GCE MARKING SCHEME

DESIGN & TECHNOLOGY
AS/Advanced

JANUARY 2013

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 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.

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DT1

SECTION A

Q.1 Materials having aesthetic characteristics and mechanical properties are used to fulfil certain functions within products.

(a) State what you understand by the terms aesthetic characteristics and mechanical properties. [4]

Aesthetic characteristics – a characteristic which refers to the quality of the material, its colour, form, texture (i.e. fabric materials, polymers and alloys used because of their forming abilities, ability to use colour and apply texture).
For the maximum mark of four the answer must refer to actual materials.

Mechanical properties – a property which refers to strength which could be tensile/compressive i.e. certain fabrics, metals, bending, brittleness, elongation, hardness, tensile strength – i.e. something under pressure or force.
A basic description of mechanical property 1 mark.

Up to 4 marks

(b) For named products, identify two aesthetic characteristics and two mechanical properties to be found in the materials which have been used. [4]

Aesthetic – Gold jewellery (ability to apply texture, rich colour of the material)

Mechanical – Lyocell – medical dressing (absorbency and ability to retain liquids, compressive and tensile strength).

Up to 4 marks

Q.2 Modelling and prototyping are two important processes which have benefits both to the client and to the manufacturer.

(a) Describe two benefits of computer generated models to the client. 2 x [2]

Computer models – benefits to client.

Viewing design concepts in particular environments, viewing concepts through the internet, clients being able to respond to a designer in another location/country, simulations possible with use of animated images.

Up to 2 marks for each benefit.

(b) Describe two benefits of Rapid Prototyping to the manufacturer. 2 x [2]

Rapid Prototyping – benefits to manufacturer.

Using a designers' drawings directly to model a prototype, accuracy and speed of manufacture, speeds up the whole process up to final manufacture (lead time).

Up to 2 marks for each benefit.

Q.3 Continuous production lines and cell production systems are forms of production used within manufacturing industry, in its organisation of plant and labour.

State the main features and two advantages of each of these forms of production. 2 x [4]

Features of Continuous Production Lines – production in a line, with assembly workers adding components.

Advantages: uses low cost unskilled labour, fast and efficient for the manufacturer, smooth running and uses computer control.

Features of Cell production – groups or cells of workers working as teams in the production process.

Advantages – small teams working together, shared responsibility, workers know their job and are able to carry out specific role to a high standard, easily traced problems, when breakdowns occur it does not affect the whole operation, workers have responsibility for parts of production which includes quality control.

Look for clear understanding of the two systems. 4 marks for each area.

Q.4 Products which have become design icons or classics over a period of time continue to influence designers in their work.

(a) Identify two design icons or classics. [2]

Design icons/classics: *'a product which has changed people's lives, remained important pieces in themselves in terms of design, function and quality'.*

Specific products, which could be from fashion (mini skirt) to graphic design (London Underground map) furniture (angle poise lamp) and car design (mini) etc.
Design icons or classics – enduring quality, historical, part of culture, recognised universally.

(b) Describe the features which classify them as design icons or classics. [6]

Features: description of important features of the icons in terms of design, function and quality.

Up to 6 marks for description of features.

Q.5 The design and manufacture of products is influenced by internal Quality Control (QC) and external Quality Assurance (QA).

Briefly describe four key features of both Quality Control and Quality Assurance.

2 x [4]

Features of Quality Control Up to 4 marks

i.e. elements involved in production – monitoring products.

- A method of monitoring and reaching standards through testing.
- Reference to materials, tolerances, quality of appearance and surface finish.
- Target setting which can be measured.
- Meeting consumer and environmental needs and expectations.
- Checks at points for accuracy and safety of product or component – so that it meets consumer and environmental expectations.
- Quality control methods: dimensional accuracy (tolerances), quality of materials (visual marks or blemishes) appearance and finish, durability.
- Dimensional accuracy may be checked with a gauge or measuring tool (micro meter, vernier, etc).

Features of Quality Assurance Up to 4 marks

i.e. process orientated – developing processes

- Application to set standards (BS, European, tests carried out on products).
- Statutory requirements relating to the end product.
- Manufacturing process is acceptable.
- Product testing through various systems and processes.
- Credit materials used for their specific qualities and characteristics.
- Reference to QA during the manufacturing process with its contribution towards the overall *end quality*.

Q.6 Products have 'above the line' and 'below the line' characteristics.

Explain the two terms in relation to a specific product or range of products. 2 x [4]

Look for a specific named product/or range (accept also one named product describing *above the line* and one product describing *below the line characteristics).*

Above the line characteristics – qualities, how it looks, image, the visual interface between user and product, materials, ergonomics, anthropometrics and function.

Below the line characteristics – product performance, how it operates, manufacture, material and components, assembly and build quality.

Note: Award up to 6 marks if no named product or products.

Q.7 State the main purpose of a risk assessment. [3]

Describe a five step risk assessment plan that would be appropriate for a named manufacturing process in a school or college workshop. [5]

Purpose – 'A risk assessment is a careful examination of what, in work, could cause harm to people, so that you can weigh up whether you have taken enough precautions or should do more to prevent harm'.

Five Step

1. Look for the hazard (being anything which may cause harm).
2. Decide who/what may be harmed and how?
3. Evaluate the risks and decide whether existing precautions are adequate or whether more needs to be done. Risk is the chance, high or low, that somebody will be harmed by the hazard.
4. Record the findings.
5. Review the assessments and revise if necessary.

The 5 stages in the incorrect order gain a maximum 3 marks.
Single words or very short phrases can be given credit – up to a maximum of 3 marks.

Q.8 (a) Describe the functions of a design specification for both the designer and the manufacturer. [4]

Function

To set goals; set targets; set out specific measurable criteria or the parameters within which design activity will take place.

The essential functions of the design specification could, for example, address product function and the user, the market sector, methods of production, material options, and aesthetic qualities. Credit is awarded where candidates differentiate between designer and manufacturer (could relate to manufacturing specification).

Up to 4 marks.

(b) Explain the importance of the design specification and its relationship to the evaluation process. [4]

Importance

Reference could be made to Primary and Secondary Specification and the importance of a clear reference to the designer and manufacturer.

Credit can be given for evidence of a clear understanding between primary and secondary specification criteria.

References made to the evaluation process (cross checking against the specification).

Reference to the specification as a tool for evaluating the design (on-going).

Up to 4 marks

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**	• 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**	• 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**	• The candidate demonstrates a clear understanding of issues associated with the question. • The use of 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 paragraph. Answers will be generally relevant and structured. • There may be occasional errors of grammar, punctuation and spelling.
Level 4 **24-30**	• The candidate demonstrates a specific ability to analyse questions, takes into account a wide range of factors and has a clear understanding of 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 C

Q.9 The Design Council interprets a design process used in industry as having four distinct phases.

- Discover – identify the design need.
- Define – understand the issues through detailed research.
- Develop – developing the product to a successful conclusion.
- Deliver – manufacturing the product for a specific market.

Discuss in detail the activities which could take place in each of the four phases.

Look for references to all the areas below in order to access the full range of marks.

Essay responses will need to refer to:

Discover – identify the design need.
Discover – identification of the design problem/opportunity. How is it identified? Consumer pull.

Define – understand the issues through detailed research.
Define – through detailed research and identification of the problem. Responses will need to make reference to how the designer defines the problem and reaches a possible specification which clearly defines the problem. Also allow reference to target market.

Develop – developing the product to a successful conclusion.
Develop – all the associated systems which will be used in developing the product to a successful conclusion i.e. types of modelling systems (physical and computer generated) running in parallel with idea generation and their subsequent development.

Deliver – manufacturing the product for a specific market.
Deliver – will involve the delivery of the product to the specified market (the diverse markets available from the product). JIT (Just In-time)

Responses will need to refer to:

- The principles of a design process.
- The development of products.

30 marks

Q.10 Designing and making products recyclable, repairable and with a longer lifetime will probably lead to better quality, though more expensive products.

Discuss this statement in relation to the future of designed products.

Essay responses are expected to make reference to the following areas:

Recyclable products – producing products that are easily disassembled for recycling, and have the correct materials for recycling.

Repairable products – producing parts for the product that are easily repaired.

Longer lifetime products – using better/improved materials and manufacturing methods.

Responses will consider higher costs in relation to the above.

Consideration of future products will be important to any successful response – stating possible benefits to the consumer, designer and manufacturer. Candidates will discuss how designers will influence the future in relation to sustainable products. Responses may refer specifically to materials and alternatives in order to improve build quality and the 'reparability' of a product.

30 marks

Q.11 The stages of production, from sourcing materials to purchasing the product must be effective for both the manufacturer and the consumer.

Discuss this statement in relation to a named product or range of products.

Give credit to definable stages for the named product/s which will fall broadly into the following:

- Sourcing - suitable geographical location.
- Preparation or primary processing the stage of getting the raw material into a workable state (thread, granules, sheet, woven forms).
- Secondary processing – the stage of forming the material through hand and machining processes.
- Assembling – the stage of bringing together components through a variety of manufacturing and joining methods (adhesion, cohesion and mechanical).
- Finishing – completed in order to protect/enhance the appearance of the product (reference may also be made to packaging and labelling at this stage).
- Distribution - reducing transportation costs.

References may be made to QC through testing and inspection.

- Higher level responses will demonstrate a clear understanding of *the stages of production.*
- In addition to new technologies becoming available to the product designer.
- Look for reference to specific processing and production methods.
- Reference to the importance of assembly and finishing – with specific examples.

30 marks

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 four ways that consideration of the product life cycle can influence the sustainability footprint of a product. [8]

Product service and repair.
Using materials that would ensure product reliability.
Product designed to be incrementally improved.
Product that can be easily maintained or repaired.
Materials to be recycled.
High build quality.

Q.2 Describe two benefits and two limitations of solar energy when used as a power source by industry. 4 x [2]

Benefits - Source of energy that is relatively cheap following initial investment.
Improved efficiency of solar technologies, government incentives such as fee-in-tariffs.
Limitations - Solar does not given consistent continuous power without some other form of energy storage, Large area required for generation.
Initial set up costs - Needs to be part of the integrated energy system.

Q.3 Explain the reasons why some products are subjected to incremental improvements over time. [8]

This could be as a result of a large initial investment to set up volume manufacturing on a production line which would require a long product life in order to recoup the initial investment and make a profit.
The injection of new, technologically advanced components, in order to make the product more appealing to the target audience.
Inclusion of styling/streamlining/aesthetics part of the initial product to meet fashion needs.

Q.4 Explain how the 'market pull' model of innovation can impact positively on the development of a product. [8]

In the period Mid 1960s - Early 1970s emerged the second-generation innovation model, referred to as the "market pull" model of innovation. According to this simple sequential model, the market was the source of new ideas for direction R & D, which had a reactive role in the process. The stages of the "market pull" model are: Market need - Development - Manufacturing - Sales.

The “market pull” model of innovation begins with heavy market research in the needs of the market and how effective the present product model is. The limitations of the present product are subject to scrutiny of the market and adjustments and improvements are considered by R & D. The injection of any new technology is also often considered and presented to focus groups who provide R & D with feedback on possible developments.

The linear models of innovation supported numerous criticisms concerning the linear nature of the models. These models ignore the many feedbacks and loops that occur between different “stages” of the process. Shortcomings and failures that occur at various stages may lead to a reconsideration of earlier steps and this often results in a new innovative step being introduced into the product.

Q.5 Describe how the use of JIT(Just in Time) manufacturing strategies has impacted on product manufacturing. [8]

Computerised control of inventory - Stock ordering and dispersal using computers - Finished product time deadlines to meet demand managed by computers - computers monitor stock levels and warn of possible shortages according to future production.

Just-in-time (JIT) is easy to grasp conceptually, everything happens *just-in-time*. For example consider my journey to work this morning, I could have left my house, *just-in-time* to catch a bus to the train station, just-in-time to catch the train, just-in-time to arrive at my office, just-in-time to pick up my lecture notes, just-in-time to walk into this lecture theatre to start the lecture. Conceptually there is no problem about this, however achieving it in practice is likely to be difficult!

So too in a manufacturing operation component parts could conceptually arrive *just-in-time* to be picked up by a worker and used. So we would at a stroke eliminate any inventory of parts, they would simply arrive *just-in-time*! Similarly we could produce finished goods *just-in-time* to be handed to a customer who wants them. So, at a conceptual extreme, JIT has no need for inventory or stock, either of raw materials or work in progress or finished goods.

Obviously any sensible person will appreciate that achieving the conceptual extreme outlined above might well be difficult, or impossible, or extremely expensive, in real-life. However that extreme does illustrate that, perhaps, we could move an existing system towards a system with more of a JIT element that it currently contains. For example, consider a manufacturing process - whilst we might not be able to have a JIT process in terms of handing finished goods to customers, so we would still need some inventory of finished goods, perhaps it might be possible to arrange raw material deliveries so that, for example, materials needed for one day’s production arrive at the start of the day and are consumed during the day - effectively reducing/eliminating raw materials inventory.

JIT and Manufacturing Techniques - logistics, part ordering, computer inventories, CAD/CAM, concurrent engineering etc.
Rapid engineering.

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 aesthetic improvement of a particular named product has impacted upon purchasing decisions made by consumers. [8]

Any number of cars can be used as evidence of aesthetic styling improvements in continuous sales.

Apple manufacturing the I Mac computer with computer and monitor integrated and no controls intruding on the visual simplicity of the design.

Dieter Rams philosophy for effective design utilised by Braun products particularly:

Good design is aesthetic. The aesthetic quality of a product is integral to its usefulness because products we use every day affect our person and our well-being. But only well-executed objects can be beautiful.

Good design is unobtrusive. Products fulfilling a purpose are like tools. They are neither decorative objects nor worked of art . Their design should therefore be both neutral and restrained, to leave room for the user's self-expression.

Good design is as little design as possible. Less, but better - because it concentrates on the essential aspects, and the products are not burdened with non-essentials. Back to purity, back to simplicity.

Q.7 Give four reasons why surface detailing is important to particular named products.

4 x [2]

Surface detailing acting as visual signposts for certain user operational features of a product.
Surface detailing giving more secure grip to certain parts of a product.
Surface colour detailing indicating the user interface for functional parts of the product.
Surface detailing using photo-chromic plastic to indicate temperature differences of the surface of a product.

Q.8 Outline four reasons for patenting a product. 4 x [2]

Protecting an idea for commercial exploitation.
Protecting an idea of industrial manufacture.
To enable public exposure of an invention.
To enable the property right, to be sold, licensed, mortgages, assigned or transferred, or given away.

Q.9 Describe, using diagrams where necessary, a processing operation that is used when forming a named plastic product or component. [8]

Description of blow moulding, compression moulding, calendaring, injection moulding, rotational moulding etc.

Blow moulding - Blow moulded PET bottle.

The Process
The process is divided into three areas:

A. Injection
The injection blow moulding machine is based on an extruder barrel and screw assembly which melts the polymer. The molten polymer is fed into a manifold where it is injected through nozzles into a hollow, heated pre-form mould. The pre-form mould forms the external shape of the pre-form. The pre-form consists of a fully formed bottle/jar neck with a thick tube of polymer attached, which will form the body.

B. Blowing
The pre-form mould opens and the core rod is rotated and clamped into the hollow, chilled blow mould. The core rod opens and allows compressed air into the pre-form, which inflates it to the finished article shape.

C. Ejection
After a cooling period the blow mould opens and the core rod is rotated to the ejection position. The finished article is stripped off the core rod and leak-tested prior to packing The pre-form and blow mould can gave many cavities, typically three to sixteen depending on the article size and the required output. There are three sets of core rods, which allow concurrent pre-form injection, blow moulding and ejection.

Q.10 (a) Explain what is meant by the term ergonomics. [2]

Ergonomics is the study of designing equipment and devices that fit the human body, its movements, and its cognitive abilities.

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system in order to optimize human well-being and overall system performance.

Ergonomics is employed to fulfil the two goals of health and productivity. It is relevant in the design of such things as safe, comfortable furniture, automobile controls and easy-to-use interfaces to machines and equipment.

Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability.

(b) Describe how you have applied an ergonomic consideration in the design of a specific particular product that you have made. [6]

Explanation of the application of ergonomic constrains within the design of a particular product that has been made by the candidate.

SECTION C

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

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

Each question carries 26 marks.

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.

Marks awarded according to the four levels within the assessment criteria. These criteria are a 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. It 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.11 Compare and contrast the ways in which two product designers of your choice, from the early 70s to the present day, have impacted on the design of a named product. [26]

This question requires an answer in essay form which assesses the way a particular designer from within the time zone has impacted upon the design of the particular product. Following the impact of the designer on the particular named product the candidate should compare that design development which contrast with the first designer chosen must then be discussed as to their importance to the product. The candidate may choose from two separate products in their answer.

Q.12 Describe the benefits that choosing specific plastic materials has on sustainability issues. Contrast these benefits with the detrimental effects of using specific plastics when designing and manufacturing new products. [26]

This question requires an answer in essay form which identifies the particular plastics components within a certain product and relates their inclusion to issues of sustainability. The candidate will identify the performance of the plastic in relation to the anticipated life cycle of the particular product and the possible economic issues that are bound up with manufacturing and sales of the product. These issues will have to be balanced with the negative detrimental effects of using plastic in products. Issues of identifying the plastic components should they be able to be recycled. If not then would they be able to be re-used as a component or further processed to pellets for another use.

Q.13 A design icon is said to be that which is readily recognized and generally represents an object or concept with great significance to a wide group within the field of design.

Fully describe how this statement applies to a product that you consider to be 'iconic' giving your interpretation of the design criteria that class the product in this genre. [26]

This question requires an answer in essay form which describes the nature of an iconic design and the exact features of a specific product that are identifiable and which allow the interpretation of a group of people to class it within this genre.
An iconic design is usually a design that is 'ground breaking' and one that sets new standards in its field. It is a design that other designers and manufacturers follow, as it becomes a bench mark for other similar products. Furthermore, an iconic design is one that stands up to the test f time, remaining a good design, despite the passing of years, decades and even centuries.

Q.14 Explain how the over use of natural resources, the consequences of pollution and over production have impacted on a design consciousness in society. [26]

This question requires an answer in essay form and addressing the three elements within the question i.e. over use of natural resources specifically mentioning the resource depletion and its impact on the environment and the consequent waste of energy, finances and disposal costs.

Q.15 Describe how the use of ICT and the internet has impacted on the designing of products and global manufacturing. [26]

This question requires an answer in essay form including the impact of ICT and the Internet for designing and manufacturing products. These two factors may be answered as separate features of as a combination of the effects of both with the close interrelationship that exists between them.

ICT including communicating across the glove to a variety of designing and production facilities, the design software that is available with secure vaults to enable concurrent design and production with editing as necessary.

The use of the internet to research and communicate information as well as to search for design and manufacturing sources for production with easy communication via e-mail, skype and video conferencing, etc.

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