# GCE MARKING SCHEME

# DESIGN & TECHNOLOGY
# AS/Advanced

## SUMMER 2014

## INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2014 examination in GCE DESIGN & TECHNOLOGY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

## DT1 - PRODUCT DESIGN

## SECTION A

**Q.1 Synthetic plastics are increasingly replacing the use of traditional materials within product design and manufacturing.**

**(a) Identify two named products and the specific synthetic plastics that have replaced traditional materials. [2]**

**(b) For each product explain the advantages that these new synthetic plastics bring to the product. 2x[3]**

A range of named products and plastics from:

Drinks bottles (PET), window frames (UPVC), clothing (Polyester, Nylon), car trims (ABS).

Advantages of using synthetic plastics within the named product (three marks for each advantage explained):

- lightness
- recycling possibilities
- less material used
- Consistent properties/characteristics for specific use.

**Q.2 Product designers and manufacturers use research methodologies to investigate sources of information which aid the design and manufacture of products.**

**(a) Explain the terms *Primary* and *Secondary* research. 2x[2]**

**(b) Describe the type of information that is gained through both Primary research and Secondary research. 2x[2]**

**Primary research**

Involves the collection of data that doesn't already exist.
Primary research involves getting original data directly about the product and market. It is designed to answer specific questions of interest to designer or manufacturer. **2 marks**

**Information gained?**
Looking at and recording what people do and how they behave.
Observing consumer behaviour.
Market researchers can use experimental techniques. e.g. product tests, taste tests.
Involves questionnaires to consumers.
Focus groups and consumer panels: A select group of consumers that the company regularly surveys to identify changing attitudes to new products.
**2 marks**

**Secondary Research**

Involves the collection of existing information/data collected from e.g. research subjects or experiments. **2 marks**

**Information gained?**
Information regarding materials used in products, ergonomic and anthropometric data, specific data which already exists and is relevant to a new product's development. **2 marks**

**Q.3 Patents, Copyrights, Registered Trade Marks, Registered Design and Design Rights are distinct intellectual property rights granted by the Intellectual Property Office.**

**Describe the features and protection provided by two of the above intellectual property rights. 2x[4]**

**Patents**

Monopoly rights to the exclusive use of an invention.
Can last for a maximum of 20 years if annual renewal fees are paid.
Becomes a property that can be bought, sold, hired or licensed.
An invention is patentable only if it is:

a. New and previously undisclosed.
b. Distinguished by an inventive step.
c. Capable of industrial application (that it could actually be made).

**Copyright**

Protects original literary, dramatic, musical and artistic works.
Copyright arises automatically.
Recognised internationally.
Becomes a property that can be bought, sold, hired or licensed.
Lasts until 70 years after the death of the author.

**Registered Trade Mark**

Any sign which can be represented graphically.
Any sign which can distinguish goods or services.
Includes words, personal names, designs, letters and the shape of goods and their packaging.
Registered for 10 years and can be renewed every 10 years indefinitely.

**Registered Design**

Grants exclusive rights in the look and appearance of a product.
You can stop people making, offering, putting on the market, importing, exporting and using a product to which your design is applied.

Design Registration protects the overall look of the whole or a part of a design. You can claim protection for the shape of a product, a two-dimensional surface pattern or graphic design, or a combination of the two.

Registered Designs can be renewed every 5 years up to a total of 25 years.

The existence of your registration may be enough to stop anyone infringing your design irrespective of whether they copied or came up with the design independently.

A registered design allows you to sell your design and the intellectual property (IP) rights to it; or licence somebody else to use your design whilst you retain the IP rights.

**Design Right**

A form of protection for the shape or configuration of articles.
Design must not be commonplace.
It is not a monopoly but a right to prevent copying.
It lasts 10 years.
Becomes a property that can be bought, sold, hired or licensed.

*Note:*

*There are specific differences between Design Right and Registered Designs. Registered Designs give you exclusive rights in a design, in the UK, for up to 25 years. You can stop people making, offering, putting on the market, importing, exporting, using or stocking for those purposes, a product to which your design is applied. You can protect two-dimensional designs or surface patterns as well as shape and configuration with a Registered Design.*

*By comparison, Design Right gives you automatic protection for the internal or external shape or configuration of an original design, i.e. its three-dimensional shape. Design Right allows you to stop anyone from copying the shape or configuration of the article, but does not give you protection for any of the 2-dimensional aspects, for example surface patterns. Protection is limited to the United Kingdom (UK) and lasts either 10 years after the first marketing of articles that use the design, or 15 years after creation of the design – whichever is earlier.*

(up to 4 marks for each feature and protection)

**Q.4 Laser cutting, injection moulding, fabrication, laminating and casting are specific processes used within product manufacture.**

**(a) Describe two of these processes. 2x[2]**

**(b) State an advantage and a disadvantage of each process. 2x[2]**

**Laser cutting** uses a laser to cut materials is used for industrial manufacturing applications. Laser cutting works by directing the output of a high power laser, by computer, at the material to be cut.

Laser cutting
- Metals
- Plastics
- Textiles

Advantages: The material melts, burns, vaporizes away, or is blown away by a jet of gas, leaving an edge with a high quality surface finish. Industrial laser cutters are used to cut flat-sheet material.

Disadvantages: Set up costs, size/scale limitations.

**Injection Moulding** is a process for producing parts from both thermoplastic and thermosetting plastic materials. Material is fed into a heated barrel, mixed, and forced into a mould cavity where it cools and hardens to the configuration of the mold cavity. Injection molding is used for manufacturing a variety of parts, from the smallest component to entire body panels of cars. Injection moulding of plastic components.

Advantages: Parts produced in high volume, finished surface finish, complex parts produced.
Disadvantages: Large set-up costs, specialised production.

**Fabrication** applies to the building of structures and other equipment, by cutting, shaping and assembling components made from certain materials.

Steel fabrication concentrates on the metal preparation, welding and assembly of products (finishes are also part of this).

Fabrication
- the joining of parts by mechanical methods.
- use of heat.
- use of adhesives.

Advantages: Large scale production possible, not expensive to set up on a small scale.
Disadvantages: Basic surface finish on some materials.

**Laminating** can apply to:
- graphic products in the protection of documents.
- textiles i.e. lightweight polyester knit fabric to a film of polyurethane in order to create a water barrier. It can be a material composed of two or more layers, at least one of which is a continuous polymer layer and at least one of which is a textile fabric. The layers are bonded closely together by means of an added adhesive.

**Casting** is where a molten material is poured or forced into a prepared mould to create a specific shape. This may be cold (e.g. plaster, resin) or hot (e.g. pewter, bronze).

Casting
- Resin – suitable for small and high volume.
- Hot casting.

Advantages: Large scale/volume casts possible
Disadvantages: High running costs. Surface finish often requires addition work

*Up to 4 marks for each chosen*

**Q.5 Both solid modelling and performance modelling are used in the development of products.**

**(a) Describe two benefits of solid modelling to the designer. 2x[2]**

**(b) Describe two benefits of performance modelling to the manufacturer. 2x[2]**

**Designer Benefits**
Ability to see ideas in two and three dimensions/different locations.
Testing product performance (mechanisms, materials).
Enables concurrent engineering.
Costs lowered by continuous use.

2 marks for each benefit

**Manufacturer Benefits**
Mould/jig preparation can be simplified.
Conversion through to Computer Aided Manufacture (CAM).
Transfer of models to other manufacturing locations.

2 marks for each benefit

**Q.6 GANTT charts, flow charts and critical path analysis charts are used by designers and manufacturers within project management.**

**For any two of the above project management systems:**

**(a) State the main features of each. 2x[2]**

**(b) Describe how they are used within project management. [4]**

**GANNT Charts**
**Features**: A Gantt chart is a type of bar chart that illustrates a project schedule. Gantt charts illustrate the start and finish dates and summary elements of a project.

**[2]**

**Used effectively** in mapping tasks, time factor, gives the user a project overview (reference to production plan, manufacturing process).

**[2]**

**Flow Charts**
**Features**: A flowchart is a schematic representation of a process. Generally the start point, end points, inputs, outputs, possible paths and the decisions that lead to these possible paths are included in the chart.

**[2]**

**Used effectively** in elements of a block flow diagram (system diagrams), flow process diagrams such as a material processing system or instructions for a bicycle's assembly.

**[2]**

**Critical Path Analysis**
**Feature**s: In project management a critical path is the sequence of project network activities with the longest overall duration, determining the shortest time possible to complete the project.

**[2]**

**Used effectively** in understanding of the critical path (the shortest route), planning the outcome of a project, the overlap of certain activities within a manufacturing process.

**[2]**

**Q.7 (a) Explain the term *Reverse Engineering.* [2]**

**(b) Identify three important insights a designer could gain by conducting Reverse Engineering on a named product 3x[2]**

Reverse engineering - *the process of discovering the technological principles of a product/component or system*. **[2]**

- Designers analyse its function, structure and operation.
- Involves taking something apart and analysing its workings in detail - usually with the intention to construct a new device.
- The new device does the same thing without actually copying anything from the original.
  The above are not principles.

Insights such as:
How the product functions/works.
The layout of components and how it is constructed.
Suitability of hidden materials and their use in its construction.

**2 marks for each principle**

Note: *Maximum of 4 marks if no product is identified in part b.*

**Q.8 Anthropometric data is used in the design of products to ensure ease of use.**

**Explain how designers have successfully used anthropometric data in four named products.**

**4x[2]**

Application of anthropometric principles – *the scientific study of human measurement taken across a range of typical human groupings*.

Explanation of how designers have successfully used anthropometric data in four named products.

- Things measured including weight, strength, speed and range of movement as well as physical sizes of products in relation to the human form.
- The designer would see anthropometry as that which is concerned with the physical fit between people and the equipment, products and spaces they use.
- They could consider human size issues essential for product success, for example - in a kettle, they could be handle size/form, weight and the movement required to pour successfully, internal physical dimensions.

Up to 2 marks for **each** explanation that clearly illustrates how a specific dimension of a product is determined by the relevant specific human dimension for **each** product.

*Note: no mark for repeated response – look for differentiation within each product.*

## SECTION B

Section B involves extended written answers in which the mark awarded must take into account the quality of written communication – as indicated to candidates in the rubric on the front of the question paper. This should form an integral part of the judgement on the question, the following criteria being applied in deciding whether the points outlined in the marking scheme are communicated sufficiently clearly to award the full credit:

- Legibility; accuracy of spelling, punctuation and grammar.
- Organisation of information clearly and coherently (appropriate to purpose and to complexity of subject matter); use of specialist terms.

At the same time it should be noted that over-rigidity in interpretation of the mark scheme is not intended, and it is accepted that points may be made in a variety of different ways. Thus, except where terms are specifically requested, correct responses using different words are acceptable providing that points are clearly communicated.

The following levels of achievement grid should be used in conjunction with question specific guidance listed below. In each case you are asked to check the mark you have arrived at against the grid before finalising it.

| | |
|---|---|
| Level 1<br><br>0-10 | • Candidate has a simplistic knowledge of the issues associated with the question.<br>• The use of terminology and technical language is basic.<br>• The candidate has little understanding of the general elements of industrial and commercial practices. Little knowledge of ICT in manufacturing systems.<br>• The candidate has limited knowledge of the form and function of products.<br>• The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant.<br>• Grammar, punctuation and spelling may be weak impacting on effective communication. |
| Level 2<br><br>11-16 | • The candidate has a basic understanding of the issues associated with the question.<br>• The use terminology and technical language is variable.<br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production.<br>• The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues not always considered.<br>• The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented.<br>• There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues. |

| | |
|---|---|
| Level 3<br><br>17-23 | • The candidate demonstrates a clear understanding of the issues associated with the question.<br>• The use terminology and technical language is reasonably accurate.<br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production.<br>• The candidate has developed a common knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered.<br>• The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured.<br>• There may be occasional errors of grammar, punctuation and spelling. |
| Level 4<br><br>24-30 | • The candidate demonstrates a specific ability to analyse questions, takes into account of a wide range of factors and has a clear understanding of the issues associated with the question.<br>• Uses correct terminology and technical language.<br>• The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production.<br>• Candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered where appropriate.<br>• The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured.<br>• There will be few, if any, errors of grammar, punctuation and spelling. |

## SECTION B

**Q.9 Global manufacturing continues to expand in order to meet the needs of consumers.**

**Discuss the advantages and disadvantages of global manufacturing for the designer and manufacturer. [30]**

Candidates may relate their response to a particular area:

- Clothing.
- Cars.
- Electrical goods, toys/games etc.

Discussion around the advantages to the designer and manufacturer:

- Transportation issues.
- Ability to work effectively across the globe using digital resources.
- Materials available locally.
- Local knowledge and expertise within a particular area.
- Large manufacturing bases set up and reducing costs.
- Cheaper workforce.
- Ability to supply quickly and on demand.
- Energy costs lower.

Candidates may also discuss the influence of these manufacturing bases i.e. on fashion and trends.

**Q.10 Fashion, style and trends are important factors in the development of products, such as the continuous development of mobile technology.**

**Discuss this statement in relation to a different product or range of products. [30]**

Discussion around fashion/style/trends:

- Importance of style and image in the development stage.
- Consumer needs.
- Style to match consumer group.
- Demonstrating a clear understanding of the issues associated with fashion, style and trends.
- User awareness of design.
- Individuality and changing fashion trends – how do designers/manufacturers respond?
- Image within certain groups.

*Note: Specific and different products or range of products used in the response (no mobile technology devices).*

**Q.11 Product designers consider aesthetics, function, maintenance, cost and disposal when developing products for mass production.**

**Discuss the implications of this statement in relation to named products.**

**[30]**

Discussions around:

**Product Aesthetics** – form and function and the development of products. The development of new materials allowing designers new possibilities. Adapting product aesthetics to trends/fashion.

**Function** – new technologies provide new possibilities. Multi-functional products being possible. Product function in relation to specific users or user groups.

**Maintenance** – implications of maintenance on a product, servicing needs (all affecting product life).

**Cost** - can include the cost to manufacture and the cost to the consumer (candidates may also refer to cost to the environment). Designers' consideration of markets and the costs of products within those markets (are they sustainable?).

**Disposal** – reference to materials and the way a product is assemble making it easier to dispose.
Environmental factors.

## DT1 - FOOD TECHNOLOGY

## SECTION A

**Q.1 (a) Give two examples of standardised food components. 2 x [1]**

Award one mark each for two appropriate examples. Examples could include pizza bases, pastry cases, ready made icing, marzipan.

**(b) Outline three reasons why manufacturers may choose to use standardised components in the production of food products. 3 x [2]**

Award up to two marks for each of three reasons.

- Saves labour with related benefits e.g. need to employ fewer staff.
- Simplifies process.
- Saves time over using raw materials.
- Less (specialist) equipment.
- Less storage needed both for raw materials and work in progress.
- Can save money.
- Less staff skills needed.
- Less staff training.
- Consistent results / quality achieved as long as have reliable supply of standardised components.
- Possible increase in quality of final product.
- Might reduce wastage.

**Q.2 Research methods used within food technology draw on various sources in order to provide reliable information for the food technologist and the food manufacturer.**

**(a) Explain the terms Primary research and Secondary research. 2 x [2]**

Primary research involves the collection of original data that doesn't already exist. Involves getting original data directly about the product and market. It is designed to answer specific questions of interest to the designer or manufacturer.

Secondary research involves the interrogation and collection of information / data collected from existing sources e.g. research subjects or experiments.

**(b) Describe the type of information that is gained through Primary research and Secondary research. 2 x [2]**

Information gained from primary research – looking at and recording what people do and how they behave – consumer behaviour. Market researchers can use experimental techniques e.g. product tests, taste tests. Involves questionnaires to consumers. Focus groups and consumer panels: a select group of consumers that the company regularly surveys to identify changing attitudes to new products. Generally a reliable source of information.

Information gained from secondary research – information regarding materials used in products, nutritional information, specific data which already exists and is relevant to a new product's development. Source may be unreliable - can be difficult to verity.

**Q.3 Patents, Copyright, Registered Trade Marks, Registered Design and Design Rights are distinct intellectual property rights granted by the Intellectual Property Office.**

**Describe the features and protection provided by two of the above intellectual property rights.**

**2 X [4]**

**Patents**

Monopoly rights to the exclusive use of an invention.
Can last for a maximum of 20 years if annual renewal fees are paid.
Becomes a property that can be bought, sold, hired or licensed.
Example - Rowntree patented aero process of manufacture in 1935.

An invention is patentable only if it is:

a. new and previously undisclosed;
b. distinguished by an inventive step;
c. capable of industrial application (that it could actually be made)

**Copyright**

Protects original literary, dramatic, musical and artistic works.
Copyright arises automatically.
Recognised internationally.
Becomes a property that can be bought, sold, hired or licensed.
Lasts until 70 years after the death of the author.
The most common use of copyright regarding food products would be for packaging, including use of images / photographs. It would also apply to information on websites as well as company databases.

**Registered Trade Mark**

Any sign which can be represented graphically.
Two dimensional ideas.
Any sign which can distinguish goods or services.
Includes words, personal names, designs, letters and the shape of goods and their packaging.
Registered for 10 years and can be renewed every 10 years indefinitely.
Celebrity chefs can trademark their own name and that of their restaurant.
Can be used to market services and products.
Brand identity very important with food products – consumer association with quality etc.

Examples: KitKat, “Twinnings”, 3 Bird logo on custard powder also the 3 stripes Red Yellow Blue. The Crossed Grain Symbol registered by Coeliac UK. Fairtrade logo.

**Design Right**

A form of protection for the shape or configuration of articles.
Design must not be commonplace.
It is not a monopoly but a right to prevent copying.
It lasts 10 years.
Becomes a property that can be bought, sold, hired or licensed.
Covers three-dimensional ideas. Does not provide protection for two-dimensional aspects.

**Q.4 Gelatinisation occurs during the manufacture of the filling for a lemon meringue pie.**

**(a) Explain the process of gelatinisation. [4]**

Gelatinisation occurs when starch is heated with moisture. In this case, corn flour is used as a thickening agent within the lemon meringue pie filling. The intermolecular bonds of starch are broken down on action of moist heat - grains swell and burst, dissolving the starch granule to create a gel. It is necessary to stir the mixture during heating to prevent lumps from forming.

**(b) Explain how sugar and acid affect gelatinisation and the implications for making a lemon meringue pie filling. [4]**

Sugar or acid e.g. lemon juice will affect the thickness of the gelatinised starch mixture and the rate at which the starch gelatinises when heated. The addition of sugar causes a reduction in the rate of retrogradation and inhibits the swelling of the starch granules because the sugar and starch compete for the available water. The implication when making the lemon meringue pie filling is that the sugar and lemon should not be added to the filling until it has thickened.

**Q.5 Explain how each of the following is used within the development of new food products:**

**(a) Databases for nutritional analysis. [4]**

Used within CAD – modelling. Databases can be used to manipulate possible combinations of food materials. Provides additional information when deciding whether to take forward a design. For choosing appropriate food materials to fit in with nutritional requirements of specification. To meet RDAs. To calculate how healthy the food product is. To provide information for labelling, particularly fat (saturate/unsaturated), sugar, salt and calories content. Helps with decisions re. traffic light labelling - whether the food product is red, amber or green. Allows food technologist to see result of altering individual ingredients by different amounts. To relate the food product to the target market.

**(b) Spread sheets for costing. [4]**

For use within CAD – for modelling. Allows for easy calculation of costs of food products. Different combinations of foods can be considered to see the cost implications of changes. Cheaper alternatives can be found in order to reduce costs. Allows costs to be easily calculated for different quantities when scaling up recipes for production runs etc. Allows costs per unit to be easily calculated.

**Q.6 GANTT charts, flow charts and critical path analysis charts are used by food technologists and food manufacturers within project management.**

For any **two** of the above project management systems:

**(a) State the main features of each. 2 x [2]**

**(b) Describe how they are used within project management. [4]**

**Gannt Charts**

*Features*: a type of bar chart that illustrates a project schedule. Gantt charts illustrate the start and finish dates and summary elements of a project.

*Used effectively* in mapping tasks, time factor, gives the user a project overview (reference to production plan, manufacturing process).

**Flow charts**

*Features:* a schematic representation of a process. Generally the start point, end points, inputs, outputs, possible paths and the decisions that lead to these possible paths are included in the chart.

*Used effectively* in elements of a block flow diagram (system diagrams), flow process diagrams such as a material processing system or instructions for a product's assembly.

**Critical Path Analysis**

*Features:* in project management a critical path is the sequence of project network activities with the longest duration, determining the shortest time possible to complete the project.

*Used effectively* in understanding of the critical path (the shortest route), planning the outcome of a project, the overlap of certain activities within a manufacturing process.

**Q.7. Enrobing is a manufacturing process used within the food industry.**

**(a) Describe how enrobing is carried out on one named food product. [4]**

Award up to four marks for accurately describing the process.

Example - biscuits / chocolates enrobed with chocolate.

The chocolate is tempered to give a shiny appearance. Chocolate heated to specific temperature to achieve correct consistency / rate of flow. Biscuits / chocolates placed on wire mesh so excess chocolate drips off. Molten chocolate flows in a continuous curtain. Biscuits / chocolates pass through the curtain of chocolate then are vibrated on a wire mesh conveyor belt to shake off any excess chocolate. A stream of air might be used to create a rippled effect before chocolate sets.

**(b) Briefly explain two benefits to the manufacturer of enrobing a named food product. 2 x [2]**

Award up to two marks for each of two benefits.

- Allows manufacturer to charge more for the product as it has added value-increase in selling price will outweigh increase in cost i.e. a chocolate coated biscuit will have a higher selling price and profit margin than a non-chocolate biscuit.
- Enhances appearance of the food product, making it more attractive to the consumer so increasing sales.
- Provides additional flavour to food product, particularly as flavoured chocolate, toppings etc. may be used.
- Provides contrast of textures e.g. between the biscuit and the chocolate coating.
- Increases shelf-life of product by reducing contact with the air e.g so biscuit stales less quickly.
- Reduces waste and increases use of food ingredients which would not otherwise be used e.g. allows small pieces of fish / chicken to be utilised in breadcrumb coated food products such as fish cakes, chicken nuggets.
- Enrobing in breadcrumbs protects fish / chicken from direct heat during frying / baking so prevents filling drying out, leads to higher quality product and increased customer satisfaction.
- Can make the food product more durable for transportation e.g. helps hold potato based product together.

**Q.8 The material chosen for packaging a food product will depend on the characteristics of that particular food product.**

**For one named food product of your choice:**

**(a) Name a specific packaging material. [1]**

Award one mark for correctly identifying a specific packaging material e.g. PET, waxed paper. Award no marks for generic terms such as plastic.

**(b) Describe the properties of this packaging material which make it suitable to use for this particular food product. [7]**

Award up to seven marks for describing the properties of a named packaging material, relating these to the characteristics / requirements of the food product packaged therein.

Example – PET used to produce a bottle for a fizzy drink.

- can be shaped / coloured / textured to form a recognisable marketing image to the consumer e.g. coca cola bottle. Often important for this type of product as brand image / brand rivalry is often important.
- Can be shaped to provide container which is easy to hold, easy and comfortable to drink from.
- Can be textured to produce good hand feel / tactile quality, container which does not slip through hand easily when being used.
- Waterproof so liquid does not leak.
- Retains gas so fizzy drink does not go flat.
- Can be made translucent so product can be seen by consumer so can tell at glance flavour of drink e.g. cola or orange.

Award maximum of **three** marks for correct description of the properties of a named packaging material without reference to named food products.

Only award mark for a specific named plastic being recyclable.

## SECTION B

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- Legibility; accuracy of spelling, punctuation and grammar.
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The following levels of achievement grid should be used in conjunction with question specific guidance listed below. In each case you are asked to check the mark you have arrived at against the grid before finalising it.

| | |
|---|---|
| Level 1<br>0-10 | • Candidate has a simplistic knowledge of the issues associated with the question.<br><br>• The use of terminology and technical language is basic.<br><br>• The candidate has little understanding of the general elements of industrial and commercial practices. Little knowledge of ICT in manufacturing systems.<br><br>• The candidate has limited knowledge of the form and function of products.<br><br>• The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant.<br><br>• Grammar, punctuation and spelling may be weak impacting on effective communication. |

| | |
|---|---|
| Level 2<br>11-16 | • The candidate has a basic understanding of the issues associated with the question.<br><br>• The use terminology and technical language is variable.<br><br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production.<br><br>• The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues not always considered.<br><br>• The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented.<br><br>• There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues. |
| Level 3<br>17-23 | • The candidate demonstrates a clear understanding of the issues associated with the question.<br><br>• The use terminology and technical language is reasonably accurate.<br><br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production.<br><br>• The candidate has developed a common knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered.<br><br>• The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured.<br><br>• There may be occasional errors of grammar, punctuation and spelling. |

| | |
|---|---|
| Level 4<br><br>24-30 | The candidate demonstrates a specific ability to analyse questions, takes into account of a wide range of factors and has a clear understanding of the issues associated with the question.<br><br>• Uses correct terminology and technical language.<br><br>• The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production.<br><br>• Candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered where appropriate.<br><br>• The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured.<br><br>• There will be few, if any, errors of grammar, punctuation and spelling. |

## SECTION B

**Q.9 The production, distribution and retailing of food are increasingly seen on a global scale. Discuss the advantages and disadvantages of the globalisation of the food industry to the consumer, the food producer and the retailer. [30]**

Advantages could include:

- increased consumer choice.
- availability of products all year round.
- meeting consumer demands.
- retailer can charge premium price.
- growers in developing countries have a market for products.

Disadvantages could include:

- environmental impact - response should focus on consumers' attitudes/ response to environmental issues.
- consumer have decreased awareness of seasonality; possible knock-on effect of loss of traditional regional cooking.
- consumers possible take products for granted and don't appreciate them sufficiently.
- increased price to consumer for value added product and to cover additional costs of e.g. transportation.
- logistics of buying food globally and arranging transportation; can be a complicated retail chain.
- possible negative impact on agriculture in e.g. developing countries if brings about large shift in crops grown.
- uncertainty of product origins / methods of manufacture.
- unreliability of food material content; open to corruption e.g. horsemeat scandal.

**Q.10 Discuss the effect of market trends and fashions on the design of food products. [30]**

Food producers / manufacturers responding to demands of the market, including:

- Developing more convenience foods – ready meals, microwave etc.; because of e.g. demands from working families;
- Developing more lower cost foods due to economic recession;
- Developing more luxury food products – trend of eating out less – increase demand for 'treating yourself' ready meals (eating in is the new eating out);
- Developing more vegetarian foods, particularly using meat analogues e.g. quorn, TVP etc;
- Developing more healthy eating ranges due to increased awareness of healthy eating issues and interest in nutritional content of foods;
- Avoidance of e-numbers, hydrogenated fats;
- Developing more sugar free, low salt products;
- Developing products which are fortified / enriched with omega-3 / 6, fortified with calcium etc.;
- Developing more foods with reduced calories because of obesity issues, increased body conscientiousness;
- Developing more foods which originate from other cultures because of increased globalisation, travel, cultural diversity; more foods from Eastern Europe because of increased number of e.g. Polish people living in UK;
- Avoiding foods with high food miles, use of local foods, using named regional producers;
- Using more Fair Trade, free range, outdoors reared, dolphin-friendly etc. food materials;
- Using more sustainability sourced food materials e.g. sustainable fishing;
- Using more organic ingredients;
- Using GM free foods;
- Developing more single portion foods because of changes in demographics and family members eating separately;
- Developing more foods to be eaten 'on the go' due to busy lifestyles;
- Developing more children's ready meals as children often eating separately from parents and parents too busy / don't want to cook;
- Using more high quality food materials e.g. named breeds of meat;
- Increased use of seasonal produce as consumers' awareness increases and concerns for environmental factors;
- Developing more part-prepared food products where consumer has to finish off dish;
- Celebrity chefs' food products;
- 'Great British Bake-off' – increased interest in baked goods;
- New food products produced in response to events e.g. World Cup;
- Outdoor living – barbeques;
- Celebrity chef ranges.

**Q.11 Discuss how the use of modern food materials and modern manufacturing techniques has influenced the production of new and innovative food products, both aesthetically and functionally. [30]**

Points discussed could include:

- modified starches have enabled development of products which thicken without need for stirring;
- increased range of vegetarian foods such as quorn with added health benefits of being low in fat etc;
- widely increased range of e.g. confectionery products, cereal products etc. which use new techniques;
- new food products with more interesting textures;
- novelty food products using encapsulation technology;
- GM foods can produce foods with improved functional properties e.g. tomatoes that can withstand cold conditions; foods with increased nutritional properties;
- fat replacers and sweeteners reduce calorie content of food products; fat replacers could have health benefits e.g. reducing risk of heart disease;
- foods with added health benefits e.g. cholesterol-lowering spreads, probiotics, fortified eggs;
- stabilisers to improve quality of a range of food products;
- edible inks for images on food products;
- encapsulation technology for new range of interesting food products;
- techniques for puffing grains to produce range of breakfast cereals.

## DT1 - SYSTEMS AND CONTROL

## SECTION A

**Q.1 Synthetic plastics are used in electronic and small mechanical components.**

**(a) Identify two specific electronic or small mechanical components and the specific synthetic plastics that are used in the construction of each.** **2x [1]**

**(b) For each component explain why these synthetic plastics are used.** **2x [3]**

A range of named products and plastics from:

Capacitor (polyester), gear wheels (nylon), cable insulation (PVC)
1 mark for each

Reasons for using plastics within the named product:

PVC for cable insulation
High insulation value
Resistant to abrasion

Three marks for reasons explained.

**Q.2 Product designers and manufacturers use research methodologies to investigate sources of information which aid the design and manufacture of products.**

**(a) Explain the terms Primary and Secondary research.** **2x [2]**

**(b) Describe the type of information that is gained through both Primary research and Secondary research.** **2x [2]**

**Primary research**

Involves the collection of data that doesn't already exist.
Primary research involves getting original data directly about the product and market. It is designed to answer specific questions of interest to designer or manufacturer. **2 marks**

**Information gained**
Looking at and recording what people do and how they behave.
Observing consumer behaviour.
Market researchers can use experimental techniques. e.g. product tests, taste tests
Involves questionnaires to consumers.
Focus groups and consumer panels: A select group of consumers that the company regularly
surveys to identify changing attitudes to new products. **2 marks**

**Secondary Research**

Involves the collection of existing information/data collected from e.g. research subjects or experiments. **2 marks**

**Information gained**
Information regarding materials used in products, ergonomic and anthropometric data, specific data which already exists and is relevant to a new product's development. **2 marks**

**Q.3 Patents, Copyrights, Registered Trade Marks, Registered Design and Design Rights are distinct intellectual property rights granted by the Intellectual Property Office.**

**Describe the features and protection provided by two of the above intellectual property rights. 2x [4]**

**Patents**

Monopoly rights to the exclusive use of an invention.
Can last for a maximum of 20 years if annual renewal fees are paid.
Becomes a property that can be bought, sold, hired or licensed.
An invention is patentable only if it is:
a. New and previously undisclosed.
b. Distinguished by an inventive step.
c. Capable of industrial application (that it could actually be made).

**Copyright**

Protects original literary, dramatic, musical and artistic works.
Copyright arises automatically.
Recognised internationally.
Becomes a property that can be bought, sold, hired or licensed.
Lasts until 70 years after the death of the author.

**Registered Trade Mark**

Any sign which can be represented graphically.
Any sign which can distinguish goods or services.
Includes words, personal names, designs, letters and the shape of goods and their packaging.
Registered for 10 years and can be renewed every 10 years indefinitely.

**Registered Design**

Grants exclusive rights in the look and appearance of a product.
You can stop people making, offering, putting on the market, importing, exporting and using a product to which your design is applied.

Design Registration protects the overall look of the whole or a part of a design. You can claim protection for the shape of a product, a two-dimensional surface pattern or graphic design, or a combination of the two.

Registered Designs can be renewed every 5 years up to a total of 25 years.

The existence of your registration may be enough to stop anyone infringing your design irrespective of whether they copied or came up with the design independently.

A registered design allows you to sell your design and the intellectual property (IP) rights to it; or licence somebody else to use your design whilst you retain the IP rights.

**Design Right**

A form of protection for the shape or configuration of articles.
Design must not be commonplace.
It is not a monopoly but a right to prevent copying.
It lasts 10 years.
Becomes a property that can be bought, sold, hired or licensed.

*Note:*

*There are specific differences between Design Right and Registered Designs. Registered Designs give you exclusive rights in a design, in the UK, for up to 25 years. You can stop people making, offering, putting on the market, importing, exporting, using or stocking for those purposes, a product to which your design is applied. You can protect two-dimensional designs or surface patterns as well as shape and configuration with a Registered Design.*

*By comparison, Design Right gives you automatic protection for the internal or external shape or configuration of an original design, i.e. its three-dimensional shape. Design Right allows you to stop anyone from copying the shape or configuration of the article, but does not give you protection for any of the 2-dimensional aspects, for example surface patterns. Protection is limited to the United Kingdom (UK) and lasts either 10 years after the first marketing of articles that use the design, or 15 years after creation of the design – whichever is earlier.*

(up to 4 marks for each feature and protection)

**Q.4 Reflow and wave form soldering are commonly used in the commercial production of electronic circuits.**

**Describe each process. 2x [4]**

**The Reflow soldering**

- reflow technique uses a solder paste
- the solder paste is screen printed on to the circuit boards
- surface mounted components are placed on to the board
- the board is heated to melt the paste in an oven
- visual inspection of solder joints for QC.

**Wave soldering**

- is used for through-hole applications
- uses high temperatures and a short heat application period
- components placed into the board
- pass the board over the top of a wave of heated solder.

**Q.5 Both breadboard modelling and CAD (Computer Aided Design) simulations are used in the development of control systems.**

**(a) Describe two benefits of breadboard modelling to the designer. 2x [2]**

**(b) Describe two benefits of CAD (Computer Aided Design) simulations to the manufacturer. 2x [2]**

**Benefits of breadboard modelling to the designer**
Using electronic or mechanical bread boarding to test functionality of system. Range of outputs for given inputs. Demonstrate potential clients the working prototype (the way a particular mechanism works to test function).

**2 marks for each benefit**

**Benefits of CAD simulations to the manufacturer**
Used to test and evaluate a particular circuit, see mechanical/electrical sequences in order to test viability. Can be sent directly (digitally to clients) to other locations across the world. Able to share ideas electronically, adapting ideas quickly, conversion to Computer Aided Manufacture (CAM), the transfer of models to other manufacturing locations.

**2 marks for each benefit**

**Q.6 GANTT charts, flow charts and critical path analysis charts are used by designers and manufacturers within project management.**

**For any two of the above project management systems:**

**(a) State the main features of each. 2x [2]**

**(b) Describe how they are used effectively within project management. [4]**

**GANNT Charts**
Features: A Gantt chart is a type of bar chart that illustrates a project schedule. Gantt charts illustrate the start and finish dates and summary elements of a project.

**2 marks**

Used effectively in mapping tasks, time factor, gives the user a project overview (reference to production plan, manufacturing process).

**2 marks**

**Flow Charts**
Features: A flowchart is a schematic representation of a process. Generally the start point, end points, inputs, outputs, possible paths and the decisions that lead to these possible paths are included in the chart.

**2 marks**

Used effectively in elements of a block flow diagram (system diagrams), flow process diagrams such as a material processing system or instructions for a bicycle's assembly.

**2 marks**

**Critical Path Analysis**
Features: In project management a critical path is the sequence of project network activities with the longest overall duration, determining the shortest time possible to complete the project.

**2 marks**

Used effectively in understanding of the critical path (the shortest route), planning the outcome of a project, the overlap of certain activities within a manufacturing process.

**2 marks**

**Q.7** **(a) Explain the term Reverse Engineering. [2]**

**(b) Identify three important insights a designer would gain by conducting Reverse Engineering on a named product . 3x [2]**

Reverse engineering - the process of discovering the technological principles of a product, component or system.

**2 marks**

- Designers analyse its function, structure and operation.
- Involves taking something apart and analysing its workings in detail- usually with the intention to construct a new device.
- The new device does the same thing without actually copying anything from the original.

**2 marks for each principle**

Note: Maximum of 4 marks if no product is identified in part b.

**Q.8.** **Anthropometric data is used in the design of products to ensure suitability and ease of use.**

**Explain how designers have successfully used anthropometric data in four named products. 4x [2]**

Application of anthropometric principles - the scientific study of human measurement taken across a range of typical human groupings.

Explanation of how designers have successfully used anthropometric data in four named products.

- Things measured including weight, strength, speed and range of movement as well as physical sizes of products in relation to tile human form.
- The designer would see anthropometry as that which is concerned with the physical fit between people and the equipment, products and spaces they use.
- They could consider issues essential for product success, for example - in a kettle, they could be handle size/form, weight and the movement required to pour successfully, internal physical dimensions.

Up to 2 marks for each explanation that clearly illustrates how a specific dimension of a product is determined by the relevant specific human dimension for each product.

Note: no mark for repeated response - look for differentiation within each product.

## SECTION B

Section B involves extended written answers in which the mark awarded must take into account the quality of written communication – as indicated to candidates in the rubric on the front of the question paper. This should form an integral part of the judgement on the question, the following criteria being applied in deciding whether the points outlined in the marking scheme are communicated sufficiently clearly to award the full credit:

- Legibility; accuracy of spelling, punctuation and grammar.
- Organisation of information clearly and coherently (appropriate to purpose and to complexity of subject matter); use of specialist terms.

At the same time it should be noted that over-rigidity in interpretation of the mark scheme is not intended, and it is accepted that points may be made in a variety of different ways. Thus, except where terms are specifically requested, correct responses using different words are acceptable providing that points are clearly communicated.

The following levels of achievement grid should be used in conjunction with question specific guidance listed below. In each case you are asked to check the mark you have arrived at against the grid before finalising it.

| | |
|---|---|
| Level 1<br><br>0-10 | • Candidate has a simplistic knowledge of the issues associated with the question.<br>• The use of terminology and technical language is basic.<br>• The candidate has little understanding of the general elements of industrial and commercial practices. Little knowledge of ICT in manufacturing systems.<br>• The candidate has limited knowledge of the form and function of products.<br>• The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant.<br>• Grammar, punctuation and spelling may be weak impacting on effective communication. |
| Level 2<br><br>11-16 | • The candidate has a basic understanding of the issues associated with the question.<br>• The use terminology and technical language is variable.<br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production.<br>• The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues not always considered.<br>• The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented.<br>• There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues. |

| | |
|---|---|
| Level 3<br><br>17-23 | • The candidate demonstrates a clear understanding of the issues associated with the question.<br>• The use terminology and technical language is reasonably accurate.<br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production.<br>• The candidate has developed a common knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered.<br>• The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured.<br>• There may be occasional errors of grammar, punctuation and spelling. |
| Level 4<br><br>24-30 | • The candidate demonstrates a specific ability to analyse questions, takes into account of a wide range of factors and has a clear understanding of the issues associated with the question.<br>• Uses correct terminology and technical language.<br>• The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production.<br>• Candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues are also considered where appropriate.<br>• The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured.<br>• There will be few, if any, errors of grammar, punctuation and spelling. |

## SECTION B

**Q.9 Global manufacturing continues to expand in order to meet the needs of consumers.**

**Discuss the advantages and disadvantages of global manufacturing for the designer and manufacturer. [30]**

Candidates may relate their response to a particular area:

- Consumer electronic devices
- Cars
- electrical goods, toys/games etc

all of which are acceptable.

Discussion around the advantages to the designer and manufacturer:

- Transportation issues.
- Ability to work effectively across the globe using digital resources.
- Materials available locally.
- Local knowledge and expertise within a particular area.
- Large manufacturing bases set up and reducing costs.
- Cheaper workforce.
- Ability to supply quickly and on demand.
- Energy costs lower.

Candidates may also discuss the influence of these manufacturing bases i.e. on fashion and trends.

**Q.10 Systems are being made smaller and smaller, but this is not always desirable in products.**

**Discuss why consumers may want products that are constructed larger than the system would require and the implications this has for the manufacturer. [30]**

Discussion around size of product for consumers:

- fashion/style/trends influencing size of product
- Anthropometric needs of user
- Style to match previous products/expectations

Implication of size of product for the manufacturer:

- Cost of materials
- Environmental concerns
- Larger storage and transportation requirements
- Larger production tooling

Note: Specific and different products or range of products used in the response.

**Q.11 Product designers consider aesthetics, function, maintenance, cost and disposal when developing products for mass production.**

**Discuss the implications of this statement in relation to named products.**

Discussions around:

**Product Aesthetics** – form and function and the development of products. The development of new materials allowing designers new possibilities. Adapting product aesthetics to trends/fashion.

**Function** – new technologies provide new possibilities. Multi functional products being possible. Product function in relation to specific users or user groups.

**Maintenance** – implications of maintenance on a product, servicing needs (all affecting product life)

**Cost** - can include the cost to manufacture and the cost to the consumer (candidates may also refer to cost to the environment). Designers consideration of markets and the costs of products within those markets (are they sustainable?)

**Disposal** – reference to materials and the way a product is assemble making it easier to dispose

## DT3 - PRODUCT DESIGN

## SECTION A

**Q.1 Identify the kind of information that is gathered by designers when compiling client profiles and explain why the information is useful. [8]**

When defining the client profile of a particular target sector the following information would be useful to the designer:

A target audience can be formed of people of a certain age group, gender, marital status, etc., e.g. teenagers, females, single people, etc. A combination of factors, e.g. men aged 20–30 is a common target audience.

Other groups, although not the main focus, may also be interested. Discovering the appropriate target market(s) and determining the target audience is one of the most important activities in marketing management for product design. The biggest mistake it's possible to make in targeting is trying to reach everybody and ending up appealing to no-one.

**Target market**
A target market is a group of customers that the business has decided to aim its marketing efforts and ultimately its merchandise. A well-defined target market is the first element to a marketing strategy.

The target market and the marketing mix variables (Four Ps) of product, place(distribution), promotion and price are the four elements of a marketing mix strategy that determine the success of a product in the marketplace.
Once these distinct customers have been defined, a marketing mix strategy of product, distribution, promotion and price can be built by the business to satisfy the target market.

**Strategies for reaching target markets**
Marketing strategists have outlined four basic approaches to satisfy target markets: mass marketing, differentiated marketing, concentrated marketing, and micromarketing / niche marketing.

**Mass marketing**
Mass marketing is a market coverage strategy in which a firm decides to ignore market segment differences and go after the whole market with one offer. It is type of marketing (or attempting to sell through persuasion) of a product to a wide audience. The idea is to broadcast a message that will reach the largest number of people possible. Traditionally mass marketing has focused on radio, television and newspapers as the medium used to reach this broad audience.
For sales teams, one way to reach out to target markets is through direct marketing.

This is done by buying consumer database based on the segmentation profiles you have defined. These databases usually come with consumer contacts (e.g. email, mobile no., home no., etc.). Caution is recommended when undertaking direct marketing efforts — check the targeted country's direct marketing laws.

Target audiences are formed from different groups, for example: adults, teens, children, mid-teens, pre-schoolers, men, women.

To market to any given audience effectively, it is essential to become familiar with your target market; their habits, behaviors, likes, and dislikes. Markets differ in size, assortment, geographic scale, locality, types of communities, and in the different types of merchandise sold.

Because of the many variations included in a market it is essential, since you cannot accommodate everyone's preferences, to know exactly who you are marketing to.

**Q.2 Describe FOUR main benefits of lean production. 4 x [2]**

The concept of lean manufacturing is based on the theory that production efficiency and profitability will significantly increase if you eliminate any waste associated with material or time.

Benefits include:
1. More efficient material handling.
2. Reduction of inventory.
3. Improved quality.
4. Faster responses to the customer and improved working conditions.

For instance, studying and reducing the number of steps it takes to accomplish a given task can result in more efficient material handling and faster customer response. Another example would be improving the ergonomics of a manual process that can reduce employee injuries and absenteeism.

**Q.3 Explain why innovation is important to the process of designing products. [8]**

It is useful, when conceptualizing innovation, to consider whether other words suffice. Invention – the creation of new forms, compositions of matter, or processes – is often confused with innovation. An improvement on an existing form, composition or processes might be an invention, an innovation, both or neither if it is not substantial enough. It can be difficult to differentiate change from innovation. According to business literature, an idea, a change or an improvement is only an innovation when it is put to use and effectively causes a social or commercial re-organisation.

Innovation occurs when someone uses an invention or an idea to change how the world works, how people organise themselves, or how they conduct their lives. In this view innovation occurs whether or not the act of innovating succeeds in generating value for its champions. Innovation is distinct from improvement in that it permeates society and can cause re-organisation. It is distinct from problem solving and may cause problems. Thus, in this view, innovation occurs whether it has positive or negative results.

Improvements in product function and reliability often develop as a result of innovative steps. Innovative products attract the target audience and entice them to purchase the product generating wealth for the manufacturer. Innovative steps can be incremental improvements that are introduced to gain a competitive advantage and so capture sales a market segment.

**Q.4 Describe what you understand by the term 'technology push', and identify two such products which illustrate innovative 'technology push' features. [8]**

The intention is that the question should apply equally to all aspects of product design. Candidates may make reference to fashion design, systems etc. Some products fit into both categories (e.g. mobile phone, earlier ones 'the bricks' were technology push, now very much market pull) – important to look for justification. Most products which start as technology push, often eventually become market pull.

**Technology push** is where radical innovation is brought to bear on a product through investing in and exploiting current scientific and technological advances. This leads to a radical improvement of a product that has been driven by technology and an example of which is the CD player which came about as a result of defence technologies in the development of lasers. Another popular example would be Dyson's use of the cyclonic systems used in sawmills to suck up dirt using a vacuum cleaner.

**Q.5 Identify FOUR incremental improvements that have been included in a named, specific product and describe how each improvement contributes to the effectiveness of the product. 4 x [2]**

Product could be selected from any of the product design disciplines

.

An example could be an electric kettle where the improvements have been:

1. Using a plastic tower to heat water more efficiently.
2. Incorporating a thermostatic switch to cut out the electricity supply once the kettle has reached boiling point.
3. Thermochromic plastics introduced to give the user a clear indication of temperature.
4. Cordless connection so that the user can transport the kettle without having to remove or trail the plug lead.

## SECTION B

**Q.6 (a) Explain what you understand by 'above the line' and 'below the line' analysis. 2 x [2]**

**(b) Describe two 'above the line' features of a named product and two 'below the line' features of the same product. 2 x [2]**

(a) 'Above the line' aspects are features that are often points of interaction by the consumer and are often control knobs, handles, switches, etc. They can also be aspects of a product that the consumer will interact with visually.

'Below the line' aspects of products are the features that often cannot be seen by the consumer and are the technologies that cause the product to function. Circuitry, technical information about materials, fixtures and fittings, etc.

(b) Named product features above the line two marks, named product features below the line two marks. This must be a description rather than a one word answer.

**Q.7 Explain the purpose of product development work within a design process. [8]**

Product development is the stage at which the designer or design team begin to firm up decisions regarding the optimum solution to a product. Specific information is decided upon as a result of convergent thinking enabling the designed to specify the actual materials, fixtures and fittings, bought-in components, manufacturing processes, etc.

This will lead to the details of final design including dimensions of all parts, patterns, manufacturing processes, etc.

**Q.8 Outline how the main elements of Registered Design, as prescribed by the Intellectual Property Office, benefit the creator of the design. [8]**

There are a number of benefits of registering a design. Some of these are listed below.

**Exclusive rights in a design**
A Registered Design grants exclusive rights in the look and appearance of a product. This can stop people making, offering, putting on the market, importing, exporting, using or stocking for those purposes, a product to which a design is applied.

**Protect all aspects of a design**
Design Registration protects the overall look of the whole or a part of a design. The designer can claim protection for the shape of a product, a two-dimensional surface pattern or graphic design, or a combination of the two.

**Long period of protection**
Registered Designs can be renewed every 5 years up to a total of 25 years.

**Easier to enforce**
The existence of a registration may be enough to stop anyone infringing your design irrespective of whether they copied or came up with the design independently.

**Make money from a design**
A registered design allows the designer to sell the design and the intellectual property (IP) rights to it; or license somebody else to use the design whilst then designer retains the IP rights.

**Deferred publication**
The designer can choose to defer registration and publication of a design for up to 12 months. This allows the designer to establish a filing date, and allows more time to develop the product or apply for a patent before publicly disclosing the design on the IP Register.

**Public benefit**
Intellectual Property registration aims to protect the creator but also to benefit the public as publication of registrations showcases developments in design and stimulates further innovation.

**Q.9 Describe the characteristics and typical uses for one of the following material classifications:**

**(a) Wood-based composites.**

**OR**

**(b) Performance fabrics.** **[8]**

The following are two examples of many acceptable materials.

(a) MDF does not contain knots or rings, making it more uniform than natural woods during cutting and in service. However, MDF is not entirely uniform in all orientations, since the fibres are pressed tightly together through the sheet. Like natural wood, MDF may split when woodscrews are installed without pilot holes, and MDF may be glued, doweled or laminated, but smooth-shank nails do not hold well. Typical fasteners are T-nuts and pan-head machine screws. Fine-pitch screws do not hold well in MDF and screw retention in the edge is particularly poor. Special screws are available with a coarse thread pitch but sheet-metal screws also work well.

Typical MDF has a hard, flat, smooth surface that makes it ideal for veneering, as there is no underlying grain to telegraph through the thin veneer as with plywood. A so-called "Premium" MDF is available that features more uniform density throughout the thickness of the panel.

(b) Stomatex is generally made from the closed-cell foam neoprene which is a synthetic rubber in a pattern of dome-shaped chambers each with a tiny pore within the centre.

**Usage**
This material can be used for a wide range of purposes but it is often made for outdoor clothing due to its properties of being able to balance thermal comfort with water protection.

It can be useful to make clothing/garments for:
- Survival suits
- Thermal underwear
- Flight
- Military and combat
- Rescue service
- Marine

It can also be used for outdoor recreational purposes such as snow sports and field sports.

**Material Characteristics**
- Waterproof
- Flexible
- Comfortable
- Durable

**Q.10 (a) Explain why the inclusion of accurate and complete dimensions is essential to the design of products. [4]**

**(b) Describe the relationships between dimensioning and the mass manufacture of a specific product. [4]**

(a) Issues related to ergonomics, target markets, proportion, aesthetics, product sales, inclusion of built in components, etc.

(b) Issues relating to machining, communication, global manufacturing, standards, etc.

## SECTION C

For each essay answer the following information will be applied.

Marks awarded according to the four levels within the assessment criteria. These criteria are best fit and if a candidate has most of the aspects within a level then the candidate can be considered for marks towards the higher end of the band. If there are some features that are weak or missing but overall the response matches many of the descriptors then the candidate could be considered for marks in the middle of the level. Candidates may be awarded marks at the bottom of the level if they have most of the descriptors in the previous level and one or two in the next level.

| | |
|---|---|
| **Level 1 0-9 marks** | • Candidate has a simplistic knowledge of the issues associated with the question.<br>• The use of terminology and technical language is basic.<br>• The candidate has little understanding of the general elements of industrial and commercial practices, with little knowledge of ICT in manufacturing systems if appropriate to the question.<br>• The candidate has limited knowledge of the form and function of products.<br>• The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant.<br>• Grammar, punctuation and spelling may be weak impacting on effective communication. |
| **Level 2 10-14 marks** | • The candidate has a basic understanding of the issues associated with the question.<br>• The use terminology and technical language is variable.<br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production.<br>• The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral. These aspects are not always considered.<br>• The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented.<br>• There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues. |
| **Level 3 15- 20 marks** | • The candidate demonstrates a clear understanding of the issues associated with the question.<br>• The use terminology and technical language is reasonably accurate.<br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production.<br>• The candidate has demonstrated a knowledge of the form and function of a product, trends and styles of products reflecting environmental, cultural and/or ethical /moral issues. These aspects are considered.<br>• The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured.<br>• There may be occasional errors of grammar, punctuation and spelling. |

| | |
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| **Level 4 21-26 marks** | • The candidate demonstrates a specific ability to analyse questions, takes into account of a wide range of factors and has a clear understanding of the issues associated with the question.<br>• Uses correct terminology and technical language.<br>• The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production.<br>• Candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues. These aspects are considered where appropriate.<br>• The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured.<br>• There will be few, if any, errors of grammar, punctuation and spelling. |

**Q.11 Discuss the ways in which two product designers of your choice, from the early 70s to the present day, have sought to influence of their chosen market segments. [26]**

Indicate the two designers chosen, the characteristics of the market segment that they are aiming their product and how they have impacted on the market segments with their designs.

**Q.12 Identify the properties of specific named materials that have been used in a specific product and describe how their selection has benefitted the performance of the product. [26]**

Identification and description of two specific named materials and their physical properties. The candidates will then be expected to indicate how the use of these materials has been of benefit to the performance of the product.

**Q.13 Product designers will often have a 'toolbox' containing various strategies for creative thinking such as brainstorming.**

**Compare, in detail, two other creative thinking strategies with which you are familiar. [26]**

**Detailed comparison of TWO of the following creative thinking strategies.**

**Problem abstraction**

**SCAMPER**
**Inversion** – turning the problem around, looking at it in alternative ways.
**Disassembly** – taking apart to analyse parts/components.
**Morphological Analysis** – a mechanistic way of analysing, developing from prepared lists.
**Analogy** – using a similar system to solve a problem (could be a comparison in nature).
**Lateral Thinking** – a different way of looking at things, opening out the thinking process.
**Bio-mimicry is an acceptable answer.**

**Q.14 'The Measure of Man and Woman, human factors in design is said to be one of the classic tools for fitting products and environments to people.'**

***Stephen B Wilcox, Introduction – The Measure of Man and Woman.***

**Fully explain how anthropometric data and ergonomic rules are of benefit to the designer. [26]**

Complete description of how important anthropometric data is in the application of human measurements of various gender and age related groups when designing products. This will include reference to the possible success or failure of a product if the application of the data is inaccurate or wrong.

The candidates should also describe how the application of ergonomic rules is important to the comfort of the user when working with the product. The application of the ergonomic rules should also impact on the effectiveness and ultimately the success of the product. These descriptions should also be directed at various gender and age related groups.

**Q.15 Discuss ways in which the four Ps are instrumental in achieving maximum sales for products. [26]**

A reasoned and balanced discussion around the use of the four Ps for selling a product.

**THE FOUR Ps**:

**Product**

- The need for the product to sell.
- How the product compares with competition.
- The product's reliability.
- The attributes or features the product has based on market research intelligence.
- How the product meets the expectations/desires of the market segment.
- The product differentiation.
- The aspects of the product that attempt to sustain brand loyalty.
- The product life cycle.

**PRICE**

**Price to fit the target market.**

- External criteria such as capturing market share.
- Rate of growth.
- Elastic demand- how much can the price change as a result of differing demand.
- The price that the market will bear.
- Costs of production will have an effect on price of the product.

**PLACE**

**How will the product be distributed?**

- Product reaches target market by being in right place at the right time.
- Distribution may be thought of as a geographical factor.
- What product sells in different parts of the country/continent?
- JIT
- Access to foreign markets.

**PROMOTION**

**About image creation for the product and manufacturer.**

- Sales push strategies.
- Coupons or money off pull strategies.
- Advertising media.
- Publicity – often free – press releases.
- Personal selling.
- Trade fairs and exhibitions.

## DT3 - FOOD TECHNOLOGY

## SECTION A

**Q.1 Outline reasons why consumers may choose to buy food products which are sourced or produced locally. [8]**

- more likely to know the provenance of the product i.e. where it is grown / reared;
- to support the local economy, help to provide local employment;
- quality - possibly fresher as reaching consumer more quickly as shorter chain from producer to consumer;
- reduced food miles – many food products bought in supermarkets have made a long journey i.e. to factory / processing plant, then to distribution centre, then to supermarket;
- environmental factors - less fuels being used to distribute food products, so less non-renewable resources being used and fewer CO2 emissions; more environmentally friendly form of transport e.g. small van rather than plane / ship if importing foods from overseas; or large lorries if sourcing from other areas of UK;
- price - possibly cheaper as savings in transport and distribution costs will probably be passed on to consumer;
- possibly higher nutrient content as fresher;
- possibly farm assured British produce indication of quality assurance;
- possibly less packaging;
- consumer loyalty to their region e.g. Welsh lamb, Cornish new potatoes;
- fruits naturally ripened, picked when in riper state.

**Q.2 Describe how feedback is used within Computer Aided Manufacture (CAM), using specific examples. [8]**

Computers control much of the process of manufacture within an automated system, for example weight, rate of flow of food materials, temperature, pressure, moisture level, pH, equipment, time processing etc. Computers constantly monitor feedback and make subtle adjustments to ensure accuracy of production. For example the speed of the conveyor belt passing through a travelling oven will be adjusted to ensure accurate level of cooking. Computers will monitor quality control and reject any item which does not adhere to standards, for example a weight checker will weigh dough before it goes into bread tins; any which is outside tolerance level (above as well as below) will be rejected and returned to be re-divided. Data is recorded to provide records of production process. Minimal human intervention is required in the process.

**Q.3 Antioxidants, preservatives and emulsifiers are sometimes used in food products. Explain how any TWO of these are used within named food products. 2 x [4]**

Up to **four** marks for each of two clear explanations:

**Antioxidants**
Oxidation reactions happen when chemicals in food are exposed to oxygen in the air. In natural conditions, animal and plant tissues contain their own antioxidants but in foods, these natural systems break down and oxidation follows. Oxidation of food is a destructive process, causing loss of nutritional value and changes in chemical composition. Oxidation of fats and oils leads to rancidity and, in fruits such as apples; it can result in the formation of compounds which discolour the fruit. Antioxidants are added to food to slow the rate of oxidation and can extend the shelf life of the food. Fats and oils, or foods containing them, are the most likely to have problems with oxidation. Fats react with oxygen and even if a food has a very low fat content it may still need the addition of an antioxidant. They are commonly used in vegetable oil, extruded snacks, meat, fish, poultry, margarine, dairy products, mayonnaise, salad dressing, baked products and instant mashed potato. Antioxidants prevent the formation of peroxides and so slow the process of the food 'going off'. Some antioxidants react with oxygen itself and so prevent the formation of peroxides. Lemon juice to reduce browning of fruits through oxidation.

**Preservatives**
Increase the shelf-life of foods and can help to maintain quality. Most preservatives today are fungistatic in their action. That means they prevent the growth of fungi, moulds and yeasts. They have little effect on bacteria but using a combination of preservatives with antibacterial properties can give good all-round protection. Food preservatives help to control the spread of bacteria which can cause life threatening illnesses such as salmonellosis or botulism. Preservatives are commonly used in low fat spreads, cheese, margarine, mayonnaise, salad dressings, bakery products and dried fruit and commonly used in a wide variety of other food products. Food preservatives have to be safe for human consumption: they must not harm the cells of the human body, so high concentrations of preservatives in food are not permitted. Natural preservatives include sugar which makes water unavailable to micro-organisms and vinegar which creates an acidic environment.

**Emulsifiers**
Emulsions in food are mixtures of oil and water. These normally do not mix and will separate if left without an emulsifier. An example is mayonnaise which contains oil and water. The emulsifier keeps these mixed and without it the oil and water separate. There are two types of emulsions. An oil-in-water emulsion contains small droplets of oil that are dispersed in water. Alternatively, a water-in-oil emulsion has small droplets of water that are dispersed in an oil. Usually the water and oil will not mix and the emulsifier, or emulsifying agent, keeps the mixture stable and prevents the oil and water from separating into two layers. Emulsifiers have a big effect on the structure and texture of many foods. They are used to aid in the processing of foods and also to help maintain quality and freshness. Emulsifiers can help to make a food appealing. In low fat spreads, emulsifiers can help to prevent the growth of moulds which would happen if the oil and fat separated.

**Q.4 Describe what you understand by the term 'technology push', identifying TWO such food products and their innovative 'technology push' features. [8]**

**Technology push**
Is where radical innovation is brought to bear on a food product through investing in and exploiting scientific and technological advances. This leads to a radical improvement of a product that has been driven by technology. Examples include breakfast cereals, aerated chocolate bars, Smart materials such as modified starches, quorn, GM foods and food products preserved using cryogenic freezing. Candidates must describe the innovative features of two products e.g. modified starches where product thickens lump-free without need of stirring or expanded cereal product with light, airy texture.

**Q.5 Describe the incremental improvements which have been made to one named food product of your choice, explaining how these changes have improved the product. [8]**

Candidates must focus their response on one named food product. They should describe the changes which have been made and explain how these changes have improved the product – possibly in terms of health benefits, organoleptic properties, suitability for specific groups e.g. coeliac.

The food product selected is likely to be from one of the following categories:

- a food product which has been altered to improve its nutritional / health properties, e.g. products which have been developed to e.g. change type of fat from unsaturated or hydrogenated, reduced salt content; use of probiotics;
- a food product which makes a health claim, for example, to lower cholesterol through use of plant stanols / sterols. These products would include Benecol spreads / yoghurts;
- a food product which has been developed to remove allergens e.g. gluten / lactose;
- a food product which has been developed as a result of technology push, e.g. encapsulation technology, Nestle's quest for the perfect food bubble;
- a food product where products have been varied and range has been developed in order to extend range / increase sales / increase market share, etc. e.g Mars chocolate and ice cream ranges.

## SECTION B

**Q.6 (a) Explain the functions of two named minerals in the diet. 2 x [2]**

Up to two marks for correctly explaining function of each of two minerals.

Examples could include:

- **Iron** is used to form haemoglobin which transports oxygen from the lungs to the tissues. Other iron-containing substances, such as the muscle protein myoglobin, utilise the oxygen within the cells. Prolonged deficiency causes anaemia.
- **Calcium** gives strength to bones and teeth. Also essential for the contraction of muscles, including the heart muscle, for nerve function, for the activity of several enzymes and for normal clotting of the blood.

Award only **one** mark for basic answer such as 'healthy bones and teeth'. Candidates must provide an explanation.

**(b) Outline TWO reasons why some orange juice is fortified with calcium. 2 x [2]**

- to improve marketability of product e.g. to parents;
- to offer it as an alternative product to milk, particularly for children;
- to give USP to product and differentiate it from other products and to increase sales;
- to create value added product; so higher price can be charged;
- implication of added health benefits;
- to fit in with 'health' trend;
- to provide a drink with high calcium for consumers who are lactose intolerant/vegan.

**Q.7 Explain the purpose of development work within a design process. [8]**

Development is the stage at which the food technologist or food product development team begin to firm up decisions regarding the optimum solution for the food product. Specific information is decided upon as a result of convergent thinking enabling the food technologist to specify the precise materials, manufacturing processes etc. This will lead to the details the final design in the form of a manufacturing specification. Various options may be trialled in terms of materials and processes in order to aid decision making and to provide prototypes for trialling. A series of modifications may be made leading up to the final specification. Feedback for target market may be incorporated. The food product may be adapted/improved to better meet the specification/requirements of the target market. Organoleptic testing may be done, as well as trials in terms of e.g. shelf-life. Calculations of nutritional values and costs may also be considered as part of development work.

**Q.8 Legislation requires that certain information is included on a food packaging label.**

**State FOUR pieces of information which must be included by law on a food label and for each give a reason why it needs to be included. 4 x [2]**

By law, the following information must be on a food packaging label:

- Name of the food.
- Ingredients – listed in descending order of weight.
- Name and address of manufacturer or packer or of the seller.
- Best before date. Use by date for foods which are highly perishable and which will have a short product life after which their consumption would present a risk of food poisoning.
- Any special storage conditions. Any storage conditions which need to be observed if the food is to retain its specific properties until the date shown must also be given.
- Special conditions of use if the consumer needs to observe certain practices once the packaging has been opened (e.g. once opened keep refrigerated and consume within 3 days).
- Instructions for use must be given if it would be difficult to make appropriate use of the food without them.
- Place or origin of the food must be shown if failure to give this information might mislead the consumer;
- Weight / volume but certain foods may be sold by number and some are exempt for quantity labelling;
- If make claim e.g. 'low in fat' must be supported by nutritional information;
- Medical claims;
- Batch code;
- Additives;
- Allergens.

Candidates must give a reason why each should be included e.g. name and address of manufacturer must be included so consumer is able to contact them if there is a problem with the food product.

**Q.9 Outline how the main features of Registered Design, as prescribed by the Intellectual Property Office, benefits the creator of the design. [8]**

There are a number of benefits of registering a design. Some of these are listed below.

**Exclusive rights in a design**
A Registered Design grants exclusive rights in the look and appearance of the product. This can stop people making, offering, putting on the market, importing, exporting, using or stocking for those purposes, a product to which a design is applied.

**Protects all aspects of a design**
Design Registration protects the overall look of the whole or part of a design. The designer can claim protection for the shape of the product, a two-dimensional surface pattern or graphic design, or a combination of the two.

**Long period of protection**
Registered Designs can be renewed every 5 years up to a total of 25 years.

**Easier to enforce**
The existence of a registration may be enough to stop anyone infringing the design irrespective of whether they copied it or came up with the design independently.

**Make money from a design**
A registered design allows the designer to sell the design and the intellectual property (IP) rights to it; or license somebody else to use the design whilst the designer retains the IP rights.

**Deferred publication**
The designer can choose to defer registration and publication of a design for up to 12 months. This allows the designer to establish a filing date and allows more time to develop the product or apply for a patent before publicly disclosing the design on the IP Register.

**Public Benefit**
Intellectual Property Registration aims to protect the creator but also to benefit the public and publication of registration showcases developments in design and stimulates further innovation.

**Q.10 It is critical that food manufacturers follow safe working practices.**

**Identify four possible hazards during the storage and distribution of food products and outline how each of these hazards could be controlled. 4 x [2]**

Candidates must offer an appropriate control for each of **four** hazards. Each must be during storage or distribution stages - award no marks for hazards and control during manufacturing.

Examples could include:

- **Risk** – cross-contamination of cooked meat from raw meat; **control** – separate storage areas for raw and cooked meat.
- **Risk** – raw materials becoming infested with vermin; **control** – regular checks that vermin is unable to enter the food premises.
- **Risk** – foods entering danger zone during transportation; **control** - regular monitoring and recording of temperature of refrigerated lorries.
- **Risk** – foods becoming contaminated with foreign bodies during transportation; **control** – foods being packaged in sealed containers before leaving processing plant.
- **Risk** - injury to workers from heavy objects falling; control - staff training on manual handling.

## SECTION C

For each essay answer the following information will be applied.

Marks awarded according to the four levels within the assessment criteria. These criteria are best fit and if a candidate has most of the aspects within a level then the candidate can be considered for marks towards the higher end of the band. If there are some features that are weak or missing but overall the response matches many of the descriptors then the candidate could be considered for marks in the middle of the level. Candidates may be awarded marks at the bottom of the level if they have most of the descriptors in the previous level and one or two in the next level.

| | |
|---|---|
| **Level 1<br>0-9<br>marks** | • Candidate has a simplistic knowledge of the issues associated with the question.<br>• The use of terminology and technical language is basic.<br>• The candidate has little understanding of the general elements of industrial and commercial practices, with little knowledge of ICT in manufacturing systems if appropriate to the question.<br>• The candidate has limited knowledge of the form and function of products.<br>• The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant.<br>• Grammar, punctuation and spelling may be weak impacting on effective communication. |
| **Level 2<br>10-14<br>marks** | • The candidate has a basic understanding of the issues associated with the question.<br>• The use terminology and technical language is variable.<br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production.<br>• The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral. These aspects are not always considered.<br>• The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented.<br>• There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues. |
| **Level 3<br>15- 20<br>marks** | • The candidate demonstrates a clear understanding of the issues associated with the question.<br>• The use terminology and technical language is reasonably accurate.<br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production.<br>• The candidate has demonstrated a knowledge of the form and function of a product, trends and styles of products reflecting environmental, cultural and/or ethical /moral issues. These aspects are considered.<br>• The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured.<br>• There may be occasional errors of grammar, punctuation and spelling. |

| | |
|---|---|
| **Level 4 21-26 marks** | • The candidate demonstrates a specific ability to analyse questions, takes into account of a wide range of factors and has a clear understanding of the issues associated with the question.<br>• Uses correct terminology and technical language.<br>• The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production.<br>• Candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues. These aspects are considered where appropriate.<br>• The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured.<br>• There will be few, if any, errors of grammar, punctuation and spelling. |

**Q.11 Discuss the work and food style of any two restaurateurs, chefs or food writers from the early 1970s to the present day and evaluate the impact each has had on the food we eat and the food choices we make. [26]**

Candidates must clearly identify two individuals and clearly describe their food style e.g. traditional / modern European / molecular gastronomy; the type of ingredients they are known for using e.g. game / vegetarian / seasonal; their ethical concerns in terms of local / organic etc. They should evaluate the influence of each.

**Q.12 Describe in detail the properties and characteristics of two specific food materials used in any named food product of your choice and explain the benefits of using each of these materials within the food product. [26]**

Candidates should fully describe the properties and characteristics, using appropriate technical terminology. They may refer to nutritional and organoleptic characteristics and properties as well as physical and aesthetic functions. They should clearly explain the benefits of each material, based on these properties.

**Q.13 Food technologists will often have a toolbox containing various strategies for creative thinking, such as brainstorming.**

**Compare, in detail, two other creative thinking strategies with which you are familiar. [26]**

There should be a detailed comparison of two of the following creative thinking strategies:

- Problem abstraction;
- SCAMPER;
- inversion – turning the problem around, looking at it in alternative ways;
- disassembly – taking apart to analyse elements;
- morphological analysis – a mechanistic way of analysing, developing from prepared lists;
- analogy – using a similar system to solve a problem;
- lateral thinking – a different way of looking at things, opening out the thinking process.

**Q.14 Discuss how food technologists make use of DRVs (Dietary Reference Values) and other dietary guidelines when designing named food products for particular target markets. [26]**

Dietary Reference Values for Food Energy and Nutrients for the United Kingdom recommends nutritional intakes for the UK adult population. The advice is summarised in the Eatwell Plate. The government recommends a healthy diet should contain plenty of starch, at least 5 fruit or vegetables a day and that protein-rich foods and dairy products should be eaten in moderation. Salt, saturated fat and sugar should be eaten less. The guidelines give specific advice in terms of quantities of various fats, sugar, salt, fibre, vitamins and minerals. Dietary guidelines can be used by food technologist to create products which fit healthy eating guidelines.

Some ways in which products have been developed to fit government guidelines could include:

- reduction in fat, particularly saturated fat – many low fat versions of ready meals, food products such as ham etc. Fat content of many e.g. crisp products has been reduced; changes in types of fat used in, e.g. baked products away from saturated and hydrogenated fats towards unsaturated fats; use of fat replacers; virtually fat free ranges;
- reduction in sugar – many low sugar foods and drinks, increased use of artificial sweeteners;
- reduced salt ready meal, etc.; salt content of some snack foods, e.g. crisp products has been reduced;
- wide range of ready meals based on starch, e.g. pasta, rice, cous cous, etc.
- increased range of wholegrain pasta, breads, breakfast cereals, etc. Making healthier alternatives more palatable to, e.g. children e.g. 'white bread with all the goodness of brown'. Increased fibre content of many food products;
- increased range of ready prepared / ready to eat fruits and vegetables e.g. bags of washed salads, ready to eat carrot sticks / fruit salads; increase in vegetarian ranges, e.g. vegetable-based ready meals. Giving consumers suggestions for serving with fruit e.g. breakfast cereals served with fresh fruit, etc.
- increase in range of fish products available; food products being fortified with omega 3 e.g. hens eggs.
- huge range of breakfast products including 'on the go'
- branded and flavoured waters.

**Q.15 Discuss ways in which the four Ps are instrumental in achieving maximum sales for food products. [26]**

A reasoned and balanced description around the use of the four Ps for selling a food product.

**Product**

- The need for the product to sell.
- How the product compares with competition.
- The product's reliability.
- The attributes and features the product has based on market research intelligence.
- How the product meets the expectations / desires of the market segment.
- The product differentiation.
- The aspects of the product that attempt to sustain brand loyalty.
- The product life cycle.

**Price**

- Price to fit the target market.
- External criteria such as capturing market share.
- Rate of growth.
- Elastic demand – how much can the price change as a result of differing demand.
- The price that the market will bear.
- Costs of production will have an effect on price of the product.

**Place**

- How the product will be distributed.
- Product reaches target market by being in the right place at the right time.
- Distribution may be thought of a geographical factor.
- What product sells in different parts of the country.
- JIT.
- Access to foreign markets.

**Promotion**

- About image creation for the product and manufacturer.
- Sales push strategies.
- Coupons or money off pull strategies.
- Advertising media.
- Publicity.

## DT3 - SYSTEMS AND CONTROL TECHNOLOGY

## SECTION A

**Q.1 Identify the kind of information that is gathered by designers when compiling client profiles and explain why the information is useful. [8]**

When defining the client profile of a particular target sector the following information would be useful to the designer:

A target audience can be formed of people of a certain age group, gender, marital status, etc., e.g. teenagers, females, single people, etc. A combination of factors, e.g. men aged 20–30 is a common target audience.

Other groups, although not the main focus, may also be interested. Discovering the appropriate target market(s) and determining the target audience is one of the most important activities in marketing management for product design. The biggest mistake it's possible to make in targeting is trying to reach everybody and ending up appealing to no-one.

**Target market**
A target market is a group of customers that the business has decided to aim its marketing efforts and ultimately its merchandise. A well-defined target market is the first element to a marketing strategy.

The target market and the marketing mix variables ( Four Ps) of product, place(distribution), promotion and price are the four elements of a marketing mix strategy that determine the success of a product in the marketplace.
Once these distinct customers have been defined, a marketing mix strategy of product, distribution, promotion and price can be built by the business to satisfy the target market.

**Strategies for reaching target markets**
Marketing strategists have outlined four basic approaches to satisfy target markets: mass marketing, differentiated marketing, concentrated marketing, and micromarketing/ niche marketing.

**Mass marketing**
Mass marketing is a market coverage strategy in which a firm decides to ignore market segment differences and go after the whole market with one offer. It is type of marketing (or attempting to sell through persuasion) of a product to a wide audience. The idea is to broadcast a message that will reach the largest number of people possible. Traditionally mass marketing has focused on radio, television and newspapers as the medium used to reach this broad audience.
For sales teams, one way to reach out to target markets is through direct marketing.

This is done by buying consumer database based on the segmentation profiles you have defined. These databases usually come with consumer contacts (e.g. email, mobile no., home no., etc.). Caution is recommended when undertaking direct marketing efforts — check the targeted country's direct marketing laws.

Target audiences are formed from different groups, for example: adults, teens, children, mid-teens, pre-schoolers, men, women.

To market to any given audience effectively, it is essential to become familiar with your target market; their habits, behaviors, likes, and dislikes. Markets differ in size, assortment, geographic scale, locality, types of communities, and in the different types of merchandise sold.

Because of the many variations included in a market it is essential, since you cannot accommodate everyone’s preferences, to know exactly who you are marketing to.

**Q.2 Explain the affect that the expected 'life cycle' of a named electronic product has on the design and manufacture of the control system within that product. [8]**

The expected or anticipated life cycle will drive the quality, reliability and general standards of the manufacture of the control system. This will include the tolerances and performance data, together with the materials, manufacturing methods and build quality selected to produce the control system. Naturally, a product that is expected to have a longer useful life will be manufactured to higher standards. This may well include set-up costs, particularly for revitalised products. Fad, disposable and low cost products will contain less reliable control systems and may be manufactured to lower standards, where automation is not used, and cheaper materials, components and methods are employed. Responses may incur planned obsolescence and fitness for purpose, and could gain credit for discussions including warranty periods / customer support and satisfaction, recall etc.

**Q.3 Explain why innovation is important to the process of designing control systems for products. [8]**

It is useful, when conceptualizing innovation, to consider whether other words suffice. Invention – the creation of new forms, compositions of matter, or processes – is often confused with innovation. An improvement on an existing form, composition or processes might be an invention, an innovation, both or neither if it is not substantial enough. It can be difficult to differentiate change from innovation. According to business literature, an idea, a change or an improvement is only an innovation when it is put to use and effectively causes a social or commercial re-organisation.

Innovation occurs when someone uses an invention or an idea to change how the world works, how people organise themselves, or how they conduct their lives. In this view innovation occurs whether or not the act of innovating succeeds in generating value for its champions. Innovation is distinct from improvement in that it permeates society and can cause re-organisation. It is distinct from problem solving and may cause problems. Thus, in this view, innovation occurs whether it has positive or negative results.

Improvements in product function and reliability often develop as a result of innovative steps. Innovative products attract the target audience and entice them to purchase the product generating wealth for the manufacturer. Innovative steps can be incremental improvements that are introduced to gain a competitive advantage and so capture sales a market segment.

**Q.4 Describe what you understand by the term 'technology push' and identify two such products and their innovative 'technology push' features. [8]**

The intention is that the question should apply equally to all aspects of product design. Candidates may make reference to fashion design, systems etc. Some products fit into both categories (e.g. mobile phone, earlier ones 'the bricks' were technology push, now very much market pull) – important to look for justification. Most products which start as technology push, often eventually become market pull.

**Technology push** is where radical innovation is brought to bear on a product through investing in and exploiting current scientific and technological advances. This leads to a radical improvement of a product that has been driven by technology and an example of which is the CD player which came about as a result of defence technologies in the development of lasers. Another popular example would be Dyson's use of the cyclonic systems used in sawmills to suck up dirt using a vacuum cleaner.

**Q.5 State TWO advantages of constructing electronic circuits on:**

**(a) Stripboard. 2 x [2]**

**(b) Printed circuit boards (PCB). 2 x [2]**

(a) Two typical advantages to the designer for strip board is that it is a low cost, standard material that any system or sub system can be modelled, prototyped and tested on. Strip board is readily available and can be manipulated to house a variety of electronic systems. Strip board allows 'real' life testing of electronic systems with actual components and the results can be physically measured. CAD simulations cannot. Strip board is appropriate for limited scale / one-off production.

(b) Two advantages to the manufacturer for PCBs are that they are specifically made for individual electronic systems, meaning that there is little waste and they are close to the minimum size required and therefore cost effective. PCBs can be single or double sided and are used widely in automated manufacture. PCBs are populated and constructed using wave, flow or reflow soldering which often uses surface mount technology. This provides miniaturisation and maintains advancement of materials, technology and manufacturing practices. PCBs are appropriate for larger scale production techniques.

## SECTION B

**Q.6 (a) Describe what you understand by 'above the line' and 'below the line' analysis. 2 x[2]**

**(b) Describe two 'above the line' features of a specific named product and two 'below the line' features of the same product. 2 x [2]**

(a) 'Above the line' aspects are features that are often points of interaction by the consumer and are often control knobs, handles, switches, etc. They can also be aspects of a product that the consumer will interact with visually.

'Below the line' aspects of products are the features that often cannot be seen by the consumer and are the technologies that cause the product to function. Circuitry, technical information about materials, fixtures and fittings, etc.

(b) Named product features above the line two marks, named product features below the line two marks. This must be a description rather than a one word answer.

**Q.7. Evaluate the importance that modelling control systems will have on the eventual success of a product. [8]**

Modelling is critical during the development and refinement of the control system. CAD often plays a huge part. Control systems are tested rigorously to ensure they meet the specifications laid out previously. Testing allows the function of the control system to be evaluated, and be improved where appropriate. Without modelling, the control system would not be ready for full scale production. Many types of models and tests are produced to check that the control system performs appropriately under the conditions intended for its use. There are also models used and tested under extreme conditions e.g. crash testing, flammability, fatigue, repetitive testing and destruction. The modelling and testing allows a full, clear understanding of the control systems performance, in order to ensure that the product will be successful.

Models can be computer generated or manufactured by hand, to a scale. This will help you determine whether your idea is going to work or needs modifying. A model allows you to test your solution quickly and cheaply. You could ask your client / customer if the design is what they are looking for.

The proportions of the product, its functionality, aesthetics and even materials, can be assessed / evaluated by manufacturing an actual model or by producing a CAD model. A model can be used by a focus group or as part of a survey of potential clients, to discuss their views.

**Q.8 Outline the main elements of registered design, as prescribed by the Intellectual Property Office, benefits the creator of the design. [8]**

There are a number of benefits of registering a design. Some of these are listed below.

**Exclusive rights in a design**
A Registered Design grants exclusive rights in the look and appearance of a product. This can stop people making, offering, putting on the market, importing, exporting, using or stocking for those purposes, a product to which a design is applied.

**Protect all aspects of a design**
Design Registration protects the overall look of the whole or a part of a design. The designer can claim protection for the shape of a product, a two-dimensional surface pattern or graphic design, or a combination of the two.

**Long period of protection**
Registered Designs can be renewed every 5 years up to a total of 25 years.

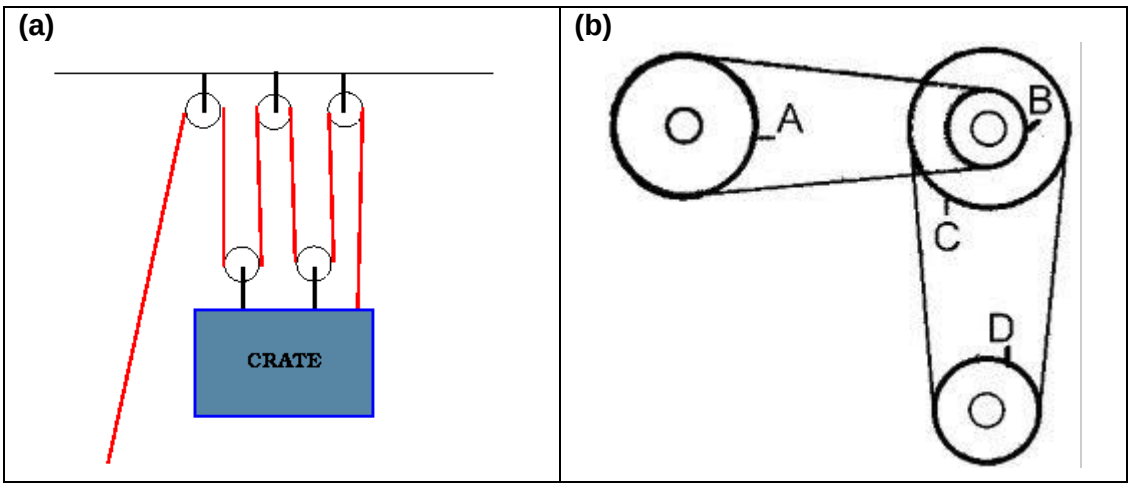
**Easier to enforce**
The existence of a registration may be enough to stop anyone infringing your design irrespective of whether they copied or came up with the design independently.

**Make money from a design**
A registered design allows the designer to sell the design and the intellectual property (IP) rights to it; or license somebody else to use the design whilst then designer retains the IP rights.

**Deferred publication**
The designer can choose to defer registration and publication of a design for up to 12 months. This allows the designer to establish a filing date, and allows more time to develop the product or apply for a patent before publicly disclosing the design on the IP Register.

**Public benefit**
Intellectual Property registration aims to protect the creator but also to benefit the public as publication of registrations showcases developments in design and stimulates further innovation.

**Q.9 Describe, with the use of diagrams, TWO different mechanical systems that transfer rotary motion and give an example of EACH in a named product. [8]**




A compound pulley `trades' force for distance through an action/reaction force pair. In a double pulley, as the rope passes over the pulley the force is transmitted entirely but the direction has changed. The effort is now pulling up on the left side of the bottom pulley.

Compound pulleys can also be used for rapidly increasing or decreasing speed or velocity using multiple pulley wheels per shaft (B). Compound pulleys for lifting are used in many machines including hoists and passenger lifts. Compound pulleys are also found on many machines including automotive, washing machines, fans for cooling etc.

**Q.10 (a) Explain why the inclusion of accurate and complete dimensions is essential to the design of products. [2]**

**(b) Describe the relationships between dimensioning and mass manufacture of a specific product. [6]**

(a) Issues related to ergonomics, target markets, proportion, aesthetics, product sales, inclusion of built in components, etc.

(b) Issues relating to machining, communication, global manufacturing, standards, etc.

## SECTION C

For each essay answer the following information will be applied.

Marks awarded according to the four levels within the assessment criteria. These criteria are best fit and if a candidate has most of the aspects within a level then the candidate can be considered for marks towards the higher end of the band. If there are some features that are weak or missing but overall the response matches many of the descriptors then the candidate could be considered for marks in the middle of the level. Candidates may be awarded marks at the bottom of the level if they have most of the descriptors in the previous level and one or two in the next level.

| | |
|---|---|
| **Level 1 0-9 marks** | • Candidate has a simplistic knowledge of the issues associated with the question.<br>• The use of terminology and technical language is basic.<br>• The candidate has little understanding of the general elements of industrial and commercial practices, with little knowledge of ICT in manufacturing systems if appropriate to the question.<br>• The candidate has limited knowledge of the form and function of products.<br>• The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant.<br>• Grammar, punctuation and spelling may be weak impacting on effective communication. |
| **Level 2 10-14 marks** | • The candidate has a basic understanding of the issues associated with the question.<br>• The use terminology and technical language is variable.<br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production.<br>• The candidate has some general knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral. These aspects are not always considered.<br>• The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented.<br>• There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues. |
| **Level 3 15- 20 marks** | • The candidate demonstrates a clear understanding of the issues associated with the question.<br>• The use terminology and technical language is reasonably accurate.<br>• The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production.<br>• The candidate has demonstrated a knowledge of the form and function of a product, trends and styles of products reflecting environmental, cultural and/or ethical /moral issues. These aspects are considered.<br>• The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured.<br>• There may be occasional errors of grammar, punctuation and spelling. |
| **Level 4 21-26marks** | • The candidate demonstrates a specific ability to analyse questions, takes into account of a wide range of factors and has a clear understanding of the issues associated with the question.<br>• Uses correct terminology and technical language.<br>• The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production.<br>• Candidate has developed a detailed knowledge of the form and function of a product, trends and styles of products. Environmental, cultural and/or ethical /moral issues. These aspects are considered where appropriate.<br>• The candidate will express complex ideas extremely fluently. Sentences and paragraphs will follow on from each other smoothly and logically. Answers will be consistently relevant and structured.<br>• There will be few, if any, errors of grammar, punctuation and spelling. |

**Q.11 Discuss the ways in which two designers of your choice, from the early 70s to the present day, have sought to influence their chosen market segments. [26]**

Indicate the two designers chosen, the characteristics of the market segment that they are aiming their product and how they have impacted on the market segments with their designs.

**Q.12 Identify the properties of specific control components that have been used in a named product and describe how their selection has benefited product performance issues of the new product. [26]**

Identification and description of two specific named materials and their physical properties. The candidates will then be expected to indicate how the use of these materials has been of benefit to the performance of the product.

**Q.13 Modernising traditional or 'retro' styled products often provides opportunities for designers to incorporate state of the art control systems.**

**Using named examples, explain how designers have combined these factors in products. [26]**

Historical or 'iconic' designs are often upgraded with modern control systems to improve performanc3e, efficiency or quality, but retain the traditional styling, looks or theme. Candidates are required to name products that typify this trend and evaluate how the designer has retained the 'retro' features and combined this with the modernising 'below the line' features.

**Q.14 'The Measure of Man and Woman, human factors in design is said to be one of the classic tools for fitting products and environments to people.'**

**Stephen B. Wilcox , Introduction – The Measure of Man and Woman**

**Fully explain how anthropometric data and ergonomic rules are of benefit to the designer. [26]**

Complete description of how important Anthropomentic data is in the application of human measurements of various gender and age related groups when designing products. This will include reference to the possible success or failure of a product if the application of the data is inaccurate or wrong.

The candidates should also describe how the application of ergonomic rules is important to the comfort of the user when working with the product. The application of the ergonomic rules should also impact on the effectiveness and ultimately the success of the product. These descriptions should also be directed at various gender and age related groups.

**Q.15 Describe how the four Ps are instrumental in achieving maximum sales for products. [26]**

A reasoned and balanced discussion around the use of the four Ps for selling a product.

**THE FOUR Ps**:
**Product**

- The need for the product to sell.
- How the product compares with competition.
- The product's reliability.
- The attributes or features the product has based on market research intelligence.
- How the product meets the expectations/desires of the market segment.
- The product differentiation.
- The aspects of the product that attempt to sustain brand loyalty.
- The product life cycle.

**PRICE**
**Price to fit the target market.**

- External criteria such as capturing market share.
- Rate of growth.
- Elastic demand- how much can the price change as a result of differing demand.
- The price that the market will bear.
- Costs of production will have an effect on price of the product.

**PLACE**
**How will the product be distributed?**

- Product reaches target market by being in right place at the right time.
- Distribution may be thought of as a geographical factor.
- What product sells in different parts of the country/continent?
- JIT
- Access to foreign markets.

**PROMOTION**
**About image creation for the product and manufacturer.**

- Sales push strategies.
- Coupons or money off pull strategies.
- Advertising media.
- Publicity – often free – press releases.
- Personal selling.
- Trade fairs and exhibitions.

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