



## **Cambridge National**

### **Science**

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

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

### **Mark Scheme for January 2015**

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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.

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Question		Answer	Marks	Guidance
1	(a)	<p>One mark for each correctly joined client requirement with suggested product feature.</p> <p>Must be easy to clean safely = Removable blade            Must be able to pour smoothie into glass = Detachable jug            Must remain stationary when working = Silicone feet pads            Must not allow user to touch blades when switched on = Interlocking lid cut-out</p> <p style="text-align: right;">(4x1)</p>	4	No marks for more than one line to one product feature
	(b)	<p>Up to two marks for points leading to a clear description related to food safety of the product.</p> <ul style="list-style-type: none"> <li>• Contamination of food</li> <li>• Risk of losing custom</li> <li>• health risk to customer</li> <li>• Legal duty of care to customers</li> <li>• Environmental health inspections</li> <li>• Loss of trading licence</li> <li>• Health and safety</li> <li>• 1 to 5 hygiene window sticker</li> </ul>	2	e.g. If customer gets food poisoning (1), they won't come back so custom lost (1)
	(c)	<p>One mark for identification of a valid of a feature and one mark for an improvement linked to the feature:</p> <ul style="list-style-type: none"> <li>• Quantity/volume of jug               <ul style="list-style-type: none"> <li>- improvements could be units/measurement on side of jug</li> <li>- increase size of the jug</li> <li>- make a bigger version of the smoothie maker</li> </ul> </li> <li>• Ease of cleaning the jug               <ul style="list-style-type: none"> <li>- change material to make cleaning easier</li> <li>- change shape to make access to clean easier</li> <li>- make dishwasher proof if not already</li> </ul> </li> <li>• Hard to tell when contents are blended</li> </ul>	2	<p>One mark awarded for a 'new' appropriate feature and one for an improvement or two marks for a justified improvement taken from a feature in 1a.</p> <p>Feature and improvements should be viable and feasible; where they are not = 'vague.' (VG)</p>

Question	Answer	Marks	Guidance
	<ul style="list-style-type: none"><li>- add auto timer</li><li>- include guidance on timing in instructions<ul style="list-style-type: none"><li>• Ease of movement of the smoothie maker</li></ul></li><li>- make lighter for easier movement</li><li>- make rubber pads less 'sticky'</li><li>- Ergonomics of the jug handle – rubber grips to help with safe movement<ul style="list-style-type: none"><li>• Removable blade</li></ul></li><li>- Interchangeable blades</li><li>- for blending various food types<ul style="list-style-type: none"><li>• Adjustable speed settings</li></ul></li><li>- Add an adjustable dial or multiple button speed settings<ul style="list-style-type: none"><li>• Timer setting</li></ul></li></ul>		

Question	Answer	Marks	Guidance
(d)	<p>One mark for each valid reason.</p> <ul style="list-style-type: none"> <li>• Target audience widened/reduced/changed</li> <li>• Budget change</li> <li>• Limitations by manufacturing/materials/availability</li> <li>• Market research/initial evidence</li> <li>• Influence of designer/engineer</li> <li>• Competitors current/future designs / Competitor arrives first to market /Market research identifies competitor products</li> <li>• Further refinement required to fully meet needs of user</li> <li>• Identification of new relevant information</li> <li>• Cost changes – fluctuation in price of components, materials</li> <li>• Change in client/user need or requirement – improvement to design</li> </ul> <p style="text-align: right;">(2x1)</p>	2	

Question		Answer	Marks	Guidance
2	(a)	<p>Up to four marks for valid ways in which the design of the multi gym could ensure that it is suitable for a range of users.</p> <ul style="list-style-type: none"> <li>- Adjustable weights</li> <li>- Strength for advanced/overweight persons</li> <li>- Adjustable seat position/ heights</li> <li>- Adjustable handlebars width</li> <li>- Range of weights for all abilities</li> <li>- colour coding easy identification</li> <li>- Angles of backrest to modify the impact of the exercise</li> </ul> <p style="text-align: right;">(4x1)</p>	4	The answers must be qualified with 'adjustable/range' which will make the particular feature suitable for different size/shape/ability of user.
	(b)	<p><b>Benefits</b></p> <ul style="list-style-type: none"> <li>- Wider target audience</li> <li>- Increase sales of multi gyms</li> <li>- Streamlined product range</li> <li>- Optimise production</li> <li>- Cost effective production</li> </ul> <p><b>Supporting description</b></p> <ul style="list-style-type: none"> <li>- Suit users of different heights &amp; sizes</li> <li>- Unisex/suitable for males and females</li> <li>- Can be adjusted for comfort (e.g. longer/shorter arm reach or more upright sitting position)</li> <li>- Suits children/young people as it can be adjusted as they grow</li> <li>- More flexibility could make it stand out against other products</li> <li>- can manufacture one product to meet the needs of multiple customers</li> <li>- Reduced product cost due to optimised production processes</li> </ul> <p style="text-align: right;">(2x1)</p>	2	One mark awarded for an identified benefit followed by any relevant supporting point to complete the description for the second mark.

Question		Answer	Marks	Guidance
(c)	(i)	<p>Up to two marks for a clear description.</p> <p>Identify phase</p> <ul style="list-style-type: none"> <li>- Discuss brief with client</li> <li>- Identify criteria and constraints</li> <li>- Carry out research</li> <li>- Identify user need</li> <li>- Explain and justify the demand</li> <li>- Consider existing products</li> </ul>	2	
	(ii)	<p>Up to two marks for a clear description.</p> <p>Design phase</p> <ul style="list-style-type: none"> <li>- Develop a design specification</li> <li>- Develop (a range of) design ideas/sketches</li> <li>- Present and justify final chosen design</li> <li>- Develop manufacturing/planning drawings</li> </ul>	2	Must be ideas/sketches - plural

Question			Answer	Marks	Guidance
3	a	(i)	<p>Appropriate appearance point relating to the design of an electric fan heater, e.g.</p> <p>The body of the fan heater will be an attractive colour (1) to integrate into the home/suit different tastes/matches other appliances (1)</p> <p>It is a compact unit and occupies a small footprint (1) /can be stored away more easily (1)</p> <p>Texture smooth(1) nice to touch whilst interacting with it(1)</p> <p>Shape of the body will be appealing (1) describe its style - sleek/modern/curved (1)</p> <p>Material is attractive (1) glossy finish/matt finish/ colour/smooth /textured (1)</p> <p>Appearance can effect sales of the product (1)</p> <p>Good quality materials used to improve appearance (1)</p>	2	<p>Simple answer 1 mark, qualified answer 2 marks</p> <p>Points relating to the five senses are creditable, i.e. 'people finding sound made by fan as soothing', 'smell of burning dust on heater makes user uncomfortable'.</p> <p>Appealing, attractive, aesthetically pleasing is too vague. Must be linked to a specific product attribute e.g. colour, style, shape or material</p> <p>Could be used as a justification for a number of other points</p>



Question	Answer	Marks	Guidance
	<p>(ii) Appropriate ergonomic point relating to the design of a fan heater, e.g.</p> <p>The fan heater will feature a handle (1) so that it can be carried/moved around comfortably (1)</p> <p>The fan heater will be as lightweight as (1) so that it is easy to move around (1)</p> <p>The fan heater will feature a dial for control(1) easy adjust on/off switch with hand (1)</p> <p>The fan heater will feature a dial for control(1) easy adjust heat settings with hand (1)</p> <p>Heat directed and diffused(1) comfortably heat without hotspot (1)</p>	2	Simple answer 1 mark, justified answer 2 marks

Question	Answer	Marks	Guidance
	<p>(iii) Appropriate life-cycle point relating to the design of a fan heater, e.g.</p> <p>At the end of the products life it can be recycled or reused (1)</p> <p>Component parts easily disassembled and recyclable (1) minimizing the impact on the environment at end of product life.(1)</p> <p>Use of standard components (1) to make production more energy/resource efficient (1)</p> <p>Design so that it can be repaired (1) so that replacing components can prolong overall product life (1)</p> <p>Minimum packaging will be used to package the fan heater (1) using less non-recyclable materials/creating less waste for disposal/making it lighter/smaller to transport. (1)</p> <p>The fan heater will transfer energy efficiently (1) it is cheaper so that it is more environmentally friendly. (1)</p>	2	<p>Simple answer 1 mark, qualified answer 2 marks</p> <p>One mark awarded for reference to recycle/reuse/sustainability etc... in general reference to the product.</p> <p>For two marks, the second mark needs to come from more specific reference to the design of the product</p>



Question	Answer	Marks	Guidance
b	<p>One mark for each valid reason.</p> <ul style="list-style-type: none"> <li>- not get electric shock when moving it around</li> <li>- not get burnt when touched</li> <li>- will not cause surrounding furniture any damage</li> <li>- when switched on, will not get burnt or receive electric shock</li> </ul> <p style="text-align: right;">(2x1)</p>	2	
c	<p>One mark for each example of how <b>performance</b> would be important.</p> <ul style="list-style-type: none"> <li>- needs to direct heat in the desired direction</li> <li>- noise made by fan heater should not be too loud</li> <li>- needs to be able to have different heat level settings</li> <li>- needs to be able to blow cold air/ without heat for summer months</li> <li>- needs to heat a given space</li> <li>- should be durable and withstand prolonged use</li> <li>- should be lightweight/portable</li> <li>- energy efficient</li> <li>- must not overheat if operated for a long period of time</li> <li>- filtered vents to stop dust being released/entering the fan</li> <li>- durable and efficient motors</li> </ul> <p style="text-align: right;">(2x1)</p>	2	<p>Do not accept 'keep you warm.'</p> <p>'Heat the room' is acceptable for one mark - BOD</p>

Question		Answer	Marks	Guidance
4	a	<p>One mark for correct identification of a feature.</p> <p>Security/tamper proof; fewer components - less money; fewer components required to fix part.</p>	1	<p>Do not accept 'cheap' on its own Cheap to <b>produce/manufacture</b> must be included</p>
	b	<p>Up to two marks for a clear description.</p> <ul style="list-style-type: none"> <li>- Speed of assembly</li> <li>- increased production output</li> <li>- reducing cost of making product</li> <li>- Easier assembly methods will be better to control quality</li> <li>- means no need for specialist skilled workers</li> </ul>	2	<p>Only award 1 mark where 2 credible answers given with limited description.</p> <p>Accept answers relevant to the ease of assembly for the end user</p>
	c	<p>Up to two marks for a clear explanation.</p> <p>Reduces time to take apart (1) which makes it easier to repair/replace damaged parts(1)</p> <p>Separation of materials made easy (1) so that parts can be recycled (1)</p>	2	
	d	<p>Up to two marks for a clear explanation.</p> <p>Easy to mould complex shapes (1) which makes manufacture less expensive (1)</p> <p>Can make large quantities of complex geometry (1) very quickly (1)</p> <p>The casing can be melted and reused through recycling (1) which is better for the environment (1)</p> <p>Easy to make and mould in any colour (1) no need for expensive paints (1)</p> <p>Plastics material provides better insulation properties (1) so no need to add an earth connection (1) □</p>	2	<p>Do not accept plastic is 'cheap' or 'cheaper' unless justified e.g. scale of production, or processes</p>

Question	Answer	Marks	Guidance
e	<p>Up to three marks for a clear explanation.</p> <p>Answers show understanding of higher set up costs, but cost savings through high volume production, e.g.</p> <p><b>Advantages:</b></p> <ul style="list-style-type: none"> <li>- Cost savings through high volume production</li> <li>- Lower unit cost achieved</li> <li>- Price of unit will be more competitive</li> <li>- Efficiency savings during long runs</li> <li>- Lower skilled labour used</li> </ul> <p><b>Disadvantages:</b></p> <ul style="list-style-type: none"> <li>- Higher set up costs</li> <li>- Increase labour and technical support</li> <li>- Machinery/moulds/specialist equipment</li> <li>- Accommodation area increase</li> <li>- Storage of materials/components/product</li> <li>- Quality issues in mass production possibly affecting large numbers of products rather than a single batch</li> </ul> <p style="text-align: right;">(3x1)</p>	3	

Question		Answer	Marks	Guidance
5	a	<p>Up to two marks from the list below.</p> <ul style="list-style-type: none"> <li>- Reduction of stock components need to be made or bought in</li> <li>- less mistakes made in production assembly due to one size used</li> <li>- Components can be made/purchased in volume Components available at reduced unit price</li> <li>- Made to very high guaranteed standard</li> <li>- Components are reliable and result in little waste or scrap after assembly</li> <li>- Reliable availability of parts, reduced risk of inability to source parts</li> </ul> <p style="text-align: right;">(2x1) □</p>	2	
	b	<p>Up to two marks for a clear description:</p> <p>Creating components to absolute dimensions would cost too much (1). The tolerance allows for acceptable variation (1) within which the item can be made for a reasonable cost and still work (1). Manufacturers can still have confidence that standard components will work/fit (1) as they know the acceptable tolerances worked to (1).</p>	2	Accept any combination of points which forms coherent description.

c	<p>Up to three marks</p> <p><b>Modern Materials:</b>  <b>Composites e.g. carbon fibre</b></p> <ul style="list-style-type: none"> <li>Carbon fibre has less weight and higher strength, energy savings and lower storage space</li> </ul> <p><b>Smart materials</b></p> <ul style="list-style-type: none"> <li>Smart materials which enable to add safety features to products, i.e. super elastic alloys, photochromic dyes, shape memory alloys, less components need in production</li> </ul> <p><b>Advanced metal alloys e.g. aerospace applications</b></p> <p><b>Environmentally safe materials e.g.</b></p> <ul style="list-style-type: none"> <li>Starch based polymers biodegradable and don't give off toxic fumes when burnt, makes manufacture more environmentally friendly</li> <li>Use of environmental safe materials that are biodegradable/easily recycled, giving production a lower carbon footprint</li> </ul> <p><b>Benefits –</b></p> <ul style="list-style-type: none"> <li>Properties e.g. strength, weight, ability to be formed/processed.</li> <li>Benefit to the product e.g. improved performance, ease of use, additional feature.</li> </ul> <p><b>Sustainable materials:</b>  <b>Biodegradable e.g. sustainable forest material</b>  <b>Starch based polymers</b>  <b>Low carbon production</b></p> <ul style="list-style-type: none"> <li>More sustainable materials may be chosen, instead of the cheapest</li> <li>Consumers may pay more for sustainably designed products</li> <li>Different material choices by producers</li> <li>Resource depletion may make it necessary to find other sustainable materials</li> <li>Using sustainable methods is good PR for companies which produce products</li> </ul>	3	<p>One mark awarded for identifying a material. Up to 2 marks for how it could benefit a product.</p> <p>One mark awarded for identifying a material. Up to 2 marks for how it could benefit a product.</p> <p>BOD if recycled 'non-sustainable' materials are listed e.g. recycled plastic/metal</p>
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Question		Answer	Marks	Guidance
6	a	<p>One mark for each correctly reason given.</p>  <ul style="list-style-type: none"> <li>• Meets British standards</li> <li>• Has been tested against nationally recognised standards</li> <li>• Ensures the product conforms to the relevant standard/quality</li> </ul>  <ul style="list-style-type: none"> <li>• meets the EU/European minimum requirements (to be allowed to be put on sale)</li> <li>• Tells the consumer that the manufacturer believes the product conforms to EU minimum requirement.</li> </ul> <p>(2x1)</p>	2	<p>One mark awarded for stating conformity to '<b>British</b>' standards</p> <p><b>DO NOT accept 'it is safe' for both answers.</b></p> <p>Only award marks once for simple response of 'meeting standards.'</p> <p>Question asks why each symbol would be important for the consumer; responses should therefore be with direct or implicit reference to the meaning of the symbol.</p> <p>BOD for stating European standards</p>



	b	<p>One mark for each valid reason.</p> <p>Successful designs are recognisable/have customer base and will sell Have generated successful revenue in the past Iconic designs have normally had a long period of success and represent good design Customers are interested and find retro design trendy</p> <p>(2x1)</p>	2	
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c	<p>Award up to six marks for a discussion of how the company presents a more responsible image by carrying out a Life Cycle Analysis.</p> <p><b>Level 3 (5–6 Marks)</b> Detailed discussion showing a clear understanding of how Life Cycle Analysis can be used by a company to present a more responsible image to customers.</p> <p>Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate can demonstrate the accurate use of spelling, punctuation and grammar.</p> <p><b>Level 2 (3–4 Marks)</b> Adequate discussion showing some understanding of how Life Cycle Analysis can be used by a company to present a more responsible image to customers.</p> <p>There will be some use of specialist terms, although these may not always be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, punctuation and grammar.</p> <p><b>Level 1 (1–2 Marks)</b> Basic discussion showing a limited understanding of Life Cycle Analysis; there may be some reference to LCA as carried out by a company to present a more responsible image to customers.</p> <p>There may be little or no specialist language. The information and structure will be limited. There will be obvious errors in spelling, punctuation and grammar.</p> <p>0 marks = no response or no response worthy of credit. Annotate as 'Seen' at end of the response.</p>	6	<p><b>Examples and relevant points could include:</b></p> <p>Materials:</p> <ul style="list-style-type: none"> <li>-Improved use of materials/ technologies/recyclable</li> <li>-Using sustainable materials</li> <li>-More sustainable materials may be chosen, instead of the cheapest</li> </ul> <p>Design:</p> <ul style="list-style-type: none"> <li>-Sustainable design means less waste from new materials and more use of recyclable components.</li> <li>-Sustainable design may lead to production efficiency, less pollution</li> </ul> <p>Production:</p> <ul style="list-style-type: none"> <li>-Time taken to prototype a product can be reduced by advances in modelling, production processes, and use of CAD modelling techniques</li> <li>-Use of improved production processes and new technologies to enable improved product features and functions, using technology in manufacture.</li> <li>-Lower waste, saving costs of waste management</li> </ul> <p>Energy:</p> <ul style="list-style-type: none"> <li>-More sustainable sources of energy could give the company a lower carbon footprint</li> <li>-Cleaner/alternative production processes will mean health environmental benefits to workers and community</li> </ul> <p>PR</p> <ul style="list-style-type: none"> <li>-Consumers may pay more for sustainably designed products</li> <li>-Manufacturer seeking alternatives to non-renewable materials, finding other sustainable materials give good public image</li> <li>-Using sustainable methods is good PR for companies which produce products</li> </ul>
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