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 2018

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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.

Annotations

Annotation	Meaning of annotation
BP	Blank page
VG	Vague
	Tick
SEEN	Noted but no credit given
	Unclear
REP	Repeat
BOD	Benefit of doubt
	Cross
DEV	Development
EG	Example/Reference
K	Knowledge
L1	Level 1
L2	Level 2
L3	Level 3

Question			Answer	Mark	Guidance
1	(a)		One mark awarded for each correctly joined answer **User needs** / **Suggested product feature** Must fit comfortably in the hand → Ergonomically designed Should be aesthetically pleasing → High-gloss finish Must be wireless → Bluetooth connectivity Must work on multiple surfaces → Optical sensor	3	
1	(b)		Award one mark for each valid example • Position of the buttons • Position of roller wheel • Shape of the buttons • Size of the buttons • Sculpted shape of the mouse • Size / weight of the mouse • Surface finish increases grip / is comfortable to use • Buttons / roller wheel have appropriate operation	2	Do not award vague responses. Responses should relate to the design of the mouse. Do not award answers that repeat the stem of the question e.g. comfortable to use unless qualified with a specific feature Do not accept anthropometric related answers

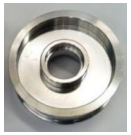
Question			Answer	Mark	Guidance
1	(c)		Award one mark for each valid example • Length of the fingers • Width of the hand • Length / size / surface area of the hand / palm of the hand • Distance between fingers • Circumference of fingers • Surface area of finger tips	2	Answers must relate to measurements of the hand and not the design of the mouse. Do not award e.g position of scroll wheel
1	(d)		Award up to three marks for a detailed description • The mouse is made from high impact plastic as it will be continually moved around on hard surfaces (1). It is wireless and may be dropped (1) and will need to be wipe clean due to constant use. (1) • The mouse will may be carried around by the user and will need to be scratch resistant (1) a high impact plastic will resist wear and tear (1) and will be resistant to corrosion from constant use (1). • The mouse will be subjected to prolonged use so should be durable. (1)	3	Only award marks related to how the material helps the use of the product in its working environment. Do not award marks related to the environment or sustainability. Do not award marks for repeating the stem of the question. Do not award marks for repetition of the same answer. e.g. dropped

Question			Answer	Mark	Guidance
2	(a)	(i)	Award one mark for each correct answer • Development of the internet and access on the mobile devices driving screen size • Trend for touchscreen devices • 'On the go' access to technology e.g. games • Trend for 'slim' phones but with a bigger screen • Taking 'selfies' / camera technology • Requirement for more features • Increased used of social media – apps • Requirement for access to the internet • Reduction of buttons to create a more minimalist design / 'one' button • Colour choice • Development of mobile technology • Headphone jack / compatibility to listen to music through the device • Requirement for accessibility has seen phone design change to allow for use by more people	2	
2	(a)	(ii)	Award two marks for a valid reason • Older customers may want a simpler phone (1) with larger buttons and less features. (1) • There could be a market need / trend for retro products. (1) The phone shown could be considered an iconic model and people may find this more desirable. (1) • The simpler phone with less complex screen technology does not use as much battery power (1) meaning the phones can last longer on a single charge. (1) • Customers may feel that they can keep the phone longer without needing to upgrade (1) as it will not become obsolete due to 'classic' design. (1)	2	

Question			Answer	Mark	Guidance
			• The older design of phone may be perceived as being less fragile and more resistant to dropping so may be appealing to particular users (1) • The simpler phone will be more cost effective (1) so will appeal to people with a smaller budget. (1)		
2	**(b)**		Award one mark for a valid example and two for a valid description. Example • Signs/symbols (1) Description • Signs and symbols can be added to identify material properties (1) and safety issues (1) • Signs and symbols can be added to show how a product can be safely disposed of/recycled (1) to meet sustainable/environmental design needs (1) Example • British Standards / CE (1) Description • Products will comply with certain standards to demonstrate they have met certain quality requirements. (1) This will give customers faith in the product. (1)	3	Award marks for reference to definitive safety requirements Award marks for specific regulations e.g. WEEE Do not award marks for reference to safeguards e.g. copyright, trademark or patents Award marks for a valid description if the example is incorrect but only when related to legislation e.g. safety
2	**(c)**		Award up to three marks for a detailed description • Sustainable design may result in products being manufactured from different materials due to some materials becoming scarce (1). This could impact on the production process (1) and possibly increase product cost. (1)	3	Do not award marks for 'making the product more durable' unless reference to improved maintenance, reuse or repair is made Award reference to the consideration of 'renewable energy sources, recyclability, use of non-finite resources.'

Question			Answer	Mark	Guidance
			• Designers may consider the manufacturing process used (1) to ensure that renewable energy is used to power factories during manufacture (1) reducing the overall products carbon footprint. (1) • Designers may consider the packaging of the product. (1) Recycled packaging could be used (1) to ensure appropriate disposal at the end of life. (1) • Designers may use recyclable materials in the product. (1) Allowing the product to be disassembled (1) and disposed of with minimal impact on the environment. (1)		

Question			Answer	Mark	Guidance
3	(a)		Award one mark for each correct answer	4	

	Example product	Manufacturing process	Ease of manufacture
1	 **Plastic school chair**	**Injection moulding**	Creates high volume, complex plastic parts in a single process
2	 **CNC machined bearing housing**	**Machining**	**Creates very accurate parts with a high surface finish**
3	 **Automotive assembly line**	**Final assembly on production line**	Allows the use of pre-manufactured and standard components
4	 **Cast pump housing**	**Sand casting**	Allows for cost effective metal component production
5	 **Prototype prosthetic hand**	**3D printing**	Can create one-off 3D components rapidly

Question			Answer	Mark	Guidance
3	(b)		Award one mark for a valid process e.g. • Laser cutting • Forging • Vacuum forming / thermoforming • Laminating • Blow / rotational / compression moulding • Composite production • Sintering • Die casting • Manual machining – turning/milling • Using hand tools • CNC machining • Extrusion	1	Accept other suitable processes Only award marks for different 'casting' or 'moulding' methods if specific applications are given e.g. die casting, blow moulding Do not award secondary processes such as 'brazing' or 'welding'
3	(c)		Award one mark for each valid response • Easily accessible components (1) • The product can be easily disassembled (1) • Features incorporated into the design to allow access for maintenance (1) • Use standard parts in their design that can be taken apart (1) • Use easily replaceable / widely available parts (1) • Use temporary fasteners (1) • Allow common tools to be used for disassembly (1) • Use components that can be easily clipped or unclipped to allow access (1) / avoid permanent snap together components (1) • Do not used permanent fixing methods e.g. welding (1)	2	Do not award 'less parts / reduce the number of components.'

Question			Answer	Mark	Guidance
3	(d)		Award up to three marks for a detailed explanation • The manufacturing process may require complex machinery that is expensive to purchase (1) making the initial investment cost high (1) and so impacting on the final product cost. (1) • The manufacturing process may require highly skilled workers (1) that demand higher salaries (1) which will impact on the final sale price of the product. (1) • The manufacturing process may require more energy or more expensive energy sources (1) this will increase operational costs (1) resulting in higher product cost. (1) • The manufacturing process may limit the scale of production. (1) If only small numbers can be made then the individual component cost will be higher (1) meaning the final product cost will be more expensive. (1)	3	Accept other valid responses

Question			Answer	Mark	Guidance
4	(a)		Award up to two marks for each correct response • Market pull (1) • Technological push (1)	2	Only award marks for the correct terminology
4	(b)		Award up to 4 marks for each correct phase 1. Identify phase 2. Design phase 3. Optimise phase 4. Validate phase	4	Do not award marks if the cycle is in the wrong order
4	(c)	(i)	Award one mark for a valid response • Questionnaires / survey (1) • Focus group (1) • Internet research (1) • Analysis of existing products (1) • Interviews (1)	1	Do not award marks for 'primary' or 'secondary' research unless a specific example is given
4	(c)	(ii)	Award up to three marks for a detailed explanation • Market research will identify what the customers want. (1) It will ensure that the designer can create a product that appeals to prospective customers (1) and allow it to stand out from competitor products. (1) • Market research can justify a gap in the market (1) ensuring that a product will sell when it is put on sale (1) securing the company's future through a growth in sales. (1)	3	Accept other valid responses

Question			Answer	Mark	Guidance
5	(a)	(i)	Award one mark for the correct answer • The ends of the cable are colour coded to ensure they are connected correctly (1)	1	
	(a)	(ii)	Award one mark for the correct answer • The position of the pins means the plug cannot be pushed into a socket in the wrong orientation (1) • Plugs contain a fuse that will blow to protect the product it is connected to (1) • The longer top pin ensures ease of location and only allows the flow of electricity when the plug is fully inserted (1)	1	
5	(b)		Award one mark for each valid example • The plug could be modified to have a larger body so it is easier to grip (1) • The plug could have ergonomic 'grooves' added making it better to grip. (1) • The plug casing could be made from a different material with a rougher high grip texture. (1)	2	Do not accept repeat answers
5	(c)		Award one mark for a valid regulation • British Standards (1) • European Conformity / CE (1) • Hygiene standards (1) • Safety regulations (1) • WEEE (1)	1	Award reference to safety e.g. 'safety regulations' or 'safe to use'
5	(d)		Award up to two marks for two valid safeguards • Trademark (1) • Patent (1) • Copyright (1)	1	

Question			Answer	Mark	Guidance
5	(e)		Award up to three marks for a detailed explanation • Products must meet regulations as this ensures that they are safe to be sold (1) and means that customers will not be injured by the product (1) risking possible legal action against the manufacturer. (1) • If products meet regulations it means the customer can be confident the product meets safety standards. (1) This will mean customers will be more likely to purchase the product (1) which could have a direct impact on sales. (1) • If products meet regulations it means they can be sold in a range of countries. (1) Different parts of the world have different standards (1) and if products meet these then companies can expand the business increasing sales growth. (1)	3	

Question			Answer	Mark	Guidance
6	(a)		Award one mark for a valid dimension • Shaft diameter (1) • Central pulley hole (1) • Overall pulley diameter (1) • The dimensions of each component where the shaft and pulley connect (1) • The length of the shaft (1)	1	Do not accept 'length' of pulley. 'Width' of shaft is acceptable
6	(b)		Award one mark for each valid reason • Tolerances ensure that the shaft and pulley fit together / function as intended (1) • Tolerances ensure that the pulley can spin on the shaft without too much interference (1) • To ensure the tolerances allow for ease of movement to reduce friction / damage to the shaft (1) • Tolerances ensure the pulley assembly can operate effectively without excessive cost in production (1) • The external diameter of the pulley wheel will have an accurate diameter to allow correct operation when connected to the belt. (1) • Tolerance ensure that all pulleys and shafts manufactured will be in the same size range / gives scope in production / are accurately made (1)	2	Accept other valid reasons
6	(c)		Award one mark for a valid reason • Making components to exact measurements is very difficult so tolerances allow for an acceptable range which manages costs. (1) • Tolerances allow for variation in accuracy due to production processes allowing a wider variety of more cost-effective processes to be used. (1)	1	Responses related to saving 'excess material' or 'waste material' should not be awarded unless this is qualified by the fact that tolerances give an acceptable range that reduces 'reject' products through unnecessary errors.

Question			Answer	Mark	Guidance
			• The more accurate a measurement needs to be the more expensive it is to produce. Tolerances compensate for this. (1) • Tolerances allow for variation which reduces the number of products that are wasted due to minor variations in dimensional accuracy. (1)		
6	**(d)***		Award up to six marks for a discussion on how environmental pressures can impact the development of a new product. **Level 3 (5–6 Marks)** Learners provide a thorough discussion of how environmental pressures can impact the development of a new product 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 discuss how environmental pressures can impact the development of a new product. Learners will demonstrate an accurate level of spelling, punctuation and grammar. **Level 2 (3–4 Marks)** Learners provide an adequate discussion of how environmental pressures can impact the development of a new product. Some examples used to illustrate how environmental pressures can impact the development of a new product.	6	Examples and relevant points could include. • Companies are under increased pressure to use materials that are sustainable or that can be replenished. Natural materials that avoid the use of non-renewable resources such as oil for plastic could be avoided. • The consumption of fossil fuels and the requirements to reduce this may mean that companies consider the power-source required to power the product. For example, the use of renewable energy systems such as solar panels or the development of battery technology in electric cars. • Companies may also consider the processes required when manufacturing a new product to ensure they are as energy efficient as possible. Manufacturers may ensure that production facilities are powered using renewable energy sources and designers may optimise product design to use the minimal amount of energy or material. • Designers could consider the overall weight, size or packaging requirements for products in order to optimise storage or transportation of the product reducing the resources required to transport or store the goods. • Manufacturers and designers are under increased pressure to reduce emissions and now pay heavy taxes for large carbon footprints. Designers may consider the processes used and manufacturers the

Question			Answer	Mark	Guidance
			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 environmental pressures can impact the development of a new product. 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.		energy consumption in production to reduce this footprint. • Companies have to consider the end of life of products so designers will consider the ease of disassembly and how easily components and materials can be disposed off after use with minimal impact on the environment.

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