OCR
Oxford Cambridge and RSA

Cambridge National

Engineering

Unit **R105:** Design briefs, design specifications and user requirements

Level 1/2 Cambridge National Award/Certificate in Engineering Design
J831/J841

Mark Scheme for June 2016

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Question			Answer/Indicative content	Mark	Guidance
1	(a)	(i)	One mark for each phase of the design cycle listed in the correct order Phase 1 identify phase Phase 2 **design phase** Phase 3 **optimise phase** Phase 4 **validate phase**	3	Do **not** credit Phase 1 – this answer is given in the question.
		(ii)	One mark awarded for **each** point added to complete the statement. During the identify stage of the design cycle designers will firstly discuss and create a design **brief** with the client. They will then carry out **research** to assess the needs of the user.	2	Accept reference to types of research as this works in the context of the answer e.g. Questionnaire, product analysis etc.

Question			Answer/Indicative content	Mark	Guidance
	(b)	(i)	One mark awarded for **each** valid point: • Testing (1) • Checking the design works (1) • Review of the product (1) • Evaluate (1) • Check against the specification (1)	**1**	
		(ii)	One mark awarded for **each** valid factor: • The choice of material (1) • The manufacturing process (1) • Scale of production (1) • Tooling costs (1) • The timescale (1) • The complexity of the designs shape (1) • The components required (1) • The needs / requirements of the market / customers (1) • The implications of where it is made (1) • Energy requirements (1) • Achieving the requirements of standards(1) • Availability of material (1) • The amount of research and development required (1)	**2**	Accept other feasible and valid response References to issues with the design following its creation e.g. Errors are not accepted

Question			Answer/Indicative content	Mark	Guidance
	(c)		One mark awarded for **each** valid reason: Many designers use the design cycle because it ensures the design can be checked at each stage (1). It allows the designer and client to discuss the design at regular intervals (1). The design cycle can save costs as development takes place in stages, reducing costly unnecessary investment in prototypes too early. (1) It also provides a consistent developmental approach that builds in complexity (1) Organised system /process (1) that allows each stage to be reviewed. (1)	**2**	Accept other feasible and valid response

Question			Answer/Indicative content	Mark	Guidance

2	(a)		One mark awarded for **each** valid requirement:
			
			• Manufacturing considerations
			• Production costs
			• Regulations and safeguards
			• Material specification
			• Sustainability.
			
			Manufacturing considerations
			• materials availability/supply chain
			• ease of manufacture
			  ○ standard components
			  ○ pre-manufactured components
			  ○ design for manufacturing assembly (DFMA)
			  ○ design for disassembly
			  ○ manufacturing processes
			• scale of production
			  ○ prototyping
			  ○ one off, batch, mass production
			• durability and reliability
			• tolerances
			• product safety
			• suatainability
			• maintenance
			
			Production costs
			Regulations and safeguards
			• copyright
			• patents
			• registered designs
			• trademarks
			• British Standards
			European conformity (EC)
				2	**Do not accept 'easy to use.'**
					
					Do **not** accept a repeat of '**User needs'** or' '**Product requirements'**
					
					Accept sub-categories listed below:
					• aesthetics
					• ergonomics
					• anthropometrics
					• benefits and features
					• product safety
					• function
					• features
					• performance
					• target group/intended users
					• working environment
					• limitations and constraints, size, weight, functional limitations
					• appearance
					• ergonomics
					• lifecycle

Question			Answer/Indicative content	Mark	Guidance
	(b)		One mark awarded for **each** valid product requirement • function – the scissors must be able to cut paper and other materials (1) • features – scissors should include long sharp blades (1) and comfortable ergonomic handles / grip (1) • performance – the blades should remain sharp even with consistent use (1) • target group/intended users – the scissors should be able to be used by a range of users (1) • working environment – must be resistant to liquids and corrosion (1) • limitations and constraints, size, weight, functional limitations – should be lightweight but durable (1) • appearance – should be highly polished with a smooth finish on the handles (1) • ergonomics - should be comfortable to hold (1) / be able to be used for extended periods (1) / have a comfortable grip (1) / be available in left and right handed versions (1) • lifecycle – should be recyclable at the end of its life (1) / should be able to be disassembled (1)	**2**	Accept other valid or feasible responses. Award only one mark for duplication of the same answer with different terminology e.g. comfortable to use, ergonomic for the user, safe to store when not in use. Do not accept single word responses such as 'ergonomics' or 'aesthetics' or 'safety'.
	(c)		Up to **two** marks for a clear explanation ***BSI Kitemark™*** or ***Kitemark*** shows that the product has been **tested/checked** (1) against particular product standards/requirements and has been found to **meet the standards**. (1) The Kitemark means BSI has independently tested it (1) and has confirmed that the product conforms to the relevant British Standard, (1)	**2**	Do not accept answers related to an ability to be sold.

Question			Answer/Indicative content	Mark	Guidance
			Manufacturers pay for the BSI service. (1) Their product is tested, (1) and the manufacturing process is assessed, at regular intervals. (1) The Kitemark is the symbol that gives consumers the assurance (1) that the product they have bought really does conform to the appropriate British Standard (1) and should therefore be safe and reliable. (1) Manufacturers are not legally required to display a Kitemark on their products, (1) but many everyday products and appliances such as fridges, electrical plugs and crash helmets have them. (1)		
	(d)		Up to **two** marks awarded for accurate identification of the symbols • Symbol 1 – Copyright (1) • Symbol 2 – Trademark (1)	**2**	
	(e)		Up to **two** marks for a clear explanation • A company would use a patent to protect an invention (1). This would stop other companies from making, selling, or importing the invention without the company's permission. (1) • A patent stops other companies copying an invention (1) as it allows for legal action to be taken. (1) • Patents can be granted for inventions, (1) they are expensive to gain (1) but give the company protection, (1) through legal action, (1) from other companies who might try to copy / use the invention without permission. (1) • After time the patent expires (1)	**2**	Accept reference to 'stops other companies copying / stealing designs'

Question			Answer/Indicative content	Mark	Guidance
3	(a)		One mark awarded for **each** valid reason • Material E is extremely lightweight which is important in racing car applications (1) • Material E has a high strength score which is an important characteristic for safety in motorsport applications (1) • The material has high strength and is lightweight but is relatively expensive in comparison with its competitors. This might limit its selection outside of high-end applications such as motorsport. (1)	**2**	
	(b)		Up to **two** marks for a clear explanation • Availability of a material is important when mass producing a product as disruption to supply may cause production to slow down or stop (1) resulting in orders not being met. (1) • Companies would want to select a material that is readily available as this can be bought in large quantities, (1) allowing mass production to take place and possibly reducing the cost of material due to bulk buying of stock. (1) • Readily available material for mass production could mean regular deliveries can be made (1) allowing Just-In-Time systems to be operated (1) reducing stock /inventory. (1)	**2**	Accept other feasible and valid response

Question			Answer/Indicative content	Mark	Guidance
	(c)		Up to **four** marks for a valid manufacturing consideration. • The frying pan is cast so therefore has thin, consistent wall thickness. (1) • The edges of the pan have all been rounded / filleted to accommodate material flow. (1) • The sides of the main body of the pan are tapered allowing for easy removal from the die / mould (1) • Does not require any additional finishing (1) • Single-piece moulding (1) • Cast iron is easily cast into complex shapes (1) • Cast iron is durable (1) • Cast iron can cope with hot temperatures (1) • Cast iron is strong and heavy (1) • Cast iron is suitable for heavy based cooking products (1) • Cast iron is a readily available material (1) • Can be melted down and recycled at the end of its life (1)	**4**	Accept any other feasible and valid response.

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Mark</th><th>Guidance</th></tr>
<tr><td></td><td>(d)</td><td></td><td>One mark awarded for each link made

<table>
<tr><th>Scale of production</th><th>Example</th></tr>
<tr><td>Batch production</td><td> 
Bread</td></tr>
<tr><td>Mass Production</td><td> 
Nuts and bolts</td></tr>
<tr><td>One-off production</td><td> 
Sport stadium</td></tr>
</table></td><td>2</td><td>Award one mark for each correctly drawn line shown.

Do not award one-off production drawn to the sports stadium as is given in the question.</td></tr>
</table>

Question			Answer/Indicative content	Mark	Guidance
4	(a)		One mark awarded for **each** valid factor e.g. • Source of material used in the product (1) • Can the product be made from recycled materials (1) • Can the materials be recycled / reused /biodegradable at the end of use (1) • How much energy is used in the disassembly / processing of materials (1) • Expected life span of the product (1) • Ease of disassembly (1) • Product labeling (1) • No toxic/hazardous materials used in the design (1)	**2**	Accept any other feasible and valid response
	(b)		Up to **two** marks for a clear explanation • The use/ consumption of a resource (1) faster than it can be replaced or replenished. (1) • The consumption of non-renewable resources such as fossil fuels (1) that are used at a rate faster than they can be replenished. (1) • The consumption of natural resources (1) both renewable or non-renewable at a rate faster than they are replenished. (1)	**2**	
	(c)		Up to **three** marks for a clear explanation • Designers may consider the use of natural materials that can be replenished (1). Natural materials that avoid the use of non-renewable resources (1) such as oil for plastic could be avoided. (1) • Designers could consider the power-source required to power the product. (1) For example, the use of regenerative braking systems in cars to replenish battery power (1) or the development of electric cars, avoiding the use of fossil fuels. (1)	**3**	Accept other feasible and valid explanations.

Question			Answer/Indicative content	Mark	Guidance
			• Designers may consider DFMA to ensure the processes used are as energy efficient as possible. (1) Designers may ensure that production facilities are powered using renewable energy sources (1) and optimise designs to use the minimal amount of energy or material (1). • Designers could optimise the weight / size / packaging space of products (1) to optimise transportation of the product (1) and reduce the resources required to transport the goods (1) • Designers may consider the use of recyclable/reusable materials (1)		
	(d)		Up to **three** marks for a clear explanation • The complete period of time that a product would exist from conception to end of life. (1) Within this, the designer / manufacturer considers the impact of all areas of its creation (1) from source of materials, (1) energy consumption (1) and the products use during operation (1) and its disassembly disposal. (1) • Considers where materials are sourced from, (1) their energy used in their production and the energy used by the product throughout its use. (1) • Consider the maintenance / repair of a product throughout its life (1) including its ease of disassembly (1) to assist repair and disposal / recycling. (1) • The end of the products life would be considered, focusing on disassembly (1) recycling (1) reuse (1) • The carbon footprint (1) of the component is considered throughout design, production (1) use and end of life. (1)	**3**	Accept other feasible and valid responses

Question			Answer/Indicative content	Mark	Guidance
5	(a)		One mark awarded for **each** valid point e.g. • Bearings used in power transmission • Gears used in drive mechanism • Bushes used in electric motors • Fuses used in electrical applications • Zips in clothing	2	Accept other valid examples
	(b)		Up to **two** marks for two advantages e.g. • No specialist tools required • Easily replaceable • Readily available • No specialist skills required • Can be disassembled and reassembled • Cost is cheaper should they need replacing	2	Accept other valid responses 'Cheap'/ 'Cheaper' must be qualified.
	(c)		Up to **two** marks for a clear explanation. • The tolerance in the dimension shown is the ± 0.3**.** (1) This means that the 11.5 diameter dimension can be 0.3 bigger or smaller but no more. (1) This would mean a maximum dimension after manufacture of 11.8 (1) and a smallest allowable dimension of 11.2. (1)	2	

Question			Answer/Indicative content	Mark	Guidance
	(d)		Up to **four** marks for a clear explanation. Creating components to absolute dimensions costs too much money. (1) This is because there is an inherent variation in manufacturing processes (1) so designers have to consider this when dimensioning critical features appropriately (1). Within the inherent variation there is always an acceptable compromise (1) that can optimise a component's production cost (1). This is the acceptable tolerance (1) of the component possible for the application and the capability of the manufacturing process and expected cost. (1).	**4**	

Question			Answer/Indicative content	Mark	Guidance
6	(a)		One mark awarded for each accurate definition. Designing products that consider how humans interact with them (1). This ensures that products 'fit' the user (1) and therefore the user can effectively interact with the product (1).	2	
	(b)		One mark awarded for each ergonomic factor.e.g. • Size of the remote control (1) • Weight of the remote control (1) • Fits in the hand (1) • Button positioning logically laid out. (1) • Circumference / external dimensions of the remote control (1) • Casing should have tactile feel (1) • Buttons should be clearly visible / easily readable (1)	2	Accept any other valid examples and products Do not accept the simple statement "easy to use".
	(c)		Award up to six marks for a discussion of the impact which improvements in materials and production processes can have on the development of a new product. **Level 3 (5–6 Marks)** Learners provide a thorough discussion of ways ergonomics and anthropometrics are considered when designing new products. They show a clear understanding of the required question material. Specialist language and terms would be used in the appropriate areas being discussed and the required information will be well structured in its presentation. Good examples used to justify the consideration of ergonomics and anthropometrics in design. Learners will demonstrate an accurate level of spelling, punctuation and grammar.	6	Examples and relevant points could include. Ergonomics: • Designers consider ergonomics when designing new products to ensure that the user can easily, use and access the functions of a given product. • Designers constantly refine products to optimise them for use by humans. • Ergonomics considers a multitude of human factors including height, weight and proportions. Ergonomics can also consider factors such as hearing, sight, temperature and touch. • Nearly all products consider ergonomics in their design. Any product that needs to be held or contains buttons or switches need to be designed in such a way that they can be easily picked up or pressed, are comfortable to hold and are not to heavy or cumbersome.

Question			Answer/Indicative content	Mark	Guidance
			Level 2 (3–4 Marks) Learners provide an adequate discussion which shows a reasonable level of understanding of the way ergonomics and anthropometrics are considered when designing new products. Some examples used to illustrate how ergonomics and anthropometrics are considered during the design of new products. Some evidence of the use of specialist language although not always in the appropriate areas being discussed. Information, for the most part, will be reasonably structured but may contain occasional errors in spelling, punctuation and grammar. **Level 1 (1–2 Marks)** Learners provide a basic discussion which shows some understanding of the question material but uses little or no specialist language. Few or no examples used to show understanding of the ways designers consider ergonomics and anthropometrics when designing new products. Answers may be ambiguous or disjointed. Contains obvious errors in spelling, punctuation and grammar 0 marks = no response or no response worthy of credit. Annotate as 'Seen' at end of the response.		• A poor ergonomic design can result in injuries such as repetitive strain injuries. Examples of this can be the design of office chairs where a poor ergonomic design can result in a series of injuries and strains for the user. • Designers must consider the ergonomic requirement of their target market. Ergonomics differ dependent on the type of individual e.g. an adult male, elderly lady or disabled user.

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