GCE MARKING SCHEME

DESIGN & TECHNOLOGY
AS/Advanced

SUMMER 2013

INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2013 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 Designers and manufacturers use ICT to produce pre-production prototypes.

(a) Give two reasons why using ICT to produce pre-production prototypes is important to the designer. 2x[2]

(b) Give two different reasons why using ICT to produce pre-production prototypes is important to the manufacturer. 2x[2]

Designer
Advantages: up to 2 marks for each advantage.

- Various visual aspects (colour, form, 3 dimensional).
- Function (working parts, scaling, simulation, form).
- Methods of assembling the product may be planned.
- Working across sites (sending drawings to other manufacturers, designers).

Manufacturer
Advantages: up to 2 marks for each advantage.

- Reference to rapid prototyping – physical model produced from CAD – speed of production.
- Testing product performance before manufacturing.
- Materials test are carried out.
- Check on the quality of the product.
- Precise mould production produced by CAD/CAM.

Q.2 (a) Explain two of the following terms that are used to describe the physical properties of materials. For each term, name a material that has that property:
density, electrical resistance, fusibility, thermal conductivity. **2x[2]**

(b) Explain two of the following terms that are used to describe the mechanical properties of materials. For each term name a material that has that property:
elasticity, toughness, durability, plasticity. **2x[2]**

(a) Description of terms and materials (two marks for each).

Density
Reference to high density materials and understanding of structure – reference to. Density is a measure of how heavy an object is for a given size, i.e. the mass of material per unit volume e.g. lead, foam and other polymers.

Electrical resistance
Reference to high/low resistance are acceptable. Electrical resistance is a ratio of the degree to which an object opposes an electric current through it (measured in ohms).

Fusibility
Fusion welding of thermoplastics and metals using parent material are mixed in the molten state e.g. nylon, steel.

Thermal conductivity
Reference to heat transfer (low or high thermal resistance) e.g. copper as a conductive material.

(b) Description of terms and materials (two marks for each).

Elasticity
The ability to return to its original state/shape, e.g. latex.

Toughness
Tough materials can deform plastically and absorb a lot of energy before breaking, e.g. Nylon.

Durability
Capable of withstanding wear and tear or decay e.g. polyester, acrylics and acetate.

Plasticity
A material able to undergo permanent deformation under load, e.g. clay/plasticine.

Q.3 Designers and researchers ensure products are suitable for their intended users by assessing against the categories of aesthetics, function and reliability.

Describe a means of assessing a named product in two of the above categories and state the criteria you would use for the assessment. [8]

Means of assessing Aesthetics - including criteria:
- Use of market research to assess consumer taste.
- Preferences to colour, style, form of products.
- Tests may include a ratings chart with preferences.

Means of assessing Function - including criteria:
- Testing the function of a product to test safety.
- Effectiveness in different situations (wind tunnel).
- How well a product performs (testing the function of a product to test its expected life).

Means of assessing Reliability - including criteria.
- Function over a period of time – undertaken within test rigs.
- A range of consumer feedback systems and ratings charts may be used to assess performance within specified market audiences.
- Consumer tests to display reliability/ease of use (this may relate to function - is the product simple to use)?

Q.4 Planned obsolescence is a feature of some everyday products.

For a named product:

(a) Describe two benefits of planned obsolescence to the consumer. 2x[2]

(b) Describe two benefits of planned obsolescence to the designer and manufacturer. 2x[2]

Benefits to consumer: costs of products are often low, easily replaced (no need for repairs), possible to keep up with developing technology.

2 marks for each detailed response.

Benefits to the manufacturer: cost of production is low, little or no repairs necessary, life cycle is short, known and secure market.

2 marks for each detailed response

Q.5 Production cells and workforce organisation are features of Flexible Manufacturing Systems (FMS).

(a) Describe two advantages of a production cell to a workforce. 2x[2]

(b) Describe two advantages of a production cell to a manufacturer. 2x[2]

Advantages of production cells:

Workforce
Working in small teams, sharing responsibility, not as monotonous as an assembly line, skills are utilised.

Manufacturer
Teams take responsibility for all aspects of production including quality control, developing workforce skills.

2 marks for each advantage.

Q.6 Ergonomics and anthropometric data are essential to the success of products.

Describe two examples in each of the following where:

(a) Ergonomics is used to inform successful design in working environments; 2x[2]

(b) Anthropometric data is used to inform successful design in specific products. 2x[2]

The importance of Ergonomics within environments.

The systematic study of human capabilities, behaviour, limitations and requirements, and the application of such knowledge on the design of products. The study of people in their working environments – the interaction between people and built products/artefacts, equipment.

Areas or situations – driving seats or positions within a range of vehicles (for operators to have comfortable sight of controls), aircraft, checkout operators working in supermarkets - a description of the important needs of each user in these situations. VDU's.

Anthropometrics within products.

A scientific study of human measurement taken across a range of human groupings). In general thing measured include dimensions, weight, strength, range of movement, physical size – the physical fit between people and the equipment/products.

Issues essential for success from handle size/form, weight, movement required to pour successfully, internal physical dimensions.

Q.7 Problem solving strategies are used by product designers to initiate design ideas.

Describe any two problem solving strategies from the following:

inversion, morphological analysis, lateral thinking, brainstorming 2x[4]

Inversion: turning the problem around, looking at it in a different way.
(all the above may also be group activities – credit only if full description provided).

Morphological Analysis: Example*: a product that could be made of 3 types of material, in 6 possible shapes, and with 4 kinds of mechanism, theoretically there are 72 (3x6x4) potential combinations of material, shape and mechanism. Some of which may already exists, others will be unusable, and those left over are prospective new products*.

Lateral thinking: is the ability to think creatively, or "outside the box" as it is sometimes referred to in business, to use inspiration and imagination to solve problems by looking at them from unexpected perspectives. Lateral thinking involves discarding the obvious, leaving behind traditional modes of thought, and throwing away preconceptions.

Brainstorming: groups write down their ideas (use of post it notes, slips of paper).

Q.8 Qualitative testing and quantitative testing must be considered when selecting materials and processes for the design and manufacture of products.

Explain what you understand by both qualitative testing and quantitative testing in relation to specific products. 2x[4]

Quantitative testing are objective, measurable criteria, which can be assessed against specific performance measurable objectives.

Marks allocated with a full description with any of the following examples up to a maximum of 4 marks:

- The material must weigh no more than…..
- The material used must be light enough to….
- Related to material hardness, malleability, ductility….. **[4]**

Qualitative testing will reflect the intended quality of certain defined aspects of a material's specification. They are a more subjective form of criteria.

Marks allocated with a full description with any of the following examples up to a maximum of 4 marks:

- The material must be aesthetically pleasing…
- Material used must be recyclable…
- The material must be bright…
- Consideration of market sectors. **[4]**

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 0-10 marks	• Candidate has a simplistic knowledge of the issues associated with the question. • The use of terminology and technical language is basic. • The candidate has little understanding of the general elements of industrial and commercial practices. Little knowledge of ICT in manufacturing systems. • The candidate has limited knowledge of the form and function of products. • The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant. • Grammar, punctuation and spelling may be weak impacting on effective communication
Level 2 11-16 marks	• The candidate has a basic understanding of the issues associated with the question. • The use terminology and technical language is variable. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production. • 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. • The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented. • There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues.
Level 3 17-23 marks	• The candidate demonstrates a clear understanding of the issues associated with the question. • The use terminology and technical language is reasonably accurate. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production. • 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. • The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling

Level 4 24-30 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. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • 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. • 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. • There will be few, if any, errors of grammar, punctuation and spelling.

Q.9 The key input of the product champion and the entrepreneur are essential to the development of innovative products.

Discuss the role of a product champion and an entrepreneur in ensuring the development and success of a product or range of products.

Product Champion

Many products (and most of the very successful products) are driven by the vision of one person, or a small group of people - these are called “product champions”.

“Design champions drive the development of the product’s function and its recognition internally and externally. Ready to play a major co-ordinating role between designers, production and marketing”.

Product champions drive new products to market through experience, use of available resources, drive, determination and vision. They have a vision for a product. They work with others around them to push that product out to the market. This new product can be an extension of existing products in an existing company. The vision may be bolder and push an existing company in a direction.

Entrepreneur

They play a key role in any economy. These are the people who have the skills and initiative necessary to take good new ideas to market and make the right decisions to make the idea profitable. The reward for the risks taken is the potential economic profits the entrepreneur could earn.

An individual who, rather than working as an employee, runs a small business and assumes all the risk and reward of a given business venture, idea, or good or service offered for sale. The entrepreneur is commonly seen as a business leader and innovator of new ideas and business processes. Person who takes on the risks of starting a new business. Many entrepreneurs have technical knowledge with which to produce a saleable product or to design new products.

Q.10 Designers and manufacturers have to consider manufacturing methods, product life and environmental factors when designing and manufacturing products.

Discuss all the elements of the above statement with reference to named products.

Responses will consider the three areas in relation to designing products.

1. **Manufacturing methods**
   Designer's important skills in their awareness of the different manufacturing methods/processes available when designing (candidates may also refer to mass, batch and one-off production methods).

2. **Product Life**
   The considerations that designers make in terms of designing specific products, the materials used, etc (appropriate product life can be described with possible references to possible planned obsolescence and sustainability.

3. **Environmental factors**
   The considerations/decisions that designers need to undertake in order to design successful products in relation to the environment.

Environmental (including cultural and moral issues) will feature in higher level responses. Candidates' responses will need to demonstrate good awareness of designing and its relationship to manufacturing methods.

[30]

Q.11 The design and manufacture of products increasingly involves research and design development being undertaken in one location and manufacturing in another.

Discuss the advantages and disadvantages of this form of product development to the designer, manufacturer and the consumer.

Advantages:
Strength and experience of design and development work in one location and manufacturing ability in another. Using resources near to the manufacturing plant. General issues of labour cost relating to manufacturing.

Disadvantages:
Opportunities to develop skills in one location are limited. Exploitation of the workforce, low cost.

Candidates will need to demonstrate good awareness of mass manufacturing methods – and the research/design development aspects, and production.

Appropriate product life, energy, cost of manufacture, quality, fit for purpose.

Responses may discuss a range of environmental issues (energy, cost, investment, environmental footprint).

Reference made to the specific advantages and disadvantages of mass manufacturing to the designer, manufacturer and consumer (to access the higher range of marks).

[30]

DT1 - FOOD TECHNOLOGY

SECTION A

Q.1 (a) Explain the meaning of the term 'cross contamination'. [2]

Award up to 2 marks for a clear explanation of the term.

Bacteria being transferred from one food / surface to another by contact. e.g. transferred on people's hands, equipment; raw and cooked foods coming into contact with one another etc. making food unsafe to eat / possibly causing food poisoning.

(b) Describe three measures taken by food manufacturers to prevent cross-contamination. [6]

Do not award marks for general hygiene points - responses must describe the procedures to **prevent** cross-contamination.

Award up to 2 marks for **each** point, described in sufficient detail:

- Colour coded equipment, e.g. chopping boards, knives.
- Separate storage areas, e.g. for raw and cooked meats.
- Food stored in containers / wrapped.
- Cleaning vegetables to prevent soil causing contamination.
- Distinct preparation areas for different foods.
- One way systems in food factories so cooked foods cannot return to raw food areas, e.g. conveyor belt systems.
- Different staff working with e.g. raw and cooked meat. Colour-coded uniforms.
- Staff training.
- Hand washing procedures and facilities.
- Staff to have short, clean nails.
- Appropriate routines with uniform i.e. changing on site, washing.
- HACCP.
- Thorough cleaning procedures, e.g. stripping machinery between batch runs. Cleaning schedules, cleaning records.

Q.2 Explain the main purposes of:

(a) Design specification;

(b) manufacturing specifications.

Award up to 4 marks each.

The purpose of a design specification is to provide the designer / food technologist with details of what a not-yet-designed food product is intended to do. Its aim is to ensure that the subsequent design and development of a food product meets the needs of the user. This includes aims of the food product, how is it to achieve its purpose, the target market, nutritional factors, appearance and finish (aesthetic considerations) etc. It also allows the designer / food technologist to test and evaluate the resulting product against user needs and to make modifications / adaptations so that the design better meets these needs. It sets goals, sets targets, sets out specific measurable criteria. The design specification may have primary criteria (those which it is essential to meet) and secondary criteria (those which it is desirable to meet).

The purpose of a manufacturing specification is to provide the food manufacturer with details of exactly how the product is to be made e.g. dimensioning, portioning; material details; specific manufacturing details; moulding / shaping / forming details; aesthetic details (colour, texture, pattern) etc.

Q.3 Problem solving strategies are used by food technologists and designers to initiate design ideas. 2 x [4]

Describe any two problem solving strategies from the following:

inversion, morphological analysis, lateral thinking, brainstorming.

Inversion: turning the problem around, looking at it in a different way.

Morphological Analysis
Evaluating possible solutions in a table or matrix and considering all possible combinations, example: considering different combinations of flavourings and decorations for a cake product.

Lateral thinking
Is the ability to think creatively, or "outside the box" as it is sometimes referred to in business, to use inspiration and imagination to solve problems by looking at them from unexpected perspectives. Lateral thinking involves discarding the obvious, leaving behind traditional modes of thought and throwing away preconceptions.

Brainstorming
Groups write down their ideas (use of post it notes, slips of paper).

(All the above may also be group activities – credit only if full description provided).

Q.4. Explain how a named food product of your choice might be adapted to:

(a) improve its nutritional content; [4]

Candidates may detail a number of factors, including:

- Reducing the amount of sugar / substituting sugar with artificial sweetener / a food which is naturally sweet, e.g. fruit.
- Using wholemeal flour instead of white flour; wholemeal pasta / rice instead of white.
- Adding seeds.
- Adding a grain such as oats.
- Reducing amount of fat used, e.g. using leaner cuts of meat, using skimmed / semI-skimmed milk instead of full fat, etc.
- Changing the type of fat used, e.g. using margarine instead of butter so unsaturated rather than saturated fat.
- Changing cooking methods to remove some of fat content.
- Reducing amount of salt or using Lo-Salt – perhaps adding herbs for flavour to compensate for reduction in salt.
- Avoiding high salt ingredients such as soy sauce.
- Using a protein source with a higher biological value.
- Fortifying with vitamins / minerals.
- Introducing fruit / vegetables.
- Changing cooking methods to reduce vitamin loss, e.g. reducing cooking time, avoiding contact with water.

(b) reduce its cost. [4]

Candidates may detail a number of factors, including:

- Use cheaper alternatives to some food materials, e.g. margarine / shortening instead of butter or vanilla flavouring instead of vanilla extract.
- Remove more expensive ingredients from the recipe e.g. alcohol.
- Reduce portion size.
- Alter manufacturing process so can be made by mass production instead of more labour intensively.
- Remove hand finishing.
- Use locally sourced foods to reduce costs of transportation.
- Bulk out more expensive ingredients with cheaper ones, e.g. cereal in sausages.
- Add water to, e.g. meat products to bulk out.
- Use of soya to allow for reduction in meat content.

Do not credit how to reduce cost of manufacturing the product e.g. bulk buying – answer must focus of *adapting product* to reduce costs.

Candidates must make specific reference to named food products to gain the full allocation of marks (maximum of 3 for a) and 3 for b) without.

Q.5 The development of a new food product involves a number of stages. [8]

Discuss the value of producing prototypes as part of the process of food product development.

Award up to 2 marks for each developed point, including:

- To test organoleptic qualities to provide information for further development.
- To test functional qualities to provide information for further development.
- To test manufacturing techniques.
- To generate food products for consumer testing.
- To generate food products for trial launch in, e.g. few stores / one region.
- To help calculate costs.
- To obtain accurate information re' weights, nutritional information for packaging.
- To check scaling up is correct, e.g. level of seasoning.
- To assist training of staff.
- To better consider quality control; ensuring product consistency can be obtained / maintained.

Q.6 Outline how manufacturers maintain the consistent quality of food products within large-scale manufacturing. [8]

Up to 2 marks for each developed point:

- Use of high-tech' industrial equipment which is very accurate.
- Using quality materials from reliable suppliers.
- CAM – many processes controlled and monitored by computers, including controlling timings, temperatures, rate of flow, speed of processes, etc.
- Computers automatically adjusting processes to ensure accuracy.
- Use of specialist equipment.
- Tolerances – products rejected if outside tolerance.
- QC /QA.
- Rejection of sub-standard products.
- HACCP.
- Data logging.
- Use of moulds / formers / shapers / cutters.
- Accurate weighing / measuring – accurate electronic measuring.
- Weight checks.
- Computerised and visual checks. Checks of quality of appearance and surface finish.
- Nutritional analysis.
- Chemical analysis.
- Using standardised components.
- Specialisation of staff so become expert.
- Rotating staffs job to alleviate boredom so maintain level of attention and motivation.
- Staff training.

Candidates may refer to checks made on production line and checks / tests made on the product itself.

Q.7 Sensory analysis tests are carried out in school food technology rooms as well as in industry.

(a) Name and describe one specific sensory analysis test with which you are familiar. 2 x [2]

Award up to 2 marks each for two clear descriptions of named tests.

Examples include:

- Rating test – where taster gives a score between 1 and 5 for the food product. 1 - dislike a lot, 2 - dislike a little, 3 - neither like or dislike, 4 - like a little, 5 - like a lot.
- Hedonic testing – smiley faces.
- Ranking test – where a taster ranks a number of food products in order of preference.
- Profiling test – where tasters fill in a star diagram with descriptors covering various organoleptic aspects of the food product. Give a score between 1 and 5 for each.
- Triangle test – where the taster chooses which of 3 samples is the odd one out (2 are identical).
- Paired comparison test – where the taster gives an opinion of pairs of food products, e.g. which is the drier, which has the lightest texture.

(b) Outline four criteria which ensure that tests are carried out fairly. 4 x [1]

- Using codes rather than names so that name does not influence taster's opinion – called a blind tasting. Codes should be presented in a random order. Avoid, e.g. a, b and c or 1, 2 and 3 – might imply an order.
- Neutral background for food product e.g. white plate.
- Neutral lighting.
- Drink of water in-between samples to cleanse palate.
- Individual testers must not be allowed to communicate with one another.
- There should be a control sample.
- Appropriate document to record results clearly.
- Only change one variable at a time.

Q.8 Qualitative testing and quantitative testing must be considered when selecting materials and processes for the design and manufacture of food products.

Explain what you understand by both qualitative testing and quantitative testing in relation to specific food products. 2 x [4]

Marks allocated with a full description up to a maximum of 4 marks.

Maximum of 3 marks if no reference to specific food products.

Qualitative testing will reflect the intended quality of certain defined aspects of a material's specification. Qualitative tests are subjective and therefore difficult to measure. They consider the aesthetic / organoleptic properties of a food product.

Quantitative tests are objective; they use measurable criteria, which can be assessed against specific performance measurable objectives, e.g. must be a certain size / weight / contain a particular amount of a specified nutrient.

SECTION B

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Level 4 24-30 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. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • 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. • 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. • There will be few, if any, errors of grammar, punctuation and spelling.

SECTION B

Answer **one** question from this section.

Your answer should be substantial and show the **depth** of your knowledge in Product Design.

Each question carries 30 marks.

Q.9 The key input of the product champion and the entrepreneur are essential to the development of innovative food products.

Discuss the role of a product champion and an entrepreneur in ensuring the development and success of a food product or range of food products. [30]

Some food products are driven by the vision of one person, or a small group of people – these are called 'product champions'. They play a major co-ordinating role between designers, production and marketing. Product champions drive new products to market through experience, use of available resources, drive, determination and vision. They have a vision for a product. They work with others around them to push that product to the market.

Q.10 Food technologists and manufacturers have to consider manufacturing methods, product life and environmental factors when designing and manufacturing food products.

Discuss all elements of the above statement with reference to named food products. [30]

Responses will consider the three areas in relation to designing food products. Environmental, cultural and moral issues will feature in high level responses. Candidates' responses will need to demonstrate good awareness of designing and its relationship to manufacturing methods. Appropriate product life can be described with possible references to sustainability.

Manufacturing methods

- Method of production and techniques to be used.
- Scale of production.
- Equipment to be used.
- HACCP, QC, QA.
- Staff training.
- Disposal of waste.
- Energy use.

Product life

- Shelf-life. Treatment of food e.g. pasteurisation / sterilisation / freeze-drying to increase shelf-life. Packaging to increase shelf-life e.g. MAP, MEP.
- Product life cycle e.g. whether product will be in demand long / short-term, whether seasonal variations, whether likely to need revitilisation, etc.

Environmental factors

- Planning for product disposal e.g. recyclable / biodegradable packaging.
- Using suitable materials within the product e.g. locally sourced food materials, air miles, GM free, organic, sustainably sourced foods, e.g. fish etc.
- Recycled packaging, paper / card from sustainable sources.
- Minimal packaging.
- Raising disposal awareness with consumers, e.g. symbols on packaging to encourage recycling.
- Food waste; food poverty.
- Energy use and energy choices.
- Transportation of foods.

Q.11 Describe the properties and characteristics of two named food materials of your choice and explain how these are effectively utilised within named food products. [30]

Candidates should demonstrate specific detailed knowledge about the properties and characteristics of **each** of **two** named food materials and how these are utilised in the manufacture of named food products. Answers may focus on physical, chemical, organoleptic, aesthetic and nutritional. Candidates should use appropriate technical terminology to explain specific functions, e.g. caramelisation, destrinisation, gelatinisation, etc.

DT1 - SYSTEMS AND CONTROL

SECTION A

Q.1 Designers and manufacturers use ICT to produce pre-production prototypes.

(a) Give two reasons why using ICT to produce pre-production prototypes is important to the designer. 2x[2]

(b) Give two different reasons why using ICT to produce pre-production prototypes is important to the manufacturer. 2x[2]

Designer
Advantages: up to 2 marks for each advantage.

- Various visual aspects (colour, form, 3 dimensional).
- Function (working parts, scaling, simulation, form).
- Methods of assembling the product may be planned.
- Working across sites (sending drawings to other manufacturers, designers).

Manufacturer
Advantages: up to 2 marks for each advantage.

- Reference to rapid prototyping – physical model produced from CAD – speed of production.
- Testing product performance before manufacturing.
- Materials test are carried out.
- Check on the quality of the product.
- Precise mould production produced by CAD/CAM.

Q.2 (a) Name two sensing devices that could be used to sense movement within a given system. [2]

(b) Describe how each could be used in a system to detect movement. [6]

(a) 1 marks for each sensing device in a given system.

(b) Up to 3 marks for each description of how the system detects movement.

Examples include:

Potentionmeter
Liquid level measurement in a car fuel tank.

- Arm and float connected to the shaft of a rotary potentionmeter.
- Fixed ends of pot connected across supply, wiper connected to output.
- Forming a potential divider circuit.
- When level changes the voltage at the output changes.

Photo diode
Movement in a computer mouse.

- A roller run on the mouse ball.
- Roller attached to a bladed disk.
- LED shines through blades on to photo diode.
- As blades move, the photo diode will be turned on and off.
- The faster the mouse moves, the faster the photo diode will turn on and off.

Micro switch
Position of a chuck guard on a metal working lathe.

- Often the micro switch will be fitted with an actuating lever.
- Roller actuator runs on a cam fitted to the guard.
- When the guard is in place, the cam allows the switch to rise.
- If guard is raised, the cam will press in the switch and cut out the machine.

Low pressure air operated valve
To detect the position of boxes on a production line.

- An air bleed hole is positioned in the bed of a line at a lift.
- When a box covers the hole, the pressure builds up.
- The diaphragm will actuate a valve.
- Operating a lift mechanism.

Q.3 Designers and researchers ensure products are suitable for their intended users by assessing against the categories of aesthetics, function and reliability.

Describe a means of assessing a named product in two of the above categories and state the criteria you would use for the assessment. [8]

Means of assessing Aesthetics - including criteria:
- Use of market research to assess consumer taste.
- Preferences to colour, style, form of products.
- Tests may include a ratings chart with preferences.

Means of assessing Function - including criteria:
- Testing the function of a product to test safety.
- Effectiveness in different situations (wind tunnel).
- How well a product performs (testing the function of a product to test its expected life).

Means of assessing Reliability - including criteria.
- Function over a period of time – undertaken within test rigs.
- A range of consumer feedback systems and ratings charts may be used to assess performance within specified market audiences.
- Consumer tests to display reliability/ease of use (this may relate to function - is the product simple to use).

Q.4 Planned obsolescence is a feature of some everyday products.

For a named product:

(a) describe two benefits of planned obsolescence to the consumer: 2x[2]

(b) describe two benefits of planned obsolescence to the designer and manufacturer. 2x[2]

(a) Benefits to consumer: costs are usually low, easily replaced (no need for repairs), possible to keep up with developing technology.

2 marks for each detailed response.

(b) Benefits to the manufacturer: cost of production is low, little or no repairs necessary, life cycle is short, known and secure market.

2 marks for each detailed response

Q.5 A 3-volt dc electric motor drives the back wheels of a small toy car via a worm and worm wheel. The worm wheel has 20 teeth.

(a) Explain the reasons for the use of the gear system in the toy car. [6]

(b) State the formula you would use and calculate the velocity ratio of the gear system. [2]

(a) Explanation for the need of the gear system in the toy car.

- Reduce speed of model car.
- Increase torque.
- To prevent stalling of motor.
- Move rotation through 90^0.

Up to 2 marks for each point

(b) Velocity ratio of gear system = number of teeth on driven/number of teeth on driver
= 20 / 1
= 20 : 1

2 marks for correct calculation and answer.

Q.6 Ergonomics and anthropometric data are essential to the success of products.

Fully describe two examples where:

(a) Ergonomics is used to inform successful design in working environments. 2x[2]

(b) Anthropometric data is used to inform successful design in specific products. 2x[2]

The importance of Ergonomics within environments. [4]

The systematic study of human capabilities, behaviour, limitations and requirements, and the application of such knowledge on the design of products. The study of people in their working environments – the interaction between people and built products/artefacts, equipment.

Areas or situations – driving seats or positions within a range of vehicles (for operators to have comfortable sight of controls), aircraft, checkout operators working in supermarkets - a description of the important needs of each user in these situations. VDU's.

Anthropometrics within products. [4]

(A scientific study of human measurement taken across a range of human groupings). In general thing measured include dimensions, weight, strength, range of movement, physical size – the physical fit between people and the equipment/products.

Issues essential for success from handle size/form, weight, movement required to pour successfully, internal physical dimensions.

Q.7 Problem solving strategies are used by product designers to initiate design ideas.

Describe any two problem solving strategies from the following:

Inversion, morphological analysis, lateral thinking, brainstorming 2x[4]

Inversion: turning the problem around, looking at it in a different way.
(all the above may also be group activities – credit only if full description provided).

Morphological Analysis: Example*: a product that could be made of 3 types of material, in 6 possible shapes, and with 4 kinds of mechanism, theoretically there are 72 (3x6x4) potential combinations of material, shape and mechanism. Some of which may already exists, others will be unusable, and those left over are prospective new products*.

Lateral thinking: is the ability to think creatively, or "outside the box" as it is sometimes referred to in business, to use inspiration and imagination to solve problems by looking at them from unexpected perspectives. Lateral thinking involves discarding the obvious, leaving behind traditional modes of thought, and throwing away preconceptions.

Brainstorming: groups write down their ideas (use of post it notes, slips of paper).

Q.8 (a) Identify a system that uses a resistor and capacitor or a restrictor and reservoir to create a time delay.

(b) For the system describe, with the aid of a circuit diagram, how the components create a time delay.

555 timer circuits
Use of the resistor to slowly charge up capacitor, build up voltage across capacitor, triggering next stage.

Pneumatic cylinder circuit
Use of restrictor to slowly pressurise a reservoir, when pressure builds up in reservoir, next stage is triggered.

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 0-10 marks	• Candidate has a simplistic knowledge of the issues associated with the question. • The use of terminology and technical language is basic. • The candidate has little understanding of the general elements of industrial and commercial practices. Little knowledge of ICT in manufacturing systems. • The candidate has limited knowledge of the form and function of products. • The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant. • Grammar, punctuation and spelling may be weak impacting on effective communication
Level 2 11-16 marks	• The candidate has a basic understanding of the issues associated with the question. • The use terminology and technical language is variable. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production. • 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. • The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented. • There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues.
Level 3 17-23 marks	• The candidate demonstrates a clear understanding of the issues associated with the question. • The use terminology and technical language is reasonably accurate. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production. • 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. • The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling

Level 4 24-30 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. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • 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. • 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. • There will be few, if any, errors of grammar, punctuation and spelling.

Q.9 The improvements to systems and their manufacture have brought benefits to the manufacturer and the consumer.

With reference to named systems and manufacturing processes, evaluate the benefits of these improvements to both the manufacturer and the consumer.

Credit improvements in systems or manufacturing processes that have brought benefits to manufacturer and/or consumer.

Improvements
- Programmable systems.
- SMT
- Smaller circuit footprints.
- Multi-functional circuits.
- FMS
- JIT
- Computer process control.

Benefits to manufacturer
- Fewer components.
- Smaller components.
- Smaller circuits being multi-functional.
- Ability to re-cycle.
- Reduced cost.
- Upgrade function of system through software upgrade.
- Rapid response to change of design/order.

Benefits to consumer
- Reference to multi-functional products.
- New materials making better styling options.
- Smaller/lightweight.
- Ergonomic/anthropometric improvements.

Q.10 Designers and manufacturers have to consider manufacturing methods, product life and environmental factors when designing and manufacturing products.

Discuss all the elements of the above statement with reference to named products.

Responses will consider the three areas in relation to designing products. Environmental, cultural and moral issues will feature in high level responses. Candidates' responses will need to demonstrate good awareness of designing and its relationship to manufacturing methods. Appropriate product life can be described with possible references to possible planned obsolescence and sustainability.

[30]

Q.11 The design and manufacture of products increasingly involves research and design development being undertaken in one location and manufacturing in another.

Discuss the advantages and disadvantages of this form of product development to the designer, manufacturer and the consumer.

Advantages:
Strength and experience of design and development work in one location and manufacturing ability in another. Using resources near to the manufacturing plant. General issues of labour cost relating to manufacturing.

Disadvantages:
Opportunities to develop skills in one location are limited. Exploitation of the workforce, low cost.

Candidates will need to demonstrate good awareness of mass manufacturing methods – and the research/design development aspects, and production.

Appropriate product life, energy, cost of manufacture, quality, fit for purpose.

Responses may discuss a range of environmental issues (energy, cost, investment, environmental footprint).

Reference made to the specific advantages and disadvantages of mass manufacturing to the designer, manufacturer and consumer (to access the higher range of marks).

[30]

GCE -PRODUCT DESIGN DT3

SECTION A

Answer **three** *questions from this section.*
This section is designed to demonstrate your **breadth** *of knowledge in Product Design.*

Each question carries 8 marks.

Q.1 Outline the factors that determine the price that a product is sold for in the market place.

[8]

- 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.
- What price will the market bear.
- Cost of production will have an effect on price of the product.
- Labour costs.
- Profit Margins.
- Material costs - brand value - high build quality
- Promotion and advertising
- Transportation

Q.2 (a) Explain the reasons why a product manufacturer must identify any risks associated with the use of a particular named product. [4]

- So that the user is aware of any risks associated with the use or disposal of the product or components used in the construction of the product.
- Also that packaging is disposed of safely.
- This will also provide some protection to the manufacturer if risk assessments are carried out and explained to purchasers.
- Electrical – maximum safety voltage, limitations in environmental use, e.g. bathrooms.
- Age-related use, flying kites, mixing volatile materials, LEV use with certain materials, e.g. solder, heat given off by products, disposal of packaging, etc.
- Minimise the impact of legal action against the manufacturer.

(b) Identify four risks associated with the use of a specific named product.

4x[1]

Identification of product and the associated risks of using that product, e.g.

- Power drill.
- Ensure that correct fuse is used with the product.
- Drill is inserted correctly and tightened securely in the chuck.
- Drill is appropriate for the material being drilled.
- where dust is a risk, a mask must be worn.
- where flying particles are a risk, goggles or some form of eye protection must be worn.

Trailing leads when product is used away from electrical source.

Q.3 Explain how high 'build quality' of products can impact on product sales in the market place. [8]

- The product still needs to sell so the price must suit the target audience.
- Comparison with competition build quality will have to be superior.
- Reliability of the product and what attributes or features should the product have based on market research intelligence aimed at the target audience.
- Meeting the expectations/desires of the market segment.
- Product differentiation, is there a plan for diffusion of the product that meets the anticipated product life cycle.
- Product designed to sustain brand loyalty.

Q.4 Describe how, as part of your research, you would analyse an existing product prior to embarking on a design task. [8]

Analysis of the 'above the line' features, the success or otherwise of the user interaction features of the product, are they required, how can they be improved. Undertake user trips to assess the function of the product.

Analysis of the 'below the line' features the functional aspects of the product, how could they be improved, are the materials for manufacture able to be substituted? Can some components be eliminated? Can improved technology be incorporated into the new product?

Q.5 Describe, using diagrams where appropriate, how you would create permanent folds in a particular sheet material and how these folds affect the design of the product. [8]

Depending on the material, the folding process must be fully described

- i.e. sheet metals – using folding bars, folding press.
- Acrylic – marking the fold using marker pen, heat both sides uniformly on strip heater, bend when material is in a plastic state.
- Textile material – construction and sewing techniques to produce pleats.
- Also credit how these folds affect the design and/or structure of the product.

SECTION B

Answer **three** *questions from this section.*
This section is designed to demonstrate your **breadth** *of knowledge in Product Design.*

Each question carries 8 marks.

Q.6 Describe how the promotion of a product will vary depending on the anticipated life cycle of the product. [8]

About image creation for the product and manufacturer. The sales push strategies vary according to rate of adaption onto the market and anticipated life cycle, i.e. fad product requires intense early promotion to make immediate impact on the market whilst a product with a slow rate of adaption will require less intense promotion but the promotion will last over a longer period of time.

Advertising media, coupons or money off pull strategies form strategies for focusing promotion at any point in a product's life cycle.

Publicity – often free, such as Dyson's battle for Intellectual Property – press releases.
Competition between brands of mature products.
Promotion if a product has incremental improvements.

Q.7 Outline the information you would expect a designer to present in the detail designing stage of a prototype product. [8]

Information including:

- Fully dimensioned orthographic drawings of all parts.
- Isometric/planometric drawings.
- Section drawings.
- Assembly drawings.
- Perspective presentation drawings.
- Solid modelling albums.
- Textiles – templates, toiles and patterns with constructional details.
- Manufacturing and processing details.

Q.8 (a) Identify a specific thermosetting composite material and describe two of its main properties. 2x[2]

- Identification of thermosetting plastic.
- Description of two main properties – sentence on each.
- Hard, opaque, tough, scratch-resistant, self-extinguishing, free from taint and odour, wide colour range, resistant to detergents and dry cleaning solvents.
- Urea-Formaldehyde is used in many manufacturing processes due to its useful properties. Examples include decorative laminates, textiles, paper, foundry sand moulds, wrinkle-resistant fabrics, cotton blends, rayon, corduroy, etc. It is also used to glue wood together. Urea-Formaldehyde was commonly used when producing electrical appliance casings (e.g. desk lamps).
- The product is widely chosen an adhesive resin due to its high reactivity, good performance, and low price. Urea-Formaldehyde resin is a chemical combination of urea and formaldehyde. Amino resins are considered a class of thermosetting resins of which Urea-Formaldehyde resins make up 80% produced globally. Examples of amino resins include automobile tyres in order to improve the bonding of rubber to tyre cord, paper for improving tear strength, moulding electrical devices, moulding jar caps, etc.

(b) Describe how one of these properties has been utilised by designers to improve the function of a product. [4]

- Description of the plastic in use and how the properties identified in (a) enable the function of the product.
- Use as handles for several kitchen appliances due to its resistance to detergents and solvents, also that it is available in a wide colour range. It is also free from taint and odour and that its tough, scratch-resistant surface is ideal for this situation.

Q.9 (a) Name a specific SMART material. [1]

Name of specific material – one mark, e.g. Piezoelectric materials, Shape memory alloys.

(b) Describe two of its main properties. 2x[2]

Description of two main properties:

- Piezoelectric materials are materials that produce a voltage when stress is applied. Since this effect also applies in the reverse manner, a voltage across the sample will produce stress within the sample. Suitably designed structures made from these materials can, therefore, be made that bend, expand or contract when a voltage is applied.
- Shape memory alloys and shape memory polymers are materials in which large deformation can be induced and recovered through temperature changes or stress changes (pseudo-elasticity). The large deformation results due to martensitic phase change.
- Chromo-genic systems change colour in response to electrical, optical or thermal changes. These include electro-chromic materials which change their colour or opacity on the application of a voltage (e.g. liquid crystal displays). Thermo-chromic materials, which change colour in response to light, for example, light sensitive sunglasses that darken when exposed to bright sunlight.

(c) Explain how these properties have been exploited by product designers. [3]

Exploitation of properties when used in products.

Q.10 (a) Name two forms of production management systems. 2x[1]

Gantt charts, flow charts, critical path analysis, etc.

(b) Describe one such system in detail. [6]

Name of two production management systems.

Full description of one form of production management system, i.e. Gantt charts, flow charts, critical path analysis, etc.

SECTION C

Section C 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.

Level 1 **0-9**	• Candidate has a simplistic knowledge of the issues associated with the question. • The use of terminology and technical language is basic. • 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. • The candidate has limited knowledge of the form and function of products. • The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant. • Grammar, punctuation and spelling may be weak impacting on effective communication.
Level 2 **10-14**	• The candidate has a basic understanding of the issues associated with the question. • The use terminology and technical language is variable. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production. • 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. • The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented. • There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues.
Level 3 **15- 20**	• The candidate demonstrates a clear understanding of the issues associated with the question. • The use terminology and technical language is reasonably accurate. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production. • 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. • The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling.
Level 4 **21-26**	• 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. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • 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. • 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. • There will be few, if any, errors of grammar, punctuation and spelling.

SECTION C

Answer **two** *questions from this section.*

Your answer should be substantial and show the ***depth*** *of your knowledge in Product Design.*

Q.11 A thorough knowledge and understanding of the properties of materials has a key role to play in the design of successful products.

Identify a specific material and explain in detail how two of its primary properties make the material suitable to the function of a specific product or group of products. [26]

Identification of specific material, therefore you should expect a detailed description of two primary properties of the material and the reasons for its suitability for the task within a specific product. The suitability for the task that the material is chosen for must relate to some functional aspect of the product or group of products, i.e. cars, mobile telephones, etc.

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.

Q.12 Compare the work of two designers you are familiar with, indicating how they have developed their design style and how this style has influenced the development of similar products on the market. [26]

Comparison of the work of two named designers which could be within one specific genre of product or they could be completely unrelated. They key elements in this question are the way that the designers have developed their design style and then how the style of their products have impacted on other similar products.

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.

Q.13 'The goal of sustainable design is to make all products 100 per cent cyclic, social, solar and safe.'

Edwin Datschefski – The total Beauty of Sustainable Products.

Suggest ways that product designers can make a significant contribution towards this sustainable target in terms of the four aspects of design identified by Edwin Datschefski. [26]

Discussion relating to product design and the way that designers can build their products to ensure that they have maximised the application of the three elements contained within the question. That is making their products cyclic, social, solar and safe.

The expectation here is that candidates can identify features that could be integrated into manufactured goods. Also, materials that could be substituted to make the product more sustainable. Candidates should also consider the social implications of global manufacturing. The last feature should investigate the use of power source to manufacture the product and/or the means of powering the product.

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.

Q.14 'Designers cannot help but give their products visual form. That visual form may be nondescript, inelegant or just plain ugly. Or it can be transformed, by styling, into a thing of beauty, admired for how it looks rather than what is does.'

Product Design – Mike Baxter – Thornes – 1999

Discuss this statement with particular reference to a specific product or a range of products on the market today. [26]

Identification of a range of products that may have non-descript, inelegant or ugly visual forms. This should be followed by a discussion of how that product may be transformed by styling. References may be made to products that have undergone this incremental improvement, here it may be relevant to discuss form over function.

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.

Q.15 Evaluate the part that CAD and CAM have played in the development of high volume product manufacturing. [26]

Analysis of the development of ICT and its impact on designing and making within the high volume product manufacturing sector. this should include a discussion relating to aspects of CAD that relate to high volume product manufacturing as well as the importance of the use of computers to machine components for products. Candidates will be expected to discuss the reasons for utilising CAM as opposed to manual manufacturing of components.

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.

DT3 - FOOD TECHNOLOGY

SECTION A

Answer **three** *questions from this section.*
This section is designed to demonstrate your **breadth** *of knowledge in Food Technology.*

Each question carries 8 marks.

Q.1 Outline the factors that determine the price a food product is sold at in the market place. [8]

Award up to 2 marks for **each** factor up to a maximum of 8 marks.

Responses may be based on the following:

- Price to fit the target market / price market will bear.
- Competitors' prices/
- External criteria such as capturing market share.
- Rate of growth.
- Elasticity of demand – how much can the price change as a result of differing demand.
- Product lifecycle.
- Psychological pricing.
- Loss leader.
- Unique Selling Point, e.g. cholesterol lowering products.
- Quality level of product / quality of ingredients used.
- Portion size.
- Skill level of workers so level of pay.
- How labour-intensive process is.
- Loss leaders.
- Costs of production / manufacturing.
- Costs of packaging.
- Costs of transportation, storage, promotion, retailing.
- Profit levels.
- Taking into account economic climate.

Award maximum of 5 marks if response is focussed only on costs.

Q.2 (a) Explain the reasons why a food manufacturer must identify any risks associated with the use of a particular named food product. [4]

- To fulfill legal obligations: risk assessments are a legal requirement – due diligence.
- To put in place e.g. data logging systems to fight any future litigation.
- To minimise risks.
- To put in place control measures.
- To plan and implement staff training.
- To establish and maintain good reputation.
- To prepare appropriate information for food labelling, including warning for consumer.

(b) Identify *four* risks associated with the use of specific named food products. 4x[1]

Examples could include:

- Bacteria e.g. salmonella in chicken / eggs, listeria in cooked meat products / soft cheeses, E. Coli in beef, salad and milk, bacillus cereus in rice etc. Can cause food poisoning. Cross-contamination.
- Moulds.
- Yeasts.
- Viruses from animals e.g. BSE causing CJD.
- Heavy metal contamination in fish / shellfish.
- Food allergens, e.g. eggs, fish, shellfish, tree nuts, peanuts, wheat, soya
- Bones which could cause choking.
- Some foods prone to infestation by pests / insects.
- Hormones / growth promoters being passed on in foods.
- Pesticides being passed on in foods.
- Choking e.g. nuts, hard sweets particularly in children's products.
- Cooking / reheating product safely.

Q.3 The control of oxygen is sometimes used to prolong shelf-life.

(a) Explain why oxygen can affect the shelf-life of particular foods. [4]

Aerobic micro-organisms such as some bacteria and fungi require oxygen. Without oxygen, aerobic bacteria will not be able to divide. So oxygen can reduce shelf-life because of bacterial division and consequent risk of food-poisoning. Oxygen is responsible for oxidation. This can cause food spoilage of e.g. fruit and is also responsible for loss of nutrients e.g. vitamins C and E. Oxidation can also be responsible for colour changes in foods and for oils in foods becoming rancid.

(b) Describe two methods of food preservation which make use of the control of oxygen. 2 x [2]

- MAP – modified atmosphere packaging. The mix of gases within a food packaging is manipulated to increase shelf-life. Oxygen is displaced with nitrogen or with carbon dioxide.
- Canning – in part long-shelf life of canned food is due to lack of oxygen (also high temperatures).
- Bottling – works through a combination of factors – preventing oxygen, sugar making water unavailable and micro-organisms being killed by high temperatures.
- Vacuum packing – air is mechanically removed from the package before sealing.
- Oxygen absorbers – small sachet placed in food packet. They absorb oxygen and effectively reduce the aerobic environment to 0% oxygen. They can extend shelf-life from 1 week to several months. High barrier packaging with a low oxygen transmission rate are used.
- CAP - controlled atmosphere packaging. The mix of gases within a storage container for e.g. fruits / vegetables are controlled.
- Antioxidants retard rancidity of fats in foods. Synthetic antioxidants include E310, E311 and E312.

Q.4 Describe how you would analyse an existing food product as part of researching market products prior to embarking on a design task. [8]

Award up to **eight** marks for clear description of analysis of an existing product. In order to achieve higher marks candidates must either describe in **detail** at least **two** factors or cover **four** factors more briefly.

A food product would be disassembled. An existing food product is analysed in detail. It is taken apart to identify its components and their inter-relationships and recreate the product. Each components is examined e.g. proportions, how they are put together, finishing techniques etc. Quantitative testing such as weighing component parts, measuring dimensions, measuring viscosity. Testing performance. Scientific analysis of food materials e.g. nutritional, pH. Test shelf-life. Qualitative testing such as sensory analysis is also carried out – detailed evaluation of organoleptic attributes of the product. To identify strengths in order to attempt to emulate them and to identify weaknesses to avoid them in subsequent food product. There could be discussion of particular types of sensory analysis tests.

Q.5 'Just in Time' is a manufacturing system frequently used in food production.

(a) Explain what you understand by the term. [2]

Products are produced 'Just in Time' – materials are brought in just as needed, finished product transported immediately – no stock held. Short time frame from delivery of ingredients to dispatch of finished product. Particularly suitable for foods with a short shelf-life.

(b) Outline the advantages of the system to the food manufacturer. [6]

Up to **two** marks for each developed response:

- Very efficient method of production as e.g. saves time of moving raw materials / products back and forth to and from storage.
- Improved quality.
- Improved shelf-life of food products produced under this system as ingredients are being used more quickly and food products are being distributed more quickly.
- No or little storage needed.
- Reduction in costs e.g. storage, staff etc.
- Can respond quickly to changes in customer demand.
- Can respond quickly to e.g. changes in the weather.

SECTION B

Answer **three** *questions from this section.*
This section is designed to demonstrate your **breadth** *of knowledge in Food Technology.*

Each question carries 8 marks.

Q.6 **Describe how the promotion of a food product will vary depending on the anticipated consumer demand of that food product. [8]**

About image creation for the product and manufacturer. The sales push strategies vary according to rate of adaption onto the market and anticipated life cycle e.ire. fad product requires intense early promotion to make immediate impact on the market whilst a product with a slow rate of adaption will require less intense promotion but the promotion will last over a longer period of time.

Advertising media, coupons or money off pull strategies form strategies for focusing promotion at any point in a product's life cycle.

Up to **two** marks for each developed response. Reference may be made to the 4Ps, but emphasis of response should be focused on the promotion element.

Product designed to target particular market e.g. pasta in shape of cartoon characters.

Pricing the product correctly for the target audience. May be in terms of pricing the product sufficiently low to be in line with what the consumer can afford / is willing to pay or possibly pricing the product sufficiently high to give consumer impression of quality.

Place. Product should be marketed in correct location e.g. some ranges only available in stores in certain regions / localities due to e.g. economic / social / cultural factors. Image of shop e.g. Waitrose / Aldi. Or in certain categories of stores which attract certain types of consumers e.g. young shop / office workers. Products should be located within the store where particular consumers are likely to look and possible placed alongside other products.

Promotion. Careful design of packaging to appeal to particular target groups e.g. age / socio-economic. Use of colour, size, shape, image and typography to target specific groups. Name of product. Importance of brands, logos, trade names and corporate identity. Special offers, free gifts etc. Where product is advertised e.g. particular magazines / TV adverts between particular programs. Inclusion / prominence of certain information e.g. real nutritional properties / health benefits of foods. Associate product with lifestyle e.g. organic, breakfast bars, celebrity chef. Links to e.g. sporting events. Choice of particular personalities to promote to particular markets. Minimal packaging / environmentally packaging. Consumer surveys to establish what is likely to be successful. Sending vouchers for linked products based on previous purchases (information from loyalty cards).

Q.7 Outline the information you would expect a food technologist to present in the detail designing stage of a prototype food product. [8]

Up to **two** marks for each developed response.

The detail designing section would contain all the technical information required to make the food product, e.g.

- Weights / quantities of all the food materials to be used.
- Manufacturing techniques to be used.
- Equipment to be used.
- Temperatures.
- Timings.
- All measurements of each element of the design.
- Finishes / decoration techniques.
- Critical control points.
- dimensioned diagrams.

Q.8 (a) State the main functions in the body of one named vitamin and outline the consequences of a deficiency. [4]

Award up to **two** marks for correctly stating the main functions of one named vitamin and up to **two** marks for correctly outlining the results of a deficiency of that vitamin.

Award no marks where the candidate does not name a specific vitamin.

(b) Explain the reasons for the fortification of some food products. [4]

Award one mark for a brief explanation of a reason; award 2 marks for a more detailed explanation of a reason, up to maximum of 4 marks.

- required by law e.g. margarine is fortified with vitamins A, D and E which are naturally present in butter;
- to replace nutrients lost in processing / storage;
- to make equivalent nutritional value e.g. margarine / butter; white bread / brown;
- value added – retailers can charge a higher price for a premium product such as orange juice fortified with calcium;
- improve image;
- to attract customers to buy product / increase sales;
- to satisfy demands of health conscious market;
- to appeal to specific target groups e.g. parents of young children, quorn for vegetarians;
- to be able to make claims;
- competition.

Do **not** credit answers such as “make healthier”, “to increase nutritional value”.

Q.9 (a) Name a specific SMART food material. [1]

One mark for naming a SMART food material. For example:

- Foods with a novel molecular structure e.g. modified starches, fat replacers and sweeteners.
- Functional foods e.g. cholesterol-lowering spreads, probiotics, fortified eggs.
- Encapsulation technology e.g. encapsulated flavours in confectionery.
- Modern biotechnology – Genetically Modified foods e.g. soya beans, tomato plants.

(b) Describe two of its main properties. 2 x [2]

Responses should focus on the properties of the material, not how it is produced.

Up to 4 marks each for providing a short description of the main properties of two specific SMART food materials. For example:

- Live cultures of bacteria improve intestinal balance so inhibit production of pathogens / harmful bacteria.
- Textured Vegetable Protein (TVP) is fibrous and porous so can soak up to three times its own weight in liquids. The fibrous structure of TVP gives it a texture similar to meat. It is very versatile and can take on the flavour and texture of various meats. TVP is high in protein – approximately equivalent to meat. It is low in fat. It can be fortified to provide vitamins which would be found in meat. TVP is low cost: it is considerably cheaper than meat. It is good at retaining weight once hydrated. TVP is suitable for vegetarians and vegans. It is very light-weight which makes it suitable for expeditions etc. It has a long shelf-life (over a year) in its dehydrated form.

(c) Explain how these properties have been exploited by food technologists. [3]

Up to **3 marks** for explanation of uses. For example:

- Probiotics are used in drinks / yoghurt products to aid digestion / relieve symptoms of bloating.
- Because TVP can soak up juices etc from food it is prepared it can be used to take on the flavours of these other foods. Because of its low cost, high protein content and because it will take on the flavours of the meat it is sometimes added to meat products; to bulk them out, reduce the cost and reduce the fat content of a dish. Because of its long shelf-life and low weight it is used in products such as dehydrated sauces.

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Q.10 (a) Name two forms of production management systems. 2 x [1]

Systems could include flow charts, Gantt charts, critical path analysis.

(b) Describe one such system in detail. [6]

Up to 6 marks for detailed description of the product management system. Where a Gantt chart is explained, for example the candidate must explain the time line, blocks of activity and the descriptions of the manufacturing activities within the blocks, that there can be concurrent manufacturing and this can de shown in the chart. That the Gantt chart is often used in conjunction with a critical path analysis. Not only are the actual activities given time schedules but the overall project is also subject to a time deadline.

SECTION C

Section C 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.

Level 1 **0-9**	• Candidate has a simplistic knowledge of the issues associated with the question. • The use of terminology and technical language is basic. • 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. • The candidate has limited knowledge of the form and function of products. • The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant. • Grammar, punctuation and spelling may be weak impacting on effective communication.
Level 2 **10-14**	• The candidate has a basic understanding of the issues associated with the question. • The use terminology and technical language is variable. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production. • 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. • The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented. • There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues.
Level 3 **15- 20**	• The candidate demonstrates a clear understanding of the issues associated with the question. • The use terminology and technical language is reasonably accurate. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production. • 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. • The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling.
Level 4 **21-26**	• 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. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • 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. • 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. • There will be few, if any, errors of grammar, punctuation and spelling.

SECTION C

Answer **two** *questions from this section.*

Your answer should be substantial and show the **depth** *of your knowledge in* Food Technology.

Q.11 A thorough knowledge and understanding of the properties of food materials has a key role to play in the design of successful food products.

Identify two specific food materials and describe in detail the primary properties which make them suitable to the function of a specific food product or group of food products. [26]

Description of food materials with reference to their particular purpose in the components / products that have been made from them followed by the characteristics of the particular material and finally the working properties of both materials. Candidates may refer to nutritional and organoleptic characteristics and properties as well as physical and aesthetic functions. For example if choosing strong plain flour, the candidate would describe the properties of bulking, gluten formation and dextrinisation.

Q.12 Compare the work of two chefs, cooks or restaurateurs you are familiar with, indicating how they have developed their design style and how this style has influenced the development of food products on the market and people's food choices. [26]

Responses should focus on the food style and values of the individual, for example aesthetic qualities of the dishes they prepare; their 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; Candidates should contrast two individuals. This needs to be followed by discussion of the way the individuals have influenced consumer demand.

Q.13 Sustain: the alliance for better food and farming estimates that between 20 and 30 per cent of global warming caused by human activity is contributed by our food and agricultural systems.

Suggest ways that food producers, manufacturers and consumers can make a significant contribution towards increased sustainability. [26]

Reference may be made to the 6Rs: reuse, reduce, recycle, refuse, rethink, repair.

Issues covered could include:

- Energy efficient production.
- Design systems to use machinery which is versatile.
- Design of premises e.g. use of natural light.
- Using JIT to reduce energy use through storage etc.;
- Water efficiency e.g. using waste water again for e.g. cooling.
- Green energy sources e.g. wind, solar.
- Disposal of waste.
- Sourcing local materials to minimise transportation (food miles).
- Using seasonal produce to e.g. reduce energy use e.g. heating in greenhouses / polytunnels.
- Avoiding food materials transported by air.
- Organic materials.
- Increasing use of vegetarian protein sources as it is a more efficient use of land than meat production e.g. smart materials such as quorn instead of meat which is very land-intensive.
- Minimising use of pesticides etc. by suppliers.
- GM foods developed to e.g. use less water.
- Avoiding use of GM foods because environmental concerns.
- Avoiding use of growth promoters.
- Avoiding use of endangered fish e.g. cod.
- Using line caught fish.
- Products with longer shelf-life to reduce waste food being thrown away.
- Recycled, recyclable, compostable (biodegradable) packaging
- Minimal packaging; redesigning packaging to use less material e.g. sleeve rather than box; square tubs rather than round ones.
- Using wood pulp from sustainably managed forests.
- Avoiding use of some plastics.
- Labelling plastics with type to aid recycling e.g. PET, putting recycling labels / symbols on packaging to encourage responsible disposal.
- Stating CO2 contribution of individual food products on packaging.
- Displaying aeroplane symbol on foods transported by air.
- Reduce portion size to minimise waste.
- Buying food products from more local retailers to cut out the stage of food being sent to a regional distrubition centre before dispatch to retailer.

Q.14 Many people are basing some of their food choices on the health benefits imparted by particular food products.

Identify specific food products on the market claiming to have added health benefits and evaluate the extent to which these foods may improve health. [26]

Candidates may focus on:

- Fat replacers – reduced calories, reduces risks from diseases associated with high fat diet; however some reports that they can cause anal leakage.
- Sweeteners – reduced calories, better dental health than eating products with sugar, reduced risk of diabetese.
- Cholesterol-lowering spreads – claim to lower blood cholesterol levels. Products are very expensive.
- Probiotics and pre-biotics – claim to balance the level of bacterial activity in the gut and so aid effective digestion and reduce e.g. bloatedness.
- Fortified foods – with various vitamins and minerals. More recently more food products are being fortified with omega 3 and 6. Health benefits have been suggested to include heart health, improved brain development in children.
- Meat analogues e.g. Textured Vegetable Protein with high protein and low fat content; often fortified with various vitamins and minerals.
- GM foods with e.g. increased protein levels. Some people have concerns about the environmental impact of GM technology.

Q.15 Evaluate the part that CAD and CAM have played in the development of high volume food manufacturing. [26]

Candidates may give examples of the use of CAD and CAM within food production and may choose to illustrate their answer with reference to specific food products. They should consider the impact that CAD and CAM has had on the manufacturing process and on the food products being provided to consumers.

They must *evaluate* the part played by CAD and CAM, for example:

- Very large production output / quantities.
- Accuracy after design is produced on software and exported to the CAM machine; standardisation.
- Quality tends to be high.
- Repeatability so produces identical products again and again.
- Reducing human error; avoid staff becoming bored / careless due to repeat processes bringing about increased standards.
- Increased safety / reduction in accidents as staff not carrying out potentially hazardous tasks due to automation.
- Possibly reduced hygiene risks because of lower human contact so improved food safety standards.
- Speed.
- System can operate 24/7 with minimal down-time for maintenance / cleaning.
- expensive to set up / maintain.
- CAD can might enable manufacturer to respond more easily to changes in demand; easier to make modifications to food products.
- QC and QA procedures are faciliated.
- Data logging allows for easy tracking of products etc.
- Higher energy requirements so increased energy costs.
- Down time for change-over.
- If breaks down production stops.
- Work of operatives can be repetitive – problems of boredom / morale / recruitment / retention.
- The need to rotate jobs in order to reduce boredom.
- Need some highly skilled, specialist operatives.
- Loss of uniqueness of product / ‘hand-made’ qualities.
- Can be difficult to response to changes in demand quickly.

DT3 - SYSTEM AND CONTROL
Mark Scheme – Summer 2013

SECTION A

Answer **three** *questions from this section.*
This section is designed to demonstrate your **breadth** *of knowledge in System and Control.*

Each question carries 8 marks.

Q.1 Outline the factors that determine the price that a product is sold in the market place. [8]

- 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.
- What price will the market bear.
- Cost of production will have an effect on price of the product.
- Labour costs.
- Profit margins.
- Material costs - brand value - high build quality.
- Promotion and advertising.
- Transportation.

Q.2 (a) Explain the reasons why a product manufacturer must identify any risks associated with the use of a particular named product. [4]

- So that the user is aware of any risks associated with the use or disposal of the product or components used in the construction of the product.
- Also that packaging is disposed of safely.
- This will also provide some protection to the manufacturer if risk assessments are carried out and explained to purchasers.
- Electrical – maximum safety voltage, limitations in environmental use, e.g. bathrooms.
- Age-related use, flying kites, mixing volatile materials, LEV use with certain materials, e.g. solder, heat given off by products, disposal of packaging, etc.
- Minimise the impact of legal action against the manufacturer.

(b) Identify four risks associated with the use of a specific named product. 4x[1]

Identification of product and the associated risks of using that product, e.g.

- Power drill.
- Ensure that correct fuse is used with the product.
- Drill is inserted correctly and tightened securely in the chuck.
- Drill is appropriate for the material being drilled.
- Where dust is a risk, a mask must be worn.
- Where flying particles are a risk, goggles or some form of eye protection must be worn.
- Trailing leads when product is used away from electrical source.

Q.3 Explain how high 'build quality' of the control system in a products can impact on sales in the market place. [8]

The build quality of the control system will dictate the level of performance given to the consumer by the product. If high quality components are used, the reliability of the control system will be greater. The manufacturing techniques used in the production of the product also affect the standards at which the control system performs, thus whether the product generates positive reviews from consumers. Product branding is affected by build quality – sector leading names will require high standard to meet expectations from the market. If a product's control system has poor build quality, the success and popularity of the product will be much smaller. Poor build quality leads to returns, faults and recalls, and manufacturer's time, money and reputation is at a loss.

Q.4 Describe how you would analyse the control system of an existing product as part of researching the market products prior to embarking on a design task.[8]

Analysing an existing product's control system obviously required careful disassembly and 'reverse engineering'. Designers would categorize the control system in terms of 'input, process, output, before examining components or sub systems to gain a clear understanding of individual parts. Designers would obtain competitor products and begin with power supply, processor components and outputs, together with user interface, buttons, components that require user input. Whilst disassembling, testing components would occur, to fully understand the role of certain components / groups of components. Below the line' analysis is critical for systems designers to fully understand and appreciate decisions made by designers and manufacturers of existing products.

Q.5 Describe, using diagrams where appropriate, how you would create permanent folds in a particular sheet material and how these folds affect the design of the product. [8]

Depending on the material, the folding process must be fully described

- i.e. sheet metals – using folding bars, folding press.
- Acrylic – marking the fold using marker pen, heat both sides uniformly on strip heater, bend when material is in a plastic state.
- Textile material – construction and sewing techniques to produce pleats.
- Also credit how these folds affect the design and/or structure of the product.

SECTION B

Answer **three** *questions from this section.*

This section is designed to demonstrate your **breadth** *of knowledge in Systems and Control Technology.*

Each question carries 8 marks.

Q.6 Describe how 'qualitative' and 'quantitative' testing can be used during the development of control systems for products. [8]

Quantitative is any measurement or analysis involving numerical data or values. Quantitative can refer to the physical characteristics of a control system. The measurement of specific function, level, quantity, output, to evaluate the operational characteristics of a control system.

- Size of a pcb, mechanism, electronic system etc.
- Cost / unit item cost / component costs.
- Power supply, provision, consumption, efficiency etc.
- Use of mathematical data, calculations, principles.
- Testing / measuring using specific equipment.

Qualitative is the testing of a substance or combination of materials / components to determine individual constituents. A test that determines the presence or absence of something, where the analysis and interpretation of data cannot be generated statistically. Factors such as touch, feel, tactile finish to inputs, visual qualities of outputs etc. that are opinion based rather than scientifically tested.

- Judging the function of a control system against the specification.
- Deciding whether any further improvements are needed.
- Undertaking a visual analysis to see if any further developments are necessary
- Asking opinions of potential consumers.

Q.7 Outline the information you would expect a designer to present in the detail designing stage of a prototype product. [8]

Information including:

- Fully dimensioned orthographic drawings of all parts.
- Isometric/planometric drawings.
- Section drawings.
- Assembly drawings.
- Perspective presentation drawings.
- Solid modelling albums
- Textiles – templates, toiles and patterns with constructional details.
- Manufacturing and processing details.

Q.8 (a) Identify a specific integrated circuit component and describe two of its main properties. 2x[2]

A typical specific IC named e.g. PIC16F84A and two properties:

- Small 16 pin IC fitting a DIL socket .
- Unique property of being reprogrammed 1000 times.
- Can control a range of, and combination of, inputs and outputs.

(b) Describe how *one* of these properties has been utilised by designers to improve the function of a control system within a product. [4]

Responses including low power usage, ability to function using 3V dc, efficient, size – compact, space saving processor which can contribute to reduced size control system, reduced costs as a result of versatility, re-programmability allows for updates, upgrades and reuse / sustainability.

Q.9 (a) Name a specific SMART material. [1]

Name of specific material – one mark, e.g. Piezoelectric materials, Shape memory alloys.

(b) Describe two of its main properties. 2x[2]

Description of two main properties:

- Piezoelectric materials are materials that produce a voltage when stress is applied. Since this effect also applies in the reverse manner, a voltage across the sample will produce stress within the sample. Suitably designed structures made from these materials can, therefore, be made that bend, expand or contract when a voltage is applied.
- Shape memory alloys and shape memory polymers are materials in which large deformation can be induced and recovered through temperature changes or stress changes (pseudo-elasticity). The large deformation results due to martensitic phase change.
- Chromo-genic systems change colour in response to electrical, optical or thermal changes. These include electro-chromic materials which change their colour or opacity on the application of a voltage (e.g. liquid crystal displays). Thermo-chromic materials, which change colour in response to light, for example, light sensitive sunglasses that darken when exposed to bright sunlight.

(c) Explain how these properties have been exploited by product designers. [3]

Exploitation of properties when used in products.

Q.10 (a) Define the term 'feedback' used in many control systems. [2]

Feedback is the use of data in a system to promote decision making / reacting to changes in data / levels / readings. Feedback allows information to inform a control system, making the product more 'intelligent' or automated.

(b) Describe, with illustrations, how feedback is used in a control system of your choice. [6]

Responses must name an appropriate control system e.g. central heating system, security alarm, automatic street light, electric garage door etc. Candidates must clearly illustrate how feedback is used in the chosen system, diagrams and text are acceptable here, a combination of both would be beneficial.

SECTION C

Section C 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.

Level 1 **0-9**	• Candidate has a simplistic knowledge of the issues associated with the question. • The use of terminology and technical language is basic. • 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. • The candidate has limited knowledge of the form and function of products. • The candidate will express ideas clearly, if not always fluently. Answers may deviate from the question or not be relevant. • Grammar, punctuation and spelling may be weak impacting on effective communication.
Level 2 **10-14**	• The candidate has a basic understanding of the issues associated with the question. • The use terminology and technical language is variable. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and some aspects of ICT in production. • 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. • The candidate will express straightforward ideas clearly, if not always fluently. Answers may deviate from the question or be weakly presented. • There may be some errors of grammar, punctuation and spelling but is still able to communicate the issues.
Level 3 **15- 20**	• The candidate demonstrates a clear understanding of the issues associated with the question. • The use terminology and technical language is reasonably accurate. • The candidate understands the general elements of industrial and commercial practices related to manufacturing systems and is aware of aspects of ICT in production. • 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. • The candidate will express moderately complex ideas clearly and fluently, through well linked sentences and paragraphs. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling.
Level 4 **21-26**	• 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. • Uses correct terminology and technical language. • The candidate understands the main feature of industrial and commercial practices related to manufacturing systems including the use of ICT and stages of production. • 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. • 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. • There will be few, if any, errors of grammar, punctuation and spelling.

SECTION C

Answer **two** *questions from this section.*

Your answer should be substantial and show the **depth** *of your knowledge in Systems and Control Technology.*

Each question carries 26 marks.

Q.11 Functional development is critical when producing new products.

Identify a specific product or product range and describe in detail how the control system provides the main thrust of innovation. [26]

The development of control systems drives radically new products. The arrival of an advanced technological material, components or method promotes products to be developed in a new, inventive or innovative way, bearing little resemblance to previous products. Revitalisation is not accepted.

Examples may include Dyson vacuum cleaner, the innovative use of the dual cyclone to radically improve performance, looks, function and user interface. Nintendo Wii movement sensor technology to promote wireless controller interfacing between users and the main console. Apple touch screen technology for IPhone / ipad. Candidates are required to identify how the control system has allowed the development of the new, 'improved' product.

Q.12 Compare the work of two designers you are familiar with, indicating how they have developed their design style and how this style has influenced the development of similar products on the market. [26]

Comparison of the work of two named designers which could be within one specific genre of product or they could be completely unrelated. They key elements in this question are the way that the designers have developed their design style and then how the style of their products have impacted on other similar products.

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.

Q.13 'The goal of sustainable design is to make all products 100 per cent cyclic, social, solar and safe'.

Edwin Datschefski - The total Beauty of Sustainable Products.

Suggest ways that product designers can make a significant contribution towards this sustainable target in terms of the four aspects of design identified by Edwin Datschefski. [26]

Discussion relating to product design and the way that designers can build their products to ensure that they have maximised the application of the three elements contained within the question. That is making their products cyclic, social, solar and safe.

The expectation here is that candidates can identify features that could be integrated into manufactured goods. Also, materials that could be substituted to make the product more sustainable. Candidates should also consider the social implications of global manufacturing. The last feature should investigate the use of power source to manufacture the product and/or the means of powering the product.

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.

Q.14 'It's very easy to be different, but very difficult to be better.'

Jonathan Ive - 2008

Discuss this statement with particular reference to the development of control systems within a specific product or a range of products on the market today.[26]

The statement refers to products that may appear to have subtle changes to other products. Products may be within one brand or manufacturer or across a range of competing manufacturers. The influence of successful products promoting the inclusion of certain features, colours, materials, functions in other products.

Responses are required to discuss the idea that designers have found difficulty in producing 'better' products. Dyson perspiration – inspiration where the often gruelling process of producing a better product than rival is extremely difficult. By defining 'better' in terms of performance, aesthetics or function, candidates need to identify the problems designers encounter during the development of a radically new product, and how the battle of overcoming problems can be extremely painstaking.

Discussions must feature a named product or range of products where candidates exemplify the easiness of producing similar products, a and the contrasting difficulties of producing new and inventive products.

Q.15 Evaluate the part that CAD and CAM have played in the development of control systems in high volume product manufacturing. [26]

Analysis of the development of ICT and its impact on designing and making within the high volume product manufacturing sector. this should include a discussion relating to aspects of CAD that relate to high volume product manufacturing as well as the importance of the use of computers to machine components for products. Candidates will be expected to discuss the reasons for utilising CAM as opposed to manual manufacturing of components.

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.

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