



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 2018

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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.

© OCR 2018

1. These are the annotations, (including abbreviations), including those used in scoris, which are used when marking



Annotation	Meaning of annotation
	Blank page
	Vague
	Tick
	Noted but no credit given
	Unclear
	Repeat
	Benefit of doubt
	Cross
	Development
	Example/Reference
	Knowledge
	Level 1
	Level 2
	Level 3

Question			Answer/Indicative content		Guidance																		
1	(a)	(i)	<p>One mark awarded for each correctly identified component.</p> <table border="1"> <thead> <tr> <th></th> <th>Component image</th> <th>Component name</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td>Washer/spacer(s)</td> </tr> <tr> <td>2</td> <td></td> <td>M8 Hex Head Bolt</td> </tr> <tr> <td>3</td> <td></td> <td>Gear / cog(s)</td> </tr> <tr> <td>4</td> <td></td> <td>Self-locking nut / nut</td> </tr> <tr> <td>5</td> <td></td> <td>Bearing(s)</td> </tr> </tbody> </table>		Component image	Component name	1		Washer/spacer(s)	2		M8 Hex Head Bolt	3		Gear / cog(s)	4		Self-locking nut / nut	5		Bearing(s)	4	<p>Accept 'Ball bearing' or reference to other bearings.</p> <p>Accept 'nut.'</p> <p>Do not accept 'Piston rings'</p> <p>Accept reference to 'gear' even if specific gear type is incorrect.</p>
	Component image	Component name																					
1		Washer/spacer(s)																					
2		M8 Hex Head Bolt																					
3		Gear / cog(s)																					
4		Self-locking nut / nut																					
5		Bearing(s)																					
	(a)	(ii)	<p>One mark for a valid example of a standard component e.g.:</p>	1	Accept suitable alternative answers of standard components.																		

Question	Answer/Indicative content		Guidance
	<ul style="list-style-type: none"> • Screws (1) • Rivets (1) • Pins (1) • Hinges (1) • Metal profiles (1) • Springs (1) • Seals (1) • O-rings (1) • Bulbs (1) • Nails (1) • Fuse (1) 		<p>Do not accept answers already stated in part (i)</p> <p>Do not accept bolt or variation of bolt as this is stated in part (i).</p> <p>Do not allow pre-manufactured items.</p>
(b)	<p>Award one mark for each valid reason e.g.</p> <ul style="list-style-type: none"> • Guaranteed quality (1) • Less expensive to purchase / cheaper (1) • Compatible with standard tools / no specialist tools required (1) • Readily available / widely used / large quantities (1) • Easily replaceable (1) • Standards understood globally (1) 	2	<p>Accept suitable alternative answers.</p> <p>Do NOT accept 'they are easy to make/not complex to make.'</p> <p>Only award 'easier to understand' if qualified by 'global standards' / 'compatible with standard tooling' or similar</p>

Question		Answer/Indicative content		Guidance
	(c)	<p>Award up to three marks for an explanation e.g.:</p> <ul style="list-style-type: none"> Standard components can improve the sustainability of new products as they allow the product to be disassembled easily (1) at the end of its life, allowing materials / components to be separated (1) and recycled (1). Standard components can improve the sustainability of new products as they allow the product to be taken apart, (1) allowing for maintenance to be carried out and components to be repaired / replaced. (1) This can extend the products life. (1) Standard components are durable extending the products life. (1) 	3	<p>Only award up to a maximum of two marks if written in bullet format and not continuous prose.</p> <p>Answers related to 'mass production' or 'continuous production' can only be awarded if qualified by the associated 'availability' allows for 'repair' or parts to be 'replaced' extended the products life.</p>







Question		Answer/Indicative content	Mark	Guidance
2	(a)	<p>Award one mark for each valid reason e.g.:</p> <ul style="list-style-type: none"> Ensure product safety (1) It is a legal requirement (1) Ensure products are fit for purpose / in tolerance (1) Ensure products meet customers expectations / expected quality (1) To meet environmental responsibilities (1) To allow for trade / sale (1) To meet EU law (1) Marketability (1) 	2	<p>Accept other valid responses.</p> <p>Do NOT accept 'in case something goes wrong' alongside 'safety'</p> <p>Do NOT award repetitions</p> <p>Do Not except reference to 'protecting ideas' as this is confused with patents, trademarks or copyright.</p>

Question		Answer/Indicative content	Mark	Guidance
(b)	(i)	Award one mark for the correct symbol 	1	Only accept the symbol in this mark scheme. Not variations e.g. EC. Letters should be capitals, curved, and in the correct order 'CE' Do NOT award marks if the E is not curved. Award:  [1]
(b)	(ii)	Award one mark for each valid symbol e.g.: <ul style="list-style-type: none"> • Recycling symbol (1) • Age guidance e.g. not suitable for children under 3 (1) • Flammability / toxicity (1) • Disposal instructions (1) • Trademark (1) • Registered Trademark R (1) • Copyright (1) • Patent (1) • Safety (1) • Fair trade (1) • British toy and hobby association (LION mark) (1) • British Standards / ISO (1) 	2	Award other valid examples Do NOT accept 'European Standard' as repeat of (b)(i)

Question	Answer/Indicative content	Mark	Guidance
(c)	<p>A registered design:</p> <ul style="list-style-type: none"> • protects the shape (1) of a design. • protects the configuration (1) of a design. • protects the appearance (1) of a design. • stops other companies from copying (1) the design. • Registers the design to a person / company (1) • prevents others from using it without your permission. (1) • allows legal action to be taken against other companies if the design were to be copied. (1) • A patent can be granted by a sovereign state (1) and is recognised internationally (1) but registered designs may only apply in the country of origin. (1) 	2	<p>Up to two marks for each point stated.</p> <p>Award marks for reference to 'shape'</p> <p>Only award one mark for reference to 'copying a design' / 'protects a design' unless qualified with 'shape', 'appearance' or 'configuration.'</p>
(d)	<p>Award up to three marks for an explanation of the difference between a registered design and a patent. e.g:</p> <ul style="list-style-type: none"> • A registered design protects the appearance of a product whilst a patent protects inventions / processes (1). • A patent stops other companies copying the way something works or is carried out whilst a registered design only protects the appearance or shape of a design. (1) • A patent lasts for 20 years from the date it is approved (1) A patent should be renewed every year after its fourth year. (1) A registered design has to be renewed every 5 years/ up to a total of 25 years. (1) 	3	<p>Award maximum of one mark for reference to preventing the copy of a design but no more unless the distinct difference between 'registered design' and 'patent' is made.</p>

Question	Answer/Indicative content	Mark	Guidance
3 (a)	Award up to three marks for an explanation e.g.: <ul style="list-style-type: none"> • The USB plug has been designed in such a way that it can only be put into a USB socket in one way (1). This stops incorrect operation during use (1) preventing the adaptor being placed in the wrong socket or causing damage due to misuse. (1) • The insulating casing prevents any electric shocks (1) that may harm the user. (1) • The USB plug has an arrow/symbol on the top (1) which identifies the correct way to insert the plug (1) stopping the user putting the USB plug in incorrectly (1) • The USB plug has grips on the side of the casing (1) this allows the USB to be correctly inserted or removed (1) without damaging the USB or associated device. (1) • The USB plug has a hard casing that prevents damage during operation (1) in addition to rubber protection around the cable that prevents excessive damage during constant use. (1) 	3	Only award marks when 'error proofing' is explained in the context of 'stopping the product being used in the wrong way' / 'preventing errors / issues during operation.' Do NOT award marks for 'testing' or 'removing errors in production.'
(b)	Award one mark for the correct phase. <ul style="list-style-type: none"> • Validate phase (1) 	1	
(c)	Award one mark for each consideration e.g.: <ul style="list-style-type: none"> • Health and safety during production (1) • Order of operations (1) • Production setup / production setup costs (1) • Production location / supply chain (1) • Quantity required / scale of production (1) 	3	Accept other valid responses. Do NOT accept reference to areas such as, sustainability, ergonomics etc. Answers should reference the the topics in a manufacturing plan. Do NOT accept 'cost' or 'size' unless qualified with

Question	Answer/Indicative content	Mark	Guidance
	<ul style="list-style-type: none"> • Time taken for each stage of manufacture / efficiency of manufacture (1) • Tolerances at each stage (1) • Components required at each stage / standard components required (1) • Material required at each stage / material availability (1) • Size of material required at each stage (1) • Tools / workers required at each stage (1) • Processes / Process instructions (1) • Machinery required (1) • Assembly processes (1) • Surface finish (1) 		'material' or 'tooling' for example
(d)	<p>Award up to 3 marks for an explanation e.g.:</p> <ul style="list-style-type: none"> • Designers would test a design to ensure all elements of the product function correctly (1). This will stop issues during production (1) which, could be costly to the manufacturer. (1) • Designers will want to ensure that the design meet expected requirements/standards (1) before it goes into production to avoid costly modifications (1). • Production setup costs are extremely high (1). Designers would want to ensure that all errors are removed from the product prior to commencing production (1) to ensure costly changes or delays in the production process are avoided (1) • Designers will want to check the design to ensure it functions properly (1), is safe to use (1) and is ready to be produced on a large scale. (1) 	3	Answers must refer to final production issues. Issues such as ergonomic, aesthetic issues would have been addressed prior to this part of the process. Award marks for reference to function.

Question	Answer/Indicative content			Mark	Guidance
4 (a)	Award one mark for each correct response.			5	
	Product	Material	Function		
1	 Formula 1 Front Wing	Carbon fibre	Lightweight and strong		
2	 Engine Camshaft	Cast alloy steel	Forged and hardened to resist wear		
3	 Motorcycle Helmet Visor	Polycarbonate	Impact resistant and transparent		
4	 Building Blocks	ABS	Non-toxic and easy to mould		
5	 High-performance bicycle brake lever	Aluminium billet	Lightweight metal, easy to machine		
6	 Cutlery	Stainless Steel	Hygienic and resistant to corrosion		

Question	Answer/Indicative content	Mark	Guidance
(b)	<p>Award one mark for each valid reason e.g.:</p> <ul style="list-style-type: none"> • To ensure that the supply chain can meet demand / ensure availability of materials (1) • To negotiate delivery times (1) • To assist the calculation of production quantities (1) • To calculate overall production costs / manage the budget (1) • To consider the environmental impact of transportation (1) • To collaborate on design when subcontracting production to specialist suppliers (1) • To ensure suppliers can deliver required quality (1) 	2	
(c)	<p>Award up to three marks for an explanation e.g.:</p> <ul style="list-style-type: none"> • The availability of a material might have an impact on the design of a new product because this could affect the material choice available to the designer (1). This could be limited by cost if the material is rare (1) which in turn could make the selling cost of the product to expensive for the target market. (1) • The availability of a material might have an impact on the design of a new product because a certain material may not be available in sufficient quantity to meet production demand. (1) This would require a different material to be selected so that customer demand can be met (1) increasing sales for the business. (1) 	3	

Question			Answer/Indicative content	Mark	Guidance
5	(a)	(i)	<p>Award up to three marks for an explanation e.g.:</p> <ul style="list-style-type: none"> Sustainable design is generally considered as the design of products that minimise their impact on the environment. (1) This might mean the use of materials that are recyclable (1) or that the product uses minimal energy during use (1) Sustainable design is the design of a product that considers the impact the product has on its environment (1). This can be associated with its operation, production or end of life (1) but could also be associated with the economic or social impact of a product (1). 	3	<p>Exemplar; 'Sustainable design means that the energy and materials used in the manufacturing is offset by the lifespan.'</p>
	(a)	(ii)	<p>Award one mark for each valid response e.g.:</p> <ul style="list-style-type: none"> Use recycled materials in its design/production. (1) Ensure the product can be disposed of / disassembled with minimal environmental impact at the end of its life. (1) Ensure the product uses renewable energy sources in its operation (1) Design products that are durable / modular / can be upgraded so their life with the user is extended. (1) Develop products that can be maintained (1) Monitor the supply chain to calculate overall environmental impact. (1) Ensure materials are gathered from a sustainable source (1) and can be recycled at the end of life. (1) 	2	<p>Accept other valid responses.</p> <p>Do NOT award marks for 'standard components' unless qualified by 'ease of disassembly' or 'improved maintenance.'</p> <p>Do NOT award repetition e.g. 'use of renewable materials' and 'use of sustainable materials.'</p>
	(b)		<p>Award one mark for each valid response e.g.:</p> <ul style="list-style-type: none"> Requirement to reduce the use of fossil fuels (1) Reduce emissions when manufacturing (1) Global warming / CO2 emissions (1) Minimise transportation of material / product (1) Safe disposal of products at the end of their life (1) Recycling of materials / products (1) 	2	<p>Do NOT accept 'minimise effect on the environment' or similar as this is vague.</p> <p>Do NOT award repetition</p>

Question			Answer/Indicative content	Mark	Guidance
			<ul style="list-style-type: none"> • Gather materials from a renewable source (1) • Carbon footprint of products (1) • Avoid the use of toxic materials (1) • Regulations and fines on r (1) • Minimise impact on the areas where materials are sourced / deforestation / wildlife / pollution (1) 		
	(c)		<p>Award up to three marks for an explanation e.g.:</p> <ul style="list-style-type: none"> • Designers can ensure that they do not contribute to environmental pressures by ensuring that they only use materials in their products that can be recycled at the end of their life. (1) They could also ensure these materials are from sustainable sources (1) and use minimal energy in their creation. (1) • Designers can ensure that they do not contribute to environmental pressures by ensuring that the products they manufacture use energy from renewable sources during their use. (1) They could also ensure that their factories are powered from renewable energy sources (1) minimising the use of fossil fuels within the lifecycle. (1) 	3	Award marks for reference to 'recycling', 'carbon footprint' or 'pollution'
Question			Answer/Indicative content	Mark	Guidance
6	(a)	(i)	<p>Award one mark for each valid response.</p> <ul style="list-style-type: none"> • One-off (1) • Batch (1) • Mass / continuous production (1) 	2	

Question		Answer/Indicative content	Mark	Guidance
(a)	(ii)	<p>Award one mark for each valid reason e.g.:</p> <ul style="list-style-type: none"> • Scale of production may define what manufacturing process can be used (1) • Scale of production may affect the final selling price / cost of production (1) • Is the material / materials being used in appropriate supply. (1) • Design geometry would depend on the manufacturing process requiring consideration during development (1) • Designs need to consider the manufacturing process and therefore scale of production to ensure they can be produced (1) 	2	Do NOT award marks for 'to know how many they need to make.'
		Guidance		Answer/Indicative content
(b)		<p>Award up to six marks for a discussion on how the scale of production can have an impact on material selection.</p> <p>Points MUST be exemplified. Do NOT accept responses related to 'one-off' being expensive or 'mass' being cheap unless properly qualified.</p> <p>Level 3 (5–6 Marks)</p> <p>Learners provide a thorough discussion of how the scale of production can have an impact on material selection.</p> <p>They show a clear understanding of the required question material. Specialist language and terms are used in the appropriate areas being discussed and the required information will be well structured in its presentation.</p> <p>Good examples used to discuss how the scale of production can have an impact on material selection.</p>	6	<p>Examples and relevant points could include.</p> <ul style="list-style-type: none"> • The scale of production can limit the suitability of certain manufacturing processes. For example, components that are required to be made from plastic would require a large scale of production to offset the cost of the investment in tooling. • Some components that use advanced / modern materials such as carbon fibre or titanium are expensive to produce in very large quantities and therefore may not be suitable for mass produced products that need to appeal to a target market that cannot afford their sale price. • Increased consideration of the sustainability of products and their associated lifecycle is important. Products that are mass-produced must consider how the materials and components used in their design can be safely disposed of. • Custom products or one-off designs will generally be more expensive for the consumer to purchase. This exclusivity may mean that the consumer is willing to

Question	Answer/Indicative content	Mark	Guidance
	<p>Learners will demonstrate an accurate level of spelling, punctuation and grammar.</p> <p>Level 2 (3–4 Marks)</p> <p>Learners provide an adequate discussion of how the scale of production can have an impact on material selection.</p> <p>Some examples used to illustrate how the scale of production can have an impact on material selection.</p> <p>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.</p> <p>Level 1 (1–2 Marks)</p> <p>Learners provide a basic discussion which shows some understanding of the question material but uses little or no specialist language.</p> <p>Few or no examples used to show understanding of how the scale of production can have an impact on material selection.</p> <p>Answers may be ambiguous or disjointed. Contains 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>		<p>pay for more exotic materials, allowing the designer to use processes and materials that may not be possible if the scale of production is high.</p> <ul style="list-style-type: none"> • Mass production processes such as injection moulding, casting or CNC machining require components to be designed with geometry that is suitable for the manufacturing process. Designers must consider this during design or the design will not be able to be produced at the scale required or with the process selected to meet the production numbers. • The target market may require large quantities of the product. This may have an impact on the process that is selected for production so that the scale of production can meet the consumer demand.

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553

© OCR 2018

