GCE MARKING SCHEME

DESIGN & TECHNOLOGY
AS/Advanced

JANUARY 2014

INTRODUCTION

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

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

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

GCE DESIGN AND TECHNOLOGY

JANUARY 2014 MARK SCHEME

DT1 - SECTION A

Q.1 Describe the following stages of production in relation to a specific material:

(a) Primary processing. [4]

(b) Secondary processing. [4]

Primary processing – the stage of getting the raw material into a workable state (thread, granules, sheet, woven forms). Taking raw materials e.g. sheet steel (from *Primary Industry*) and using them to make industrial materials.

Then, these would go under another process called *Secondary Manufacturing* that uses these products and turn them into finished goods

Up to 4 marks

Secondary processing – a further stage of manufacturing, the stage of forming the material through hand and machining processes. Processes such as machining, use of CNC machines, moulding, shaping are all acceptable.

Up to 4 marks

Q.2 Alloys and composite materials have properties and characteristics which are essential to many products.

(a) Name one alloy and one composite material and an appropriate application for each. 2 x [2]

(b) Describe the composition of each named material. 2 x [2]

Alloys: brass, steel, bronze, aluminium alloys, pewter, solders etc.
Named alloy and one appropriate application for the named alloy. 2 marks

Composition/structure of each alloy:
An alloy is a metal (parent metal) combined with other substances (alloying agents), resulting in superior properties such as; strength, hardness, durability, ductility, tensile strength and toughness.

Alloys can be composed of just one metal, as well as other non-metal elements. Cast iron is an example, as it is a combination of iron (metal) and carbon (non-metal) or two or more metals such as zinc being added to copper to make brass

Responses may give examples of copper alloys and their composition, steel alloys or aluminium alloys etc. 2 marks

Composites: e.g. carbon fibre, Formica (layered composite), glass fibre (GRP), concrete, MDF, tufnol, manufactured boards such as chipboard, plywood and corrugated card.
Textiles include composite materials that are made from a synthetic component and a natural component, e.g. Polyester Cotton, wool and nylon, lycra and cotton, viscose, silk and acrylic.

Named composite and one appropriate application for the named composite 2 marks

Composition/structure of each composite: examples include, layered Formica – heat resist layer produced, MDF – fibre bonded with synthetic resin to produce fine surface finish, plywood layers at right angles, strands of glass (or carbon fibre) set in rigid polyester resin, tufnol is a layered composite with woven linen impregnated.

A blended composite example: - polyester cotton is made by blending polyester and cotton fibres together to make one yarn which is then knitted/woven to form the fabric.

A mixed composite example: - micro fibre in weft threads, wool/cotton/linen in the warp threads (woven structure only).

A layered composite example: - tough cordura outer layer and a woven Kevlar inner layer or laminated fabrics such as a permatex breathable membrane to an outer layer of nylon. **2 marks**

Q.3 Textiles have thermal properties, metals have conductive properties and plastics have moulding properties which are all important material properties for a product designer to consider.

(a) Define two of the above properties. 2 x [2]

(b) Explain how these two properties are used in the design and manufacture of products. 2 x [2]

Description of property **2 marks for each**

Thermal – ability to prevent heat transfer between different items (textile) Wool – trapping of air between fibres

Conductivity (credit both electrical – the ability of the material to conduct an electrical current and thermal – the ability of the material to conduct heat)

Moulding qualities – shaping and forming methods (the ability of the material to be formed from a liquid state, shaped under pressure and/or heat)

Making use of the property - Look for understanding of the two selected materials and how their property is utilised within a specific material, how does the property influence the design and manufacture of products?

Accept product or components

Full credit can be given if the candidate states how the property influences a particular design. **4 marks**

Q.4 Using ICT has benefits to the designer and manufacturer.

(a) Identify two areas where ICT is used effectively within designing. 2 x [2]

(b) Describe two areas where ICT is used effectively within the manufacturing process. 2 x [2]

Use of ICT – research and design **up to 4 marks**

Use of databases, internet, communicating with individuals or companies through e-mail.
Use of software for design (look for clear descriptions and understanding).

Use of ICT – product development and manufacturing process **up to 4 marks**

Product modelling, rapid prototyping (Credit for this can only be given once therefore either part (a) or part (b) but not both.), use of specialist CNC equipment within various areas of manufacture.
TQM is acceptable.

Note: Communicating across sites using ICT would be acceptable in both categories

Q.5 BSI (British Standards Institution) and ISO (International Organisation for Standardisation) set standards that apply to a range of products and components.

Describe four positive effects that these standards have on the design of products or components. 2 x [4]

Importance to the public - safety reassurances

- Positive effects related to:
- More sales.
- Frequent use and proven safety.
- Meeting standards.
- Customers know what they are buying.
- Safety features and warning signs or logos.
- Indicates quality products.
- Safe materials. i.e. not lead or toxic material.
- Quality assurance aspects from. Products: crash helmets, safety clothing, toys, specific electrical products.
- Tests carried out: crash resistance, flammability, component size and material in relation to toys, electrical safety.

2 marks for each positive effect

Described and qualified statements for 2 marks

Q.6 Explain the following scales of production and provide examples of products produced by each:

(a) batch or modular production; 2 x [2]

(b) high volume production. 2 x [2]

Batch or modular production - is when a small quantity of identical products are made.

- Batch production may also be labour intensive where jigs and templates are used to aid production.
- Batches of the product can be made as often as required.
- The machines can be easily changed to produce a batch of a different product.

e.g. fashion items, a range of seasonal products.

Mass or continuous production - is when hundreds of identical products are made, usually on a production line.

- Mass production often involves the assembly of a number of sub-assemblies of individual components.
- Parts may be bought from other companies.
- There is usually some automation of tasks (e.g. by using *Computer Numerical Control* machines) and this enables a smaller number of workers to output more products.

e.g. a range of machinery parts, a range of kitchen/household products.

Responses may also refer to:
Continuous flow production is when many thousands of identical products are made.

- The difference between this and mass production is that the production line is kept running 24 hours a day, seven days a week to maximise production and eliminate the extra costs of starting and stopping the production process.
- The process is highly automated and few workers are required.

e.g. pins, nails, screws, a range of high volume components.

Q.7 JIT (Just in Time) manufacturing benefits both the manufacturer and the supplier of materials or components.

Describe the principles of JIT manufacture and its benefits to both the manufacturer and supplier. 2 x [4]

Key principles of Just in Time (JIT) manufacture:

- Manufacturing according to an agreed plan
- Governed by material and resource availability.
- Principles may be descriptions of aspects of production and meeting the needs of customers.
- Control of stock
- The arrival of materials and components *just in time*

Benefits to both the manufacturer and the material or component supplier. (Up to two marks for each benefit.):

- Less storage space
- Efficient and faster manufacturing system thereby:
- Getting products to the customer/consumer quickly
- Releasing capital for use elsewhere
- No depreciation in material costs
- Increased profit margins
- Consistent deliveries
- Ability to specialise in component production.

Q.8 The range of strategies used by designers when generating and developing design ideas includes disassembly, brainstorming and trialling.

Describe any two of these strategies and how they are used by designers to generate and develop design ideas. 2 x [4]

Disassembly: taking apart to analyse parts/components (features of above and below the line).

Brainstorming: a group activity designed to increase the quantity of fresh ideas. Getting other people involved can help increase knowledge and understanding of the problem (groups write down their ideas - use of post it notes, slips of paper)

Trialling: designers and researchers enrol volunteers into studies and subsequently conduct larger scale studies with consumers that often compare a new product with others already on the market. This can involve a single piece of research in one country or multiple countries.

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 and 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 of 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 the 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 paragraphs. 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 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 With reference to a specific product, describe how it has developed and improved over a period of time through changes in its design, developments in materials and manufacturing methods.

Changes in design
- Comparisons with past products
- Where are the improvements over a period of time
- New opportunities for designers and manufacturers

Developments in materials
- The development of SMART materials.
- Composites used in specific products.
- Characteristics and benefits of new materials.
- The discovery and development of new and improved materials.

Manufacturing methods
- Relates to efficient methods of forming materials and producing improved products
- Comparisons with past products – where are the improvements?
- Particular uses of new materials, forming and manufacturing methods used

Note: Look for reference to all three areas. **[30]**

Q.10 Discuss how the use of a specific modern material has influenced both the design and manufacture of named products.

Named modern material and its influence on the development of a new product or products:

(a) Influence on Design

Improvement aesthetically – Aesthetic appeal – particular market (who does it appeal to), colour, shape, form.
Improvement functionally - (Strength, weight, durability). Its development over a period of time through new and improved materials. Can also include its performance – in use, in the market place (fitness for purpose) working correctly. Product price – target (therefore fit for purpose of selling into a market) set correctly.

(b) Influence in Manufacture

Manufacturing process – Named modern material and its ability to be formed easily (responses may include a description of the manufacturing process relevant to the named material). **[30]**

Note: Look for reference to named products as exemplars.

Q.11 ***'Design is not just what something looks like and feels like. Design is how it works.'***

Discuss this statement in relation to a number of products in everyday use.

The specific function (how it works) of a product in everyday use:

Simplicity in use:

- What is the function and purpose of the product?
- What materials are used to make the product?
- How well does the product do its job compared with other similar products?
- If two or more products are similar and do the same sort of job, what are their unique points?
- Analysing different aspects such as needs, trends, materials etc.

Responses may refer to:

- Different parts of the product and how do they work together?
- Which processes were used to make the product?
- Who would buy this product? **[30]**

GCE DESIGN AND TECHNOLOGY

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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 Describe in detail, using diagrams if appropriate, a mechanical process of permanently joining two similar materials. [8]

Joining steel sheet by riveting giving full description of the preparation of the joint, marking out and drilling, type of rivet used, and the tools and processes used to form the joint.
A **snap fastener** (also called **press stud**) is a pair of interlocking discs commonly used in place of buttons to fasten clothing. A circular lip under one disc fits into a groove on the top of the other, holding them fast until a certain amount of force is applied. Snap fasteners are often used in children's clothing, as they are relatively easy for children to use.

Snaps can be attached to fabric by hammering (using a specific punch and die set), plying, or sewing. For plying snap fasteners, there are special snap pliers.

Q.2 Explain how CAD (Computer Aided Design) has influenced the development of concurrent engineering for high volume product manufacturers. [8]

Explanation of how CAD has influenced concurrent engineering with drawings produced accurately that can be easily edited and dimensioned. Also include any example of solid modelling software and FEM. FEM (**finite element method)** is a powerful design tool that has significantly improved both the standard of engineering designs and the methodology of the design process in many industrial applications. The introduction of FEM has substantially decreased the time to take products from concept to the production line. It is primarily through improved initial prototype designs using FEM that testing and development have been accelerated. In summary, benefits of FEM include increased accuracy, enhanced design and better insight into critical design parameters, virtual prototyping, fewer hardware prototypes, a faster and less expensive design cycle, increased productivity, and increased revenue.

These drawings can then be exchanged to a number of design teams globally through secure vaults where other design developments can also be seen and the part that is being designed can be placed in context with all other components.

Global mark of eight marks for similar responses.

Q.3 The mobile phone and iPad have been subject to technology push and market pull forces in their product evolution.

Explain how a different named product of your choice has been affected by these forces. [8]

Description of market pull and technology push models of innovation as they have influenced a named product excepting the mobile phone named in the question. e.g. Thermo chromic kettle.

The use of thermo chromic materials has been the technology push factor in the development of these products. Turning increasingly more luminous red, the intelligent teapot keeps its user informed and alert during the entire course of water boiling. Useful as green tea for example requires a lower water temperature of 150-160 degrees Fahrenheit so as not to ruin the delicate infusion, while black and most herbal teas call for boiling water to unleash their essence.

In an act of precision, the ultra-stylish Creative tea Kettle employs thermo chromic technology in its paint to embrace some temperature sensitivity.

Yet preceding this market pull forces ensured that the kettle was eco-friendly when boiling water, that there was a thermostatic cut off switch.

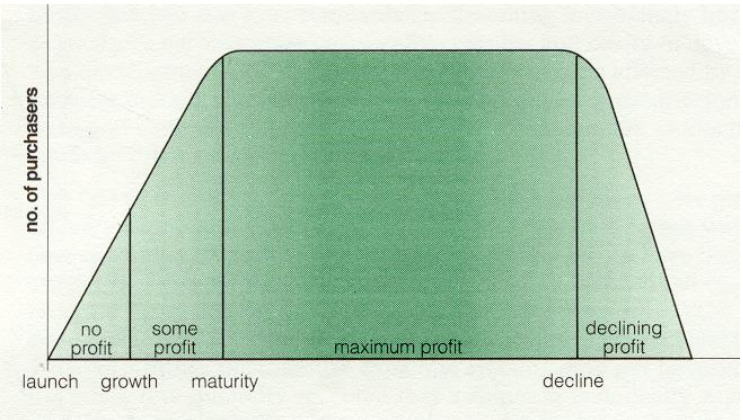
Q.4 (a) Explain the product life cycle using diagrams where relevant. [4]

Essential features must include:
Product launch characterised by slow growth of sales as the product is launched on the market. The company incurs large costs with advertising and promotion considerations.

Growth of the product then follows depending on impact on target audience, and the 4 Ps, and there is a steady rise in growth.

Maturity where sales are at their maximum level and profits remain stable.

Decline where sales and profit begin to drop off. At this point the company has to decide whether to inject incremental improvements to boost sales or to allow the decline to continue with the implications of ending production. If the candidate has decided to draw a labelled diagram for part (a), the shape is not critical (though labelling will be), i.e. it need not have a large plateau.



Product Life Cycle

4 Marks

Part (a) asks for a diagram, but if the candidate has drawn a diagram in (a) and then refers to this for part (b), credit should be given as appropriate. If the candidate has produced a *flow diagram* with accurate descriptions, allow the full mark range.

(b) Describe the product life cycle features of a fad product. [4]

Fad product will have a steep curve after launch requiring a great deal of advertising and promotion. It is essential to maximise sales in a very short time because these sales are limited by market factors e.g. niche market, small target audience, short-term impact. Decline will then happen very soon after the maximum sales of the product have been achieved. Very little extension to the maturity point.

Q.5 Radical improvements can take place in a product during its lifetime.

Identify a radical improvement that has been made to four different products and explain how each change has contributed to the improvement of the product. [2 x 4]

Award one mark for identifying the radical improvement and one mark for a brief description of how the radical improvement contributes to the overall product improvement.

Dual cyclone in the vacuum machine by James Dyson increasing suction to enable more efficient product use and dispensing with the need for duct bags.

Flat screen television using plasma or LED screens. This has enabled the development of high definition pictures that would not have been possible using previous television technologies.

Wi-fi technology used in laptops enabling internet access remotely. **Wi-Fi** is a popular technology that allows an electronic device to exchange data or connect to the internet wirelessly using radio waves.

Many devices can use Wi-Fi, e.g. personal computers, video-game consoles, smartphones, some digital cameras, tablet computers and digital audio players. These can connect to a network resource such as the internet via a wireless network access point. Such an access point (or hotspot) has a range of about 20 meters (65 feet) indoors and a greater range outdoors. Hotspot coverage can comprise an area as small as a single room with walls that block radio waves, or as large as many square miles achieved by using multiple overlapping access points.

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 Explain why material selection is important to the success of products. [8]

Issues of material selection relating to the Product's life and build quality also the function and aesthetics of the product. The suitability of the material to be formed or moulded using appropriate manufacturing processes.

e.g. European Oak for furniture directed at a particular target market where affordability is secondary to build quality and aesthetics. Oak is a hardwearing material which will last a considerable length of time. Also the material has the ability to take a range of stains that enhance the material's aesthetic appeal, it is a dense wood which machines well and is able to be easily finished by hand or machine.

Q.7 (a) Describe what you understand by the term Quality Assurance. [4]

Quality assurance (**QA**) refers to the systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled. It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention. This can be contrasted with quality control, which is focused on process outputs.

Two principles included in QA are: "Fit for purpose", the product should be suitable for the intended purpose; and "Right first time", mistakes should be eliminated. QA includes management of the quality of raw materials, assemblies, products and components, services related to production, and management, production and inspection processes.

Suitable quality is determined by product users, clients or customers, not by society in general. It is not related to cost and adjectives or descriptors such "high" and "poor" are not applicable.

For example, a low priced product may be viewed as having high quality because it is disposable where another may be viewed as having poor quality because it is not disposable.

(b) How does Quality Assurance impact on the production of products? [4]

Customers recognize that quality is an important attribute in products and services. Suppliers recognize that quality can be an important differentiator between their own products and those of competitors (quality differentiation is also called the quality gap). In the past two decades this quality gap has been greatly reduced between competitive products and services. This is partly due to the outsourcing of manufacture to countries like India and China, as well internationalization of trade and competition. These countries amongst many others have raised their own standards of quality in order to meet International standards and customer demands. The ISO 9000 series of standards are probably the best known International standards for quality management.

Q.8 Describe the physical properties and working characteristics of two man-made materials that you have used in your course of study. 2 x [4]

Material
Physical properties.
That is their physical and chemical composition, classification, material indices, giving statistical analysis into the data for allowable values for properties on which design can be based. These can be easily pinned down and are identified by classification into such groups as malleable, flexible, stiff, density, etc.

Material
Characteristics
The characteristics of materials are somewhat more subjective nature such as the aesthetic appeal of a material, the way that a material interacts with the senses, is it cold, hard or is it warm and soft to the touch. These are more ethereal values of materials that are nonetheless crucial to designers when selecting the most appropriate material for a particular function. How well does a material perform a particular function as a component within a product?

Q.9 Discuss what you understand by the term Intellectual Property. [8]

Intellectual property (IP) is any form of original creation that can be bought or sold - from music to machinery. The four main types of IP rights are patents, trademarks, designs and copyright but there are many other ways to protect a product's Intellectual Property**.**

It would be difficult to copy the process, construction or formulation from the product itself, a trade secret may give the protection that a product needs. The designer could file for a Patent which would start to protect the technology from competitors. There must be no disclosure of the product before it is filed with the Patent Office.

Design or Artistic Creation If the design of your product is unique and makes you stand out from your competitors then consider design registration. Original, creative and artistic works are automatically covered by copyright.

Q.10 Explain why extensive research is a significant factor to achieving a successful design outcome. [8]

Research is the aspect of investigating knowledge and concepts which may be keys to unlocking a problem. It may be undertaken at several points in the design cycle but essentially it is undertaken when design activity is in a divergent mode. The gathering of relevant research material ensures a pool of knowledge which can be drawn upon to help achieve an optimum solution to a design problem. The greater the extent of relevant knowledge by focused research the more likely it is that the designer will be able to refine the solution to the problem.

SECTION C

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

Your answers 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 of 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 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 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 are 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.11 Identify a specific product, or range of products, and give a detailed account of the changes in design, function and the styling of the product by a product designer/s from the 1970s onward. [26]

The answer should seek to identify a specific product or range of products and to examine their functional development brought about by a specific designer. The candidate should go on to examine styling details and their development and comment upon the styling developments and how they have impacted on the overall design of the product.

Q.12 Identify the properties of two specific named materials that have been used in the manufacture of a specific product and describe how their selection has impacted upon the manufacture and performance of the product.

Identification of the two materials with particular references made to their physical properties. There should be a detailed description of how these properties have resulted in an improved performance of the actual product together with their impact on the manufacture and performance of the product. **[26]**

Q.13 'Packaging is a reflection of our consumer society and to a large extent it has shaped the world we live in."
***Why shrink wrap a cucumber* – Miller and Aldridge – Laurence King - 2012**

Discuss the benefits and limitations of packaging products. [26]

Packaging is the technology of enclosing or protecting products for distribution, storage, sale, and use. Packaging also refers to the process of design, evaluation, and production of packages. Packaging can be described as a coordinated system of preparing goods for transport, warehousing, logistics, sale, and end use. Packaging contains, protects, preserves, transports, informs, and sells.

Packaging and package labeling have several benefits:

Physical protection – The objects enclosed in the package may require protection from, among other things, mechanical shock, vibration, electrostatic discharge, compression, temperature, etc.

Barrier protection – A barrier from oxygen, water vapor, dust, etc., is often required. Permeation is a critical factor in design. Some packages contain desiccants or oxygen absorbers to help extend shelf life. Modified atmospheres or controlled atmospheres are also maintained in some food packages. Keeping the contents clean, fresh, sterile and safe for the intended shelf life is a primary function.

Containment– Small objects are typically grouped together in one package for reasons of efficiency. For example, a single box of 1000 pencils requires less physical handling than 1000 single pencils. Liquids, powders, and granular materials need containment.

Information transmission – Packages communicate how to use, transport, recycle, or dispose of the package or product. With pharmaceuticals, food, medical and chemical products, some types of information are required by governments. Some packages and labels also are used for track and trace purposes.

Marketing – The packaging can be used by marketers to encourage potential buyers to purchase the product. Package graphic design and physical design have been important and constantly evolving phenomenon for several decades. Marketing communications and graphic design are applied to the surface of the package and (in many cases) the point of sale display.

Security – Packaging can play an important role in reducing the security risks of shipment. Packages can be made with improved tamper resistance to deter tampering and also can have tamper-evident features to help indicate tampering.

Anti-counterfeiting Packaging - Packages can be engineered to help reduce the risks of package pilferage or the theft and resale of products: Some package constructions are more resistant to pilferage and some have pilfered indicating seals. Counterfeit consumer goods, unauthorized sales (diversion), material substitution and tampering can all be prevented with these anti-counterfeiting technologies. Packages may include authentication seals and use security printing to help indicate that the package and contents are not counterfeit. Packages also can include anti-theft devices, such as dye-packs, RFID tags, or electronic article surveillance tags that can be activated or detected by devices at exit points and require specialized tools to deactivate. Using packaging in this way is a means of loss prevention.

Convenience – Packages can have features that add convenience in distribution, handling, stacking, display, sale, opening, reclosing, use, dispensing, reuse, recycling, and ease of disposal.

Portion control – Single serving or single dosage packaging has a precise amount of contents to control usage. Bulk commodities (such as salt) can be divided into packages that are a more suitable size for individual households. It is also aids the control of inventory: selling sealed one-liter-bottles of milk, rather than having people bring their own bottles to fill themselves.

Packaging limitations could include catering for the following:

Package development involves considerations for sustainability, environmental responsibility, and applicable environmental and recycling regulations. It may involve a life cycle assessment which considers the material and energy inputs and outputs to the package, the packaged product (contents), the packaging process, the logistics system, waste management, etc. It is necessary to know the relevant regulatory requirements for point of manufacture, sale, and use.

The traditional “Three R’s” of reduce; reuse, and recycle are part of a waste hierarchy which may be considered in product and package development.

Prevention – Waste prevention is a primary goal. Packaging should be used only where needed. Proper packaging can also help prevent waste. Packaging plays an important part in preventing loss or damage to the packaged-product (contents). Usually, the energy content and material usage of the product being packaged are much greater than that of the package. A vital function of the package is to protect the product for its intended use: if the product is damaged or degraded, its entire energy and material content may be lost.

Minimization –The mass and volume of packaging (per unit of contents) can be measured and used as one of the criteria to minimize during the package design process. Usually “reduced” packaging also helps minimize costs. Packaging engineers continue to work toward reduced packaging.

Reuse – The reuse of a package or component for other purposes is encouraged. Returnable packaging has long been useful (and economically viable) for closed loop logistics systems. Inspection, cleaning and repair are often needed. Some manufacturers re-use the packaging of the incoming parts for a product, either as packaging for the outgoing product or as part of the product itself.

Recycling – Recycling is the reprocessing of materials (pre- and post-consumer) into new products. Emphasis is focused on recycling the largest primary components of a package: steel, aluminum, papers, plastics, etc. Small components can be chosen which are not difficult to separate and do not contaminate recycling operations. Packages can sometimes be designed to separate components to better facilitate recycling.

Energy recovery – Waste-to-energy and Refuse-derived fuel in approved facilities are able to make use of the heat available from the packaging components.

Disposal – Incineration and placement in a sanitary landfill are needed for some materials. Certain states within the US regulate packages for toxic contents, which have the potential to contaminate emissions and ash from incineration and leachate from landfill.

Development of sustainable packaging is an area of considerable interest by standards organisations, government, consumers, packagers, and retailers.

Q.14 Explain, in detail, the importance of specific features of a *design process* that may be used to design innovative and creative products. [26]

Explain the aspects of the design process such as:

- Problem analysis
- Problem Investigation
- Research and Reflection
- Generating innovative and creative ideas
- Detail Designing
- Communication skills
- Planning for manufacture

Q.15 "People will say nice things rather than be too critical. Also, we tend to edit out the bad so that we hear only what we want to hear...If instead of seeking approval, you ask, What's wrong with it? How can I make it better? You are more likely to get a truthful, critical answer."

Paul Arden Creative Director Saatchi and Saatchi.

Evaluate how this quotation resonates with the creative and innovative activities of designing and making products. [26]

Reasoned discussion around the successes and failures within design methodology and how designers learn from mistakes. Designing being an iterative process that is always probing for strengths and weaknesses of design ideas.

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