tolerance of 1 or 2 mm will be required for positioning holes depending on the type of fixings being used, to ensure that they align correctly.

With a mould for a drink bottle cap, it is essential that the thread on a bottle fits well to facilitate the threading and unthreading of the cap. It is important that the thread is of the correct form to ensure that the bottle can be opened and closed easily. The tolerances of the thread will need to be controlled to ensure that the thread is not too small or too large. The tolerances for the thread will be determined by the function of the bottle cap and the materials used in the moulding process and make any necessary modifications to the design.

4.2 Use of digital design tools by industry professionals

1 This diagram below shows the way that colours can be used to identify areas of maximum stress in a proposed design for a structural part of a product using FEA. The red areas indicate high levels of stress and the blue areas indicate the least stress, so parts that are at risk of failing can be identified.

This MFA of an injection-moulded plastic box shows the highest temperatures in red, going to the lowest temperatures in blue. It allows designers to predict how well the plastic will flow into various parts of the mould during the moulding process and make any necessary modifications to the design.

2 How designers use the cloud to work and collaborate is shown in the diagram below:
4.3 Approaches to design thinking

1. An example Gantt chart:

<table>
<thead>
<tr>
<th>Wed, 10 Feb</th>
<th>9 am – 10.30 am</th>
<th>11 am – 12.30 pm</th>
<th>1.30 pm – 3.30 pm</th>
<th>3.30 pm – 4.00 pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut steel for brackets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weld brackets</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mark out and cut joints for timber frame</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glue up timber frame</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Likely collaborators may include:
- Designers – generating and documenting ideas
- Manager – co-ordinating the work of the design team
- Specialists – input on technical issues such as electric motors and food-preparation requirements
- Stakeholders – financial backing and support
- Users – design input through focus groups etc.

3. Systems thinking is an approach to design where the designer concentrates on the way that various elements of the product, and the user’s interaction with them, are connected.

In terms of a battery-powered lawnmower, the designer would think about:
- Battery charging – introducing lights to indicate the charge level or increasing the capacity of the battery so that users do not have to charge the lawnmower as often.
- Cutters removal, sharpening and/or replacement – making it impossible to access the blades when they are spinning to avoid accidents and linking this to safety devices such as tilt switches.
- Grass box – how to compress the grass cuttings so that users had to empty the box less regularly.

4. A diagram to show iterative designing to improve a seat design:

- Seat adjustment system now requires modification
- Research alternative seat adjustment methods
- Modify seat design to fit reinforced frame
- Ideas sketches
- Lever needs to be attached to frame
- Research ways of reinforcing the frame
- Sketch reinforcement idea
- Initial research
- Further research of seat designs
- Reinforcement means that the seat design needs to be modified
- Cycle continues in search of optimum design
- Further analysis, research, modelling, sketching and evaluation
- Research alternative seat adjustment methods
- Modify design to suit new adjustment method

5. The cradle-to-cradle approach is based on products being designed so they can be fully disassembled in a way that maintains the integrity of the materials that have been used. Raw materials (technical nutrients) can therefore re-enter the supply chain in a pure form that does not cause any degradation of the stock. This can be continued indefinitely as a circular process, in contrast to the linear model where much of a finished product often has to be sent to landfill at the end of its life.

5.3 Properties/characteristics of materials

1. Functional performance, aesthetics, cost and availability, properties and characteristics, environmental considerations, social, cultural and ethical factors.

2. How the product works or functions.

3. Any three from: colour, texture, form, shape, style.

4. Any two from: conserving resources, the source of the resources (renovable or non-renovable), the recyclability of the material, the possible emissions during manufacture.

5. Physical and mechanical.

5.2 Materials used when designing and manufacturing products and prototypes

1. Any three from:
- They are available in large sheets (e.g. 1220 × 2440 mm).
- They are dimensionally stable – they do not shrink or expand, warp or twist as much as natural timbers.
- They have consistent properties and thickness across the whole board and between other boards.
- They can be pre-finished using laminated plastic sheet (melamine), foil (PVC) or natural veneer surfaces.
- They have environmental benefits because they can be made from lower-grade timbers and utilise waste associated with the manufacturing of natural timber.

2. Aluminium has a very low melting temperature (660 °C) compared to other metals, making it easy and energy-efficient to recycle.

3. A composite is a material comprised of two or more different materials, resulting in a material with enhanced properties.

4. A smart material has physical properties that change in response to an input or a change in the environment, such as electricity, pressure, temperature or light.

5. Modern materials have been developed to perform specific functions, through the invention of new or improved processes. They are not naturally occurring materials.

6.1 Structural integrity

1. Structural integrity is the ability of a product or system to hold together when under load.

2. The frame could be reinforced by adding cross members in a triangulation.

3. A sacrificial part is a weaker part of a product which is designed to fail first in order to protect more significant parts.

4. Stresses.

5. The fuse.

6.2 Designing products to function effectively within their surroundings

1. Cellulose and acrylic paint.

2. Zinc.

3. Powder coating.

4. Any two from:
- To prevent the metal from absorbing moisture
- To protect against decay, corrosion or wear
- For ease of maintenance through dusting or washing
- To enhance the appearance of the final product.

5. Aluminium.
6.3 Smart and modern technologies

1. Photochromic pigment.
2. Examples include: liquid crystal displays (LCDs), smart goggles and motorcycle helmets, self-darkening rear-view mirrors in cars, window glass with different tint settings for privacy screens.
3. Shape-shifting materials are materials that can change their shape in response to a physical stimulus such as an electric voltage or current, a change in temperature or the presence of a magnetic field.
4. It is highly water repellent.
5. Examples include: soft-closing drawers, doors and toilet seats, adjustable suspension in vehicles, earthquake-dampening systems, motion control gels in bearing systems.

7.1 Using materials and processes to make iterative models

1. Additive methods are those where materials are joined or built up in some way during manufacture, such as welding or 3D printing. Subtractive methods are those where material is removed by cutting with tools such as saws, carving tools and lathes.
2. Modelling is the creation, exploration and improvement of designs through a variety of media, such as graphics and computer or physical models. These are vital in exploring and communicating ideas in the iterative design process, as it is dependent on making a series of improvements in the search for the optimum design. Without modelling it would be difficult to communicate ideas to stakeholders who need to be involved and evaluate the potential of proposed improvements.
3. A CNC laser would be ideal for this since 2D files such as DXFs can be sent directly to the machine for precise cutting. This machine is also capable of producing an intermittent cut that serves as a type of scoring so that models bend easily in the correct places.
4. FDM printers are based on a polymer such as ABS being heated and extruded from a fine nozzle. The nozzle moves relative to a table in three axes (X, Y and Z), where it builds up the form of the model in a series of layers, which computer software has determined by ‘slicing’ the CAD model according to the level of accuracy that the printer is capable of.
5. Advantages include:
   - Virtual reality can be used in order to present a 360° view that can serve a variety of purposes. These range from specialists being able to inspect the design for particular issues to potential users giving their opinion of the product’s aesthetics.
   - The iterative design process is well supported, as modifications can be easily made and subjected to further scrutiny and testing.

7.2 Using materials and processes to make final prototypes

1. Any two from: modesty blocks, barrel nuts and bolts, cam-lock connectors, wood screws, coach bolts.
2. KD fittings allow products to be assembled and disassembled many times, without weakening the joint.
3. Low temperature casting.
4. They eliminate the need to repeatedly mark out.
5. CAD = computer-aided design. CAM = computer numerically controlled.

7.3 Using materials and processes to make commercial products

1. Examples include drink bottles, shampoo bottles, detergent bottles, plastic drums, tubs, and storage tanks.
2. Advantages include:
   - Robots are not subject to manual handling issues or repetitive strain injuries and can work without breaks in hazardous environments to produce the same quality of item repeatedly.
   - Robots can be easily programmed to carry out different tasks such as painting or welding and do not require upskilling like a manual workforce.
   - Robots still require human intervention for servicing, quality control etc.
3. Disadvantages include:
   - High initial layout costs.
   - Software or system breakdowns that stop production and can impact on costs.
   - Programming robots is a specialist job (workers may require retraining).
   - Some programme languages do not communicate across different software platforms.
3. Their purpose is consistency in manufacturing by ensuring that each product is the same quality, the joints and connections are in the same place and the processing can be carried out quickly, with repeated accuracy.
4. Assembly jigs are used to hold parts in place while a process is being carried out. So for example, they could be used to hold mild steel square tubing in place while it is MIG welded together to form climbing frames, bike frames and exhaust pipes.
5. A fixture holds work in a given position while a manufacturing process takes place. Fixtures are always fixed to the machine bed.

7.4 How manufacturing is organised and managed for different scales of production

1. The windows would be batch produced, as there would be several windows of a similar type. It would, therefore, be viable to set up jigs, fixtures and templates to enable the work to be done more efficiently.
2. Examples include: screw fasteners, light bulbs, bolts, headlights, batteries, resistors, sockets, plugs and connectors to enable the work to be done more efficiently.
3. Bespoke products are made entirely or nearly entirely to an individual customer’s order. Mass customisation allows certain elements of a design to be customised such as an embossing a name on trainers or a particular combination of finish, wheels and audio system for a car.
4. Direct digital manufacturing (DDM) is a manufacturing system that uses machines such as 3D printers to print parts directly from 3D CAD files. It is becoming increasingly useful in the manufacture of specialist parts in metals such as titanium which would be impossible to make by other means. Selective Laser Sintering (SLS) is the process normally used for this type of manufacture using metals.
5. Any three from:
   - The monitoring, costing and ordering of materials or parts (using barcodes, RFID tags, kanbans).
   - Computerised warehouse organisation with automatic guided vehicles (AGVs), forklifts and new-age stacking robots
   - Distribution through optimum loading patterns for freight containers and delivery schedules
   - Electronic point-of-sale (EPS) systems which record sales of products and automate re-stocking
   - Organisation of optimum level of buffer stock, if required.

7.5 Controlling quality through manufacture

1. Quality assurance (QA) is particular set of policies and procedures that are put in place to ensure that products meet quality standards and are ‘right first time and every time’. Quality control (QC) refers to the wide range of monitoring, checking and testing that is carried out before, during and after production to ensure that the tolerances and other standards set out in the QA specifications are strictly adhered to.
2. Examples include:
   - Aluminium, which is used for car radiator manufacture, must have the correct chemical composition in order to be compatible with manufacturing processes and the product’s working environment. Samples are taken from every delivery and subjected to spectrographic analysis before they are accepted for use in manufacture.
   - Sand, which is a major constituent in the manufacture of glass bottles, must not have a moisture content which is too high as it can clog the plant that feeds the glass furnace. A sample of the sand is therefore weighed, dried and weighed again to check the moisture content. A delivery of sand will only be accepted if the moisture content is within certain limits.
3. When the design for the mould has been created as a CAD file, an analysis (MFA) software can be used to establish how well the plastic will flow into the mould to ensure that all the design details will be produced as required. When multiple moulds are used, each one will have a unique identification code. This means that any mouldings that are subsequently rejected during a QC check can be traced back to a particular mould.

8.1 Assessing whether a design solution meets its stakeholder requirements

1. Kitemark®.
2. 2 To ensure measurements are the same for all manufacturers. Changes in size or poor tolerances would result in parts not fitting correctly and not working.
3. Any four from:
   - Materials and components costs
   - Design and development costs
   - Production and manufacturing costs
   - Legal costs
   - Marketing costs
4 Inclusive design considers how easily a product can be used by everyone without the need for special adaptation.

5 Any four from:
- Material costs
- Printed areas and colours
- Level of protection for the product
- Additional functions or requirements such as water resistance
- Added value in terms of appeal
- Environmental impact.

8.2 Assessing whether a design solution meets the criteria of technical specifications

1 Tolerance is the permissible range of variation in the dimension of an object.

2 Children at Halloween parties will often encounter sources of ignition – candles on cakes or in pumpkins. Fancy dress clothing should not easily catch fire and tests would be used to ensure that they burn slowly if they do, to avoid injury.

3 Any three from checks on:
- Uniformity of parts
- Tolerances
- Performance
- Differences in materials
- Machinery tolerances
- Machine sensor accuracy.

4 Any three from tests measuring:
- Tearing strength
- Breaking strength
- Bursting strength
- Air permeability
- Wicking
- Abrasion resistance
- Pilling.

5 The three ways are:
- Destructive physical tests
- Non-destructive physical tests
- User trialling.

8.3 Determining whether design solutions are commercially viable

1 Examples include: rent, mortgage, insurance, machinery.

2 Changes in consumer spending may mean that new products or non-essential products do not gain traction in a market during an economic downturn. It is likely that fewer products will be sold, meaning manufacturers may have too much supply and too little demand.

3 A reduction in costs may come from:
- reducing the costs of parts or materials from suppliers
- reducing waste.

4 Unexpected problems that may occur after a roll out include:
- language barriers
- loyalty to competitor brands
- poor market place traction.

5 Over-engineering can cause increased costs which leads to an increased price point and reduced sales. It may also result in an overly long lifespan which may reduce future or repeat sales.

9.1 Ensuring safety in a workshop environment

1 Anything that could cause someone harm.

2 A statutory process that considers what might cause harm to people and what reasonable steps might be taken to prevent that harm.

3 Examples may include: hard hat, protective footwear, high-visibility jackets, ear protectors.

4 To keep employees safe; to keep machinery and vehicles in a designated zone away from pedestrians.

5 Provision of training, provision of PPE, safety signage in the workshop.

9.2 The implications of health and safety legislation on product manufacture

1 The main piece of legislation for British health and safety law.

2 Provide PPE and ensure people are trained in how to use it properly.

3 First-aid procedures and a safety data sheet with information on safe use, safe storage and ingredients.

4 Any two from: acute toxicity, gases under pressure, health hazard (e.g. skin irritation), flammable, explosive, harmful to the environment, oxidising, Serious health hazard (e.g. respiratory, carcinogen), corrosive.