Cambridge National

Engineering

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

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

Mark Scheme for January 2017

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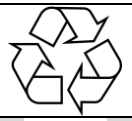
This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

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.

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Mark</th><th>Guidance</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>One mark for each correct statement given in the table.

<table>
<tr><th></th><th>Symbol</th><th>The symbol indicates:</th></tr>
<tr><td>1</td><td>  </td><td>That a product is made from recyclable material</td></tr>
<tr><td>2</td><td>  </td><td>That a product has been tested and proven to meet the recognised industry standard and is safe to use.</td></tr>
<tr><td>3</td><td> 
</td><td>That a product is not suitable for children under 3 years.</td></tr>
<tr><td>4</td><td>  </td><td>“Conformité Européene” – European Conformity mark</td></tr>
<tr><td>5</td><td>  </td><td>That a product is or may contain material that is flammable.</td></tr>
</table></td><td>4</td><td>Do not award symbol 2 as this is given in the question.

Accept reference to ‘European Standard) for answers related to the CE mark.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>One mark awarded for a valid reason.

• show the consumer that the product is fit for purpose / been approved / is to standard (1)
• show the consumer that the product has been appropriately tested (1)
• show the consumer that the product meets all appropriate regulation (1)
• alert the consumer to any potential hazards associated with the product (1)
• can inform the consumer about care, storage, maintenance and safe disposal of product (1)</td><td>1</td><td></td></tr>
</table>

Question			Answer/Indicative content	Mark	Guidance
	(b)		One mark for **each of two** valid responses e.g.: • Designers can test their products to ensure that they can function under their operating conditions. (1) • Designers can choose materials that are non-toxic (1) • Designers can ensure they do not use coatings that may be hazardous to the user (1) • Designers can ensure that products are suitable for the target user e.g. no small parts in products for young children / no sharp edges / poor conductor. (1) • Designers can error proof their designs to prevent misuse (1)	2	Accept other feasible and valid responses Do not award 'check they are safe.'
	(c)		Up to **three** marks for a clear explanation e.g.: • It is important for manufacturers to ensure products are safe so that their customers do not get injured when using the product. (1) If customers suffer an injury because of the product then the manufacturer would be liable (1) and face prosecution or trial. (1) • Manufacturers must ensure their products are safe because they have to meet regulations and standards for their product to be sold. (1) If their product does not meet the standards set by a country or standards body then they will not be able to be sold (1) affecting the reputation of the company. (1) • Manufacturers have a legally defined (1) duty of care to retailers and customers. (1) Products must be 'fit for purpose'. (1)	3	Accept other feasible and valid responses

Question			Answer/Indicative content	Mark	Guidance
2	(a)	(i)	One mark awarded for **each of two** valid responses e.g.: • The number of components has been kept to a minimum. (1) • Standard components have been used. (1) • The product is easy to assemble. (1) • The motor can be fixed easily first without obstruction prior to the outer casing being added. (1) • Standard tools can be used for assembly (1) • Motor / casing assembly can be turned through 180° and still be assembled (1)	2	Do not award reference to 'quick' or 'cheap'
		(ii)	Up to **three** marks for a clear explanation. • Design for manufacturing assembly (DFMA) is the consideration of the design of a component or product to optimise its manufacture or assembly. (1) The product geometry is designed in such a way that it can be manufactured efficiently by the given process. (1) Components have geometry that allows them to be assembled effectively without obstruction using the minimal amount of parts possible. (1)	3	Accept other feasible and valid responses Award one mark for reference to 'quicker, cheaper and easier.'
	(b)		One mark awarded for **each of two** valid responses. • Standard parts can be used (1) • Common tools can be used for disassembly (1) • Manufacturing processes keep different materials separable allowing for separation at the end of its life. (1) • Temporary fixings are used in assembly (1) • Avoidance of permanent fixings such as welding or gluing (1)	2	

Question			Answer/Indicative content	Mark	Guidance
	(c)		Up to **three** marks for a clear explanation e.g.: • Design for disassembly is important so that components and materials can be separated at the end of the products life. (1) This allows them to be reused or recycled (1) making the product more sustainable and better for the environment. (1) • Design for disassembly is important as this allows for maintenance to be carried out. (1) The life of the product can be extended if it can be maintained (1) with key components having the ability to replaced or repaired. (1)	3	

Question			Answer/Indicative content	Mark	Guidance
3	(a)	(i)	One mark awarded for correct definition • Market pull is when a product is designed and produced based on needs identified within the market (1)	1	
		(ii)	One mark awarded for correct definition • Technological push is when a new product is developed based on new technology without the current market existing. (1)	1	
	(b)		One mark awarded for **each of two** valid factors e.g.: • Fashion trends change creating a demand by consumers (1) • A problem or issue needs a solution therefore creating a demand (1) • Competitors releasing new products creating the need for a new product to maintain market share (1) • Issues with existing products create a need for a better solution (1) • Environmental pressures require the development of low-energy/environmentally friendly alternatives (1) • Cost of raw material / cost of living changes create a market for low-cost alternatives (1)	2	Accept other feasible and valid factors
	(c)		One mark awarded for **each of two** valid methods e.g.: • Focus groups (1) • Surveys (1) • Assessing existing products (1) • Review market / sales data (1) • Interviews with customers (1) • Monitoring of trends and fashions (1)	2	Accept other feasible and valid methods. Do not award marks for 'Research' 'Primary research', Secondary research'

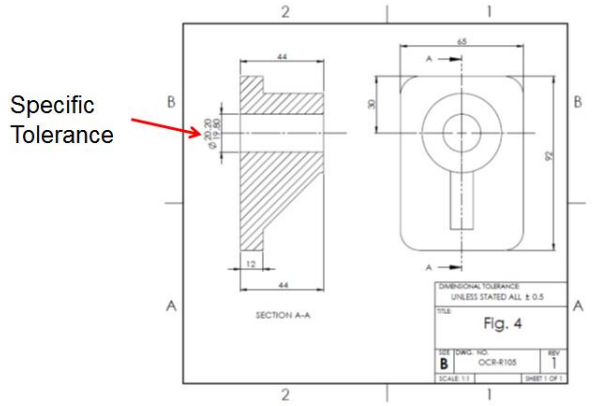
Question			Answer/Indicative content	Mark	Guidance
	(d)		Up to **four** marks for a description e.g.: • The designer would be provided with an initial design brief from the client (1), from this the designer will undertake a discussion with the client to identify what is possible within budget, timeframe and scope of the project. (1) Based on this a set of product requirements detailing each individual aspect of the component will be defined (1) which will be set out in specific categories such as user needs, manufacturing considerations and legislation that becomes the final design specification. (1)	4	Accept other feasible and valid responses

Question			Answer/Indicative content	Mark	Guidance
4	(a)	(i)	One mark for a correct definition • The study of the human body often related to measurement (1)	1	
		(ii)	One mark awarded for **each of two** valid considerations e.g.: • Length of the users legs are important to define pedal positions (1) • Length of users arms to define handle bar position (1) • Length of the users legs are important to define seat position (1) • Circumference of grip to define handle bar grip diameter (1) • Weight range of users to define the strength capability of components during operation (1) • Age range of target users to define overall bicycle geometry. (1)	2	Accept other feasible and valid considerations
	(b)		Up to **two** marks for a description e.g.: • The bicycle seat is adjustable (1) allowing for use by a range of different size users (1) • The positions of the seat, handle bars and pedals have all been optimised (1) to allow the user to sit comfortably on the bicycle (1) • The height of the bicycle from the ground has been set (1) so that it is easy to get on and off for users of varying heights (1) • The seat has been designed so that it follows the contours of the body (1) making it more comfortable to sit on (1) • The handle bars incorporate brake handles that are within easy reach (1) so that they can be operated without the need to remove hands from the bike (1)	2	Accept other feasible and valid responses

Question			Answer/Indicative content	Mark	Guidance
	(c)		One mark awarded for **each of two** valid responses e.g.: • Improve the rigidity of the bicycle (1) • Make the bicycle more lightweight (1) • Make the bicycle more stronger (1) • Improve durability / wear / abrasion on components making it more reliable (1) • Allow for the construction of more complex geometry (1), improving aerodynamics (1) • Allow for complex parts to be produced in one-piece (1) / reduce component numbers (1)	2	Award marks for appropriate, named modern material characteristics/properties. E.g. Carbon fibre is lightweight.
	(d)		Up to **three** marks for a clear explanation e.g.: • New production processes may allow complex geometries to be created in a single piece. (1) This improves the components structural integrity (1) and reduces the number of components required in assembly. (1) • New production processes may allow components to be produced accurately in very large quantities (1), this would allow products to be manufactured at a lower cost (1) reducing the unit price and helping sales. (1) • New production / assembly processes may use advanced adhesives to join components together (1) this can reduce the number of components in a design (1) reduce weight (1) and improve structural integrity (1) whilst reduces assembly time / complexity. (1)	3	

Question			Answer/Indicative content	Mark	Guidance
5	(a)	(i)	Up to **two** marks for two valid tests e.g.: • Operational test – check the volume of liquid/ice cube created (1) • Strength test (1) – subject the tray to an operational twist / bend load (1) • Temperature test – ensure the ice cube tray can withstand freezing temperatures / changes in temperature. (1)	2	Accept other valid methods
		(ii)	Up to **three** marks for a clear explanation e.g.: • Testing is important to ensure that the product is safe to put on sales. (1) This may involve testing for toxic materials or that the component does not break during operation (1). This will ensure the customer is not injured by the project. (1) • Testing is important when developing a new product as it ensures that it will function in the way it is intended. (1) If a product fails during operation then customers will be dissatisfied (1) and this may affect future sales. (1) • Testing is part of quality assurance processes within a business (1) that identifies whether a product is fir for purpose (1) and matches the design specification / brief set by the client before being put on sale. (1)	3	Accept other valid features

Question			Answer/Indicative content	Mark	Guidance
	(b)	**(i)**	One mark for **each of two** valid methods e.g.: • Design components so they only fit together one way (1) • Design the component so that it cannot be used in the wrong way (1) e.g. plug cannot be inserted incorrectly • Incorporate safety functions / switches to stop the product from functioning if used incorrectly (1) • Reduce the number of components to stop incorrect assembly (1) • Use visual indicators to highlight when a product is functioning incorrectly (1) or a component is being assembled incorrectly (1)	2	
		(ii)	Up to **three** marks for a clear explanation e.g.: • Error proofing ensures that products are manufactured / assembled without errors. (1) The design is produced in such a way that it cannot be misused / assembled incorrectly (1). This ensures safe use / easy assembly (1) • Error proofing ensures that users cannot operate the product in a way that it is not intended. (1) this ensures that accidents are avoided (1) and the product is safe in almost all situations (1). • Error proofing ensures that the product cannot be used by the consumer in the wrong way (1). This ensures that operation is simplified (1) making the product more accessible to a range of users. (1)	3	

Question			Answer/Indicative content	Mark	Guidance
6	(a)	(i)	One mark awarded for each correctly added label.  	1	Award marks where the candidate has clearly labelled the Specific tolerance.
		(ii)	Up to **three** marks for a clear explanation e.g.: • Engineering drawings may have a general tolerance to tell the manufacturer the accuracy required across all dimensions of the component (1). There may be some dimensions in this case that require a tighter tolerance (1) this will require a specific tolerance. (1) • Some dimensions on a component may not be as critical as others and therefore only require a general tolerance (1). There are others that may be locating features for other components that require tighter, specific tolerances (1). This helps to inform the manufacturer and balance production cost / time. (1) • Specific tolerances are concerned with location and fit: (1) they ensure that the product will assemble correctly (1) and function effectively. (1)	3	

Question			Answer/Indicative content	Mark	Guidance
			Guidance		**Answer/Indicative content**
	(b)		Award up to six marks for a discussion on how designers can influence final production costs when developing new products. **Level 3 (5–6 Marks)** Learners provide a thorough discussion of how designers can influence final production costs when developing 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 how designers can influence final production costs when developing new products. Learners will demonstrate an accurate level of spelling, punctuation and grammar. **Level 2 (3–4 Marks)** Learners provide an adequate discussion which shows a reasonable level of understanding of how designers can influence final production costs when developing new products. Some examples used to illustrate how designers can influence final production costs when developing 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 how designers can influence final	6	Examples and relevant points could include: • Designers can control production costs through the use of manufacturing processes that minimise the cost per component. • Designers can design components that have geometries that are suitable for the manufacturing process being used making tooling production easier and component manufacture more cost effective. • Designers can consider the amount of material required to manufacture a given component and try and minimise this reducing resourcing costs. • Designers can try to minimise the amount of components that are required within the assembly of the product which will reduce assembly and inventory costs. • Designers may use standard components within the design which are easily accessible, can be bought in bulk, are low cost and are easily to assemble. • Designers may use new assembly methods such as clip together fixings or adhesives that reduce the numbers of components required and improve ease of assembly reducing assembly time. • Components can be optimised to fit the manufacturing process which will allow them to be produced using standard tools and fixings reducing the need to develop bespoke tooling / processes during production. • Designers can use error proofing techniques in component design that remove errors and issues in assembly, improving quality, reducing defects and saving expensive rework costs. • Designers can consider the materials being used and utilise low-cost or readily available materials rather than more expensive, premium materials. • Production methods: use of materials, generation/disposal of waste: e.g. injection moulding versus vacuum forming, forging versus machining.

Question			Answer/Indicative content	Mark	Guidance
			production costs when developing 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.		• Tessellation and waste reduction. • Use of tolerances to reduce post production rejection. • Mould design with ribs, webs, thinning, hollows to use minimum material while still ensuring structural integrity of a '***strong enough for long enough'*** lightweight form.

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