GCE A LEVEL MARKING SCHEME

SUMMER 2025

A LEVEL
DESIGN AND TECHNOLOGY - UNIT 3
ENGINEERING DESIGN
1601U30-1

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

GCE A LEVEL DESIGN AND TECHNOLOGY

UNIT 3 – ENGINEERING DESIGN

SUMMER 2025 MARK SCHEME

Question 1

The picture below shows an outdoor children's climbing frame.		AO3	AO4	Mark
(a)	**Explain why powder coating is an appropriate finish for the climbing frame.**		✓	**5**
	Answers that explain why powder coating is an appropriate finish for the climbing frame should be awarded five marks based on: Provides a hard, durable finish resistant to wear e.g. from children's shoes. A wide range of colours are available. Protects the metal frame from rusting. Easy to apply to cylindrical shapes – gives an even coat – excess spray can be recycled and re-used. Less fading from UV rays. Resistance to chipping. Can withstand extremes of temperature. Thicker coats can be applied than with paint. No response worthy of credit.			0
	A basic response that refers to a good range of colours or gives good protection from the user or the elements.			1
	A response that refers to a good range of colours or gives good protection from the elements. Hard wearing enough to withstand the scuffs and scrapes caused by users.			2-3
	A response that refers to a good range of colours. Less fading than paint and can withstand extremes of temperature; gives good protection from UV light. Hard wearing enough to withstand the scuffs and scrapes caused by users. Less fading is achieved by powder coating and thicker coats can be applied than painting. Easier to cover unusual shapes.			4-5

(b)	**Name a polymer that can be used to manufacture the ropes on the climbing frame, and explain why this is a suitable material.**		✓	**3**
	No answer or no relevant information presented or discussed.			0
	Nylon / Polyester or Polypropylene Explanations may include: Does not absorb water. Strong and durable. Wear resistant. Resistant to rot. Resistant to most chemicals, mildew, mould, and oils.			1 2
	Award up to **3 marks** for naming any a polymer and explaining why it is suitable.			3
		Total		**8**

Question 2

	The graph shown below shows the stress-strain curves for three common materials.	**AO3**	**AO4**	**Mark**
(a)	A (i) State which material is most plastic. (ii) State which material is most ductile. (iii) State which material is most brittle.		✓	**3**
	No answer or no relevant information presented or discussed.			0
(i)	C			1
(ii)	B			1
(iii)	A			1
(b)	**Explain the difference between the elastic and plastic states when a material is being stressed.**		✓	**5**
	Answers that explain the difference between elastic and plastic states when the material is being stressed should be awarded 5 marks based on: The main difference between a plastic body and an elastic body is based on their ability to regain their shape and size after an external force is applied to the bodies. An elastic state means that the body will return to its original shape and size when the force is removed. A plastic state means that the body will not return to its original shape and size when the force is removed. It will be permanently deformed. Bodies that exceed the elastic limit and enter the plastic state are often deemed dangerous in use.			
	No answer or no relevant information presented or discussed.			0
	A material will stretch when loaded.			1
	A material will stretch when loaded and return to its original shape when the load is removed.			2-3
	A full understanding of the elastic and plastic states including the permanent deformation that can occur. A material will return to its original shape as long as it remains below its elastic limit. Plasticity will occur when the material is over-stretched (beyond the elastic limit) and will not return to its original shape. Deformation in the material occurs.			4-5
		Total		**8**

Question 3

The picture below shows a modern bicycle frame which has been manufactured from carbon fibre reinforced polymer (CFRP) using the 'lay-up' process.		AO3	AO4	Mark
(a)	**Describe the advantages of manufacturing the bicycle frame using CFRP**		✓	**5**
	No answer or no relevant information presented or discussed.			0
	A basic response: CFRP is strong and light.			1
	A more developed response: Frame is strong and light. Frame can be produced as a monocoque (one piece structure) with no joints.			2-3
	A fully developed response: Frame is strong and light. Frame can be produced as a monocoque (one piece structure) with no joints. Complex (organic or aerodynamic) shapes can be produced. Different weaves and orientation can be achieved to increase strength in critical areas.			4-5
(b)	**Describe how production and planning systems are used to improve efficiency during the manufacture of bicycles.**		✓	**3**
	Answers that describe both production and planning systems should be awarded 3 marks based on: Production: Use of jigs, patterns and templates can ensure that parts are held in position for machining or assembly. Standard components are used (JIT). Parts could be rapid prototyped. Parts / assemblies could be sub-contracted out. Use of CAD/CAM/CNC. Planning: Use of GANTT charts. Use of flow charts. Critical path analysis. Correct production type – one off/batch/mass/flow. Quality Control and Quality Assurance part of both production and planning systems. No answer or no relevant information presented or discussed.			0
	Brief answer lacking depth GANTT charts can be produced for planning.			1
	Answer includes more depth A GANTT chart has aided planning by visually showing the steps / stages for the production systems along with QC checks.			2
	A good response covering several relevant points A GANTT chart has aided planning by visually showing the steps / stages for the production systems along with QC checks. Parts have been manufactured using good CAD and CAM systems. Quality control systems are in place to ensure conformity. All bought in components are quality assured and acquired on a JIT basis.			3
			Total	**8**

Question 4

A desktop fan with a possible circuit to control its operation is shown below.		AO3	AO4	Mark
(a)	**Explain how the circuit functions as the temperature of the room changes.**		✓	**4**
	Answer that explains how the circuit function should be awarded up to 4 marks When the room is hot, the thermistor's resistance decreases, and the Vin increase. Once the base of the transistor reaches 0.6 / 0.7v, the transistor will activate and turn on the motor that controls the fan. (A diode could be added to prevent back emf / protect the transistor / motor. The resistance of the thermistor decreases… …this results in Vin increasing… …the transistor switches on at 0.6v/0.7v… …and the motor will switch on or off depending on the thermistor. The diode prevents back emf.			
	No answer or no relevant information presented or discussed.			0
	A basic response: The resistance of the thermistor will decrease.			1
	A limited explanation: The resistance of the thermistor will decrease that will send a signal to the transistor turn on the fan.			2
	A more detailed explanation: The resistance of the thermistor will decrease resulting in a increase in voltage from the potential divide/Vin this will switch on the transistor that will turn on the motor controlling the fan			3
	A fully detailed explanation: The resistance of the thermistor will decrease this will result in the voltage from the potential divider increasing. When it increases to 0.6v at the base of the transistor, the transistor will switch on allowing current to flow and the motor to turn on. A diode has been added to prevent back EMF.			4
(b)	**The logic diagram below is an alternative solution for controlling the fan.**		✓	**4**
	No answer or no relevant information presented or discussed.			0
				4

A	B	C	D	E	X
0	0	0	1	1	0
0	0	1	1	1	1
0	1	0	1	1	0
0	1	1	1	1	1
1	0	0	0	0	0
1	0	1	0	0	0
1	1	0	0	1	0
1	1	1	0	1	1

Give **ONE MARK** for every **TWO** correct rows.

	Total	**8**

Question 5

Portable electronic products such as the tablet shown below are constantly changing as technology advances. To some, this type of product could be viewed as fulfilling a 'need' in the market, while others may view this product as satisfying a 'want' in the market.		AO3	AO4	Mark
(a)	**Distinguish between 'needs' and 'wants' when considering the role of products in current markets.**		✓	**3**
	Answers that distinguish between needs and wants should be awarded up to 3 marks. A need is something that we cannot do without e.g. food, warmth and shelter. In a product, a need is a requirement that is essential for that product to function correctly. All similar products in the marketplace will have the same needs e.g. a mobile phone must enable the user to make calls or a watch that should tell the time. A want is a feature or addition to a product that is not functionally essential but may be included to increase sales of a particular product / become competitive in the marketplace e.g. a mobile phone may have a scanner included. 'Extra features' are often referred to as a perceived need. Marketing experts are very good at creating 'wants'. Marks should be awarded up to a maximum of 3 if wants and needs are defined, and an example(s) given. No answer or no relevant information presented or discussed.			0
	A basic response – A need is a feature that will enable the product to do its job e.g. a watch must tell the time.			1
	A more developed response – A need is a feature that will enable the product to do its job e.g. a watch must tell the time. A want is an additional feature that has been included such as a watch displaying the date or including a stopwatch.			2
	A fully developed response – A need is a feature that will enable the product to do its job e.g. a watch must tell the time. A want is an additional feature that that been included such as a watch displaying the date or including a stopwatch. Modern products may include more advanced features such as voice activation, access to the internet or well-being options such as heart rate monitors etc.			3

(b)	**Explain how *one* specific named market research strategy can be used in product development.**		✓	**3**
	Answers that describe a named market research strategy and its use in product development can be awarded up to 3 marks. Check existing products on the market. Ensure that a suitable market exists. Potential competitors. Identify market wants and needs. Product comparison. Price comparison. Any prohibitive (or other) legislation. Identify materials for manufacture. No answer or no relevant information presented or discussed.			0
	A basic response – Market research can be used to check out competitor products.			1
	A more developed response – Market research can be used to check out competitor products and to ensure that there is a market for them. Price and availability of competitor products can be established.			2
	A fully developed response – Market research can be used to check out competitor products and to ensure that there is a market for them. Price and availability of competitor products can be established. New market opportunities can be established. Manufacturing, assembly, and materials used in competitor products can be evaluated. Or any other relevant answers.			3
(c)	**Other than Computer Aided Design (CAD) and Computer Aided Manufacture (CAM) describe how ICT can be used in the manufacturing of engineered products.**		✓	**2**
	Answers that describe how ICT is used in the manufacturing of engineered products can be awarded up to 2 marks. ICT systems for use during the ordering / procurement stage. Internet / portable storage devices for the transfer of data e.g. to machines. Automated invoicing / billing. Automated / advanced inspection techniques. Stock control (databases). No answer or no relevant information presented or discussed.			0
	A basic response – ICT can be used to order stock.			1
	A more developed response – ICT can be used to order stock and for internal stock control. Automated payment systems, invoicing and billing can be achieved. Design and manufacturing data can be transmitted to machine tools and automated inspection systems can be included. Or any other relevant answers.			2

(d)	**Discuss the reasons why portable electronic products become obsolete.**		✓	**4**
	Answers that discuss why portable electronic products become obsolete can be awarded up to 4 marks. FAD products. The technology is no longer available e.g. floppy discs, VHS videos, dial-up connections, cassette tapes … Energy requirements change e.g. cars that use petrol/diesel being replaced by cleaner electric/hybrid versions. Cash is being replaced by contactless payments. Innovations that make the products worthless, inconvenient, or unattractive. New technologies that disrupt the way the items are produced. Decline in overall demand for the items (due to changes in trends) More competition and therefore more pressure to offer the latest and greatest. Updates in computer operating systems. Reduced availability of spare parts or accessories. No answer or no relevant information presented or discussed.			0
	A basic response – New technologies take over and older ones become obsolete e.g. video / CD's have been replaced by downloads.			1
	A more developed response – New technologies take over and older ones become obsolete e.g. video / CD's have been replaced by downloads. New devices and technologies such as voice activation simplify designs by removing the number of components (buttons).			2
	A detailed response – New technologies take over and older ones become obsolete e.g. video / CD's have been replaced by downloads. New devices and technologies such as voice activation simplify designs by removing the number of components (buttons). More efficient use of energy in products, both at the manufacturing stage and during use.			3
	A fully detailed discussion – Products become less fashionable (particularly FAD products). New technologies take over and older ones become obsolete e.g. video / CD's have been replaced by downloads. New devices and technologies such as voice activation simplify designs by removing the number of components (buttons). More efficient use of energy in products, both at the manufacturing stage and during use. Or any other relevant answers.			4
			Total	**12**

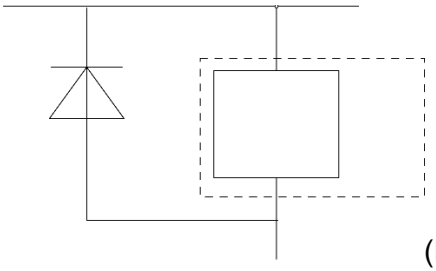
Question 6

The picture below shows a remote control unit.		AO3	AO4	Mark
(a)	**Describe the benefits of using rapid prototyping in the development of the remote control.**		✓	**2**
	Describe the benefits of rapid prototyping in the development of products can be awarded up to 2 marks. **Guidance:** Model can be used by production engineers to develop necessary tooling and manufacturing methods. Fine details can be included e.g. split lines, internal compartments (battery location) and location of fixing points can be modelled and tested. Much faster than modelling by hand. Allows realism to be included, e.g. plastic pigment colours, decals etc. Allows modelling to test anthropometric fit (button spacing etc). Allows modelling to test ergonomic integrity (shape, texture, comfort etc). Model can be used to get consumer feedback. Or any other suitable response. No answer or no relevant information presented or discussed.			0
	A basic response – Models can be produced quickly (e.g. by 3D Printing) and can be user-tested e.g. for fit (ergonomics).			1
	A more developed response – Models can be produced quickly (e.g. by 3D Printing) and can be user-tested e.g. for fit. Manufacturing process and tooling can be developed e.g. component placement, fixing points etc.			2

(b)	**Explain how designers have considered anthropometric and ergonomic factors in the development of the remote control**		✓	**6**
	Answers that include … **Guidance:** Anthropometric data: General hand sizes. Finger 'pad' width (for button size and spacing). Grip sizes (for remote control enclosure size). Grip strength (for weight and balance of the remote control). Ergonomic considerations: Use of colour for identification of features. Use of ideograms on buttons – allows 'instant recognition' of function, caters for colour blindness, caters for a range of languages. Commonly used buttons could be larger or a different shape. Use of white text on black to ease reading. Texture applied to commonly used buttons e.g. volume control. Non-recessed buttons for ease of use. Enclosure design to be comfortable to hold – rounded edges, textured or rubber grip etc. Ease of access to change batteries. Allow any other valid relevant response. No answer or no relevant information presented or discussed.			0
	A basic answer with a few relevant points. Answer will be mainly descriptive and may show confusion between anthropometrics and ergonomics.			1-2
	A good answer with good knowledge and understanding of anthropometrics and ergonomics and how they relate to product design. Answers may be descriptive rather than showing an understanding of how anthropometrics and ergonomics influence design.			3-4
	A detailed answer with an excellent demonstration of knowledge and understanding of anthropometrics and ergonomics and how they relate to product design. A clear distinction between anthropometrics and ergonomics and how they interrelate in the design of products.			5-6

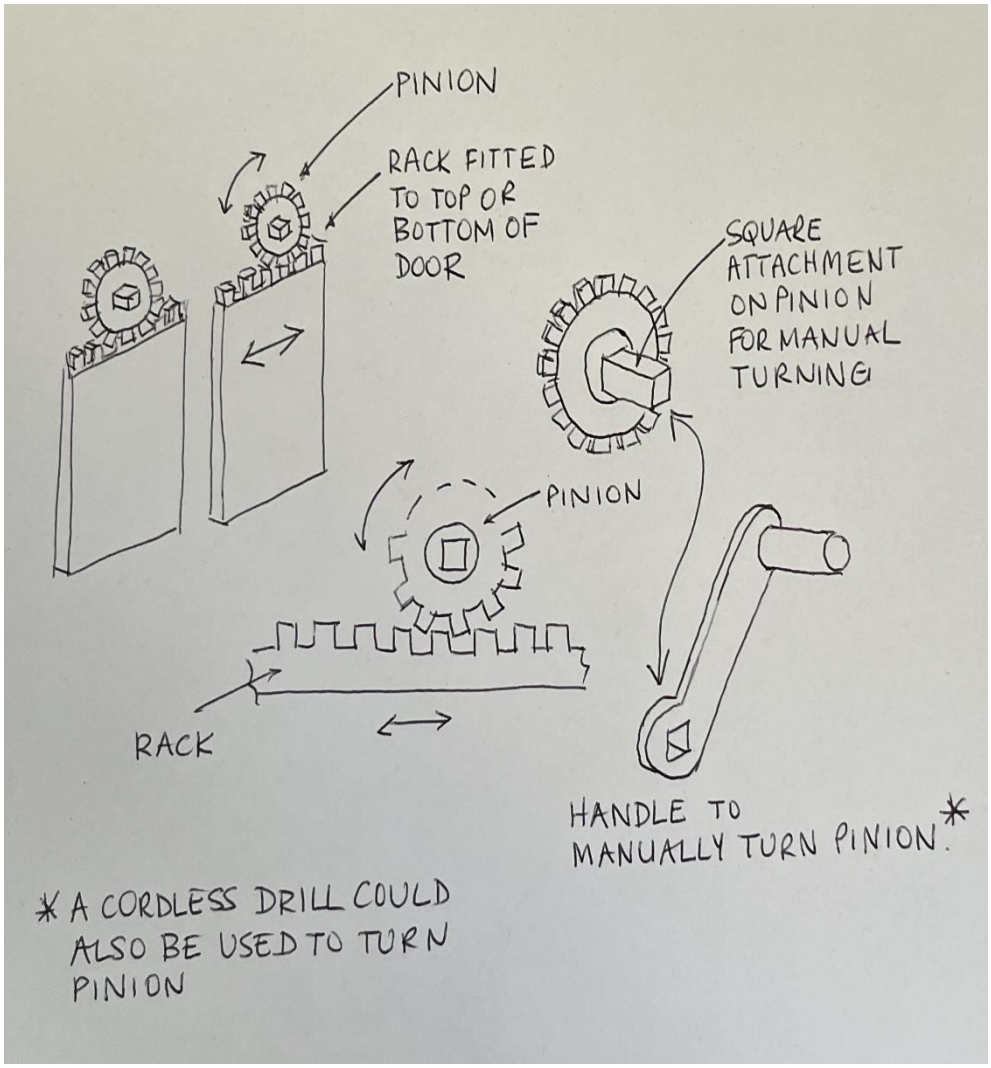
(c)	**The casing for the remote control is manufactured by injection moulding. The mould requires a draft angle.**			**4**
(i)	Explain the purpose of a draft angle.			
	Guidance: A draft angle is a slope that is added to the mould. The draft angle makes sure that the component does not get stuck in the mould. A draft angle ensures that the component can be removed from the mould easily. No answer or no relevant information presented or discussed.			0
	A basic response – a slope that aids removal from the mould.			1
	A more developed response – Draft angles ensure that the part can be released from the mould easily. The draft angle will prevent damage to both the part and the mould. Wear and tear on both the part and the mould is reduced.			2
(ii)	Give **two** reasons why injection moulding is a suitable process to manufacture the remote control casing.			
	No answer or no relevant information presented or discussed.			0
	Guidance: Parts can be mass / batch produced at a low cost. Parts can be produced very quickly. Parts are very accurate. Parts can be produced in a range of polymers. Parts can be easily changed e.g. a wide range of colours. Surface textures can be applied to the parts during the moulding process. Award **ONE MARK** for **EACH** relevant point.			2
			Total	**12**

Question 7

An automatic lighting system with a possible circuit diagram is shown below.		AO3	AO4	Mark
(a)	**Describe an advantage of connecting the lamps in parallel instead of in series.**		✓	**2**
	Guidance: If one lamp fails, the rest will stay on. More lights can be added in future. All lamps will have the maximum brightness. Lower risk of overheating because of the arrangement / current. No answer or no relevant information presented or discussed.			0
	A basic response Lamps will stay on if one in the line fails.			1
	A more developed response – All lamps will remain lit even if one fails. All lamps will maintain maximum brightness and more lamps can be added if required.			2
(b)	**On the diagram below, add a diode that will act to protect the transistor.**			**2**
	 (Do not penalise hollow triangle) **One** mark for correct symbol. **One** mark for correct orientation and connection.			(2x1)

(c)	**The image below shows a commercially produced circuit board where components are positioned using automation and fixed using reflow soldering.**		✓	**8**
(i)	Explain the advantages to the manufacturer of using these techniques			
	Guidance: First, apply a solder paste to the board. The board will move on to the pick and place machine. This machine is a robotic device that places surface mount components on a prepared electric board. Next, ensure the solder and components stay solidified by adhering components to the board; this process is called reflow. After this, the board is transferred to a conveyor belt, which moves through a large reflow oven that heats the board gradually. No answer or no relevant information presented or discussed.			0
	Basic/less developed response: The components are placed on the board automatically and then soldered into place.			1-2
	A more developed response: The components are placed on the pre-soldered board automatically and then soldered into place in an oven.			3-4
	A detailed / developed response: The components are placed on a pre-soldered circuit board. The components are placed automatically, usually by robots. The board is then put into an oven where the components are finally fixed into place by melting the solder.			5-6
	The components are placed on to a pre-soldered circuit board. The components are placed automatically, usually by robots – this method is called Pick and place. The board is then put into an oven where the components are finally fixed into place by melting the solder. This method is called reflow Soldering.			7-8
		Total		**12**

Question 8				
The figure below shows a diagram of a compound gear train.		**AO3**	**AO4**	**Mark**
(a) (i)	**The input gear rotates at a speed of 90 rpm.** **Calculate the speed of the output gear.**		✓	**3**
	No answer or no relevant information presented or discussed.			0
	Overall VR = Product of drivers + Product of driven = (40x80) / (30x20) = 5.33 Or (40/30) + (80/20) = 5.33 Output speed is 90 x 5.33 = =480rpm Accept alternative methods of calculation: RV of A x T = RV of B x T (90 x 40 = 30 x?) = 120rpm RV of C x T = RV of D x T (80 x 120 = 20 x?) = 480 rpm			1 1 1
(ii)	Name the feature shown as **X** on the diagram and state its purpose.		✓	**2**
	No answer or no relevant information presented or discussed. Feature – Keyway / key. Purpose – To prevent gears spinning on shaft / lock gears on to shaft.			0 1 1
(iii)	Describe the reasons why bevel gears are sometimes used when designing mechanical systems.		✓	**2**
	No answer or no relevant information presented or discussed. A basic response: To transmit rotary motion between non-aligned shafts. Or To transmit motion between shafts that are at 90 degrees to each other. Or To change the direction of motion of shafts. A more developed response: To transmit rotary motion through 90 degrees changing the direction of rotation.			0 1 1 1 2

(b)	**In the space below, design a mechanical system that can be used to open the doors in the event of an electrical failure. Add all explanatory notes and labels.**		✓	**5**
	Guidance: • Selection of an appropriate system. • Clear illustration. • Explanatory notes and labels.  			1 2 2
	No answer or no relevant information presented or discussed.			0
	A basic response – Limited solution showing a basic method of opening the door / little or no annotation.			1-2
	A good response – A good range of clear sketches and /or annotations with a good description of the function of the mechanism.			3-4
	A fully developed response – A clearly drawn and annotated solution with a good description of the components, their function and the method of opening the doors.			5
		Total		**12**

Question 9

	AO3	AO4	Mark
"One of the most significant design principles is to omit the unimportant in order to emphasise the important". (Dieter Rams) **Analyse this quote and how this can apply to cradle-to-grave and cradle-to-cradle philosophies.**	✓		**10**

Guidance:
The syllabus does not require an in-depth knowledge of Rams' 10 principles of good design, but the following could be included to illustrate any answer:

Some of the relevant principles of good design, as outlined by Rams, are as follows:

1. **Good design is innovative.** According to Rams, good design should be original and should offer new solutions to problems. It should not be derivative or uninspired.
2. **Good design is long-lasting.** A product should be built to last and should not need frequent replacement or repair. It should be durable and able to withstand wear and tear.
3. **Good design is environmentally friendly.** A product should not have a negative impact on the environment and should be designed with sustainability in mind.
4. **Good design is as little design as possible.** A product should be simple and uncluttered and should not include unnecessary features or decorations. Good design is about achieving the maximum effect with the minimum means.

Reference should be made to the life cycle of products and possible refer to the 6R's, particularly in response to cradle-to-grave approaches.
Reference to a circular economy should also be included in response to cradle-to-cradle approaches.
Reference to the Product Lifecycle chart could be utilised.

Guidance – to summarise:
1 – Be helpful – Good design is useful, innovative, honest, long-lasting, and conscious of its environment. We should serve a greater purpose than just designing products.
2 – Be thoughtful – Good design is aesthetic, understandable, unobtrusive, thorough, and as little design as possible. We should be concerned with more than just raw features and specifications; aesthetic and psychological attributes are critical as well.
"Back to purity, back to simplicity."

	No answer or no relevant information presented or discussed.	0
	Little or no account of any of the relevant principles of good design. Some reference to the product life cycle.	1-2
	A superficial account of any relevant principles of good design and some tentative relationship to the product life cycle. Few, or no, examples included to support the answer.	3-4
	Some inclusion of some of any relevant principles of good design have been included along with a mention of how they relate to the product life cycle. Some reference has been made to the products end-of-life both in regard to cradle-to-grave and cradle-to-cradle approaches. Some examples have been included to support the response.	5-7
	A response that refers to several relevant principles of good design and how they relate to the product life cycle. Consideration has been given to a product from inception (including raw materials) to the eventual disposal (cradle-to-grave), or reintegration (cradle-to-cradle). Examples have been used to elucidate the response.	8-10
	Total	**10**

Question 10

		AO3	AO4	Mark
	Evaluate the reasons why it can be important for companies to introduce a new version of an engineered product every 12–18 months. Marks will be awarded for the content of the answer and the quality of written communication.	✓		**10**
	Candidates should demonstrate knowledge and understanding and apply it to the reasons why companies introduce a new version of an engineered product every 12–18 months to be awarded up to **10 marks** based on: • To block competition. • To fragment the market. • To defend against competition. • To help reposition the organization. • To better meet the needs of existing consumers. • To better need the future needs of the market. • To meet the needs of a new segment. • To increase profitability. • To deliver growth for the organization. • To meet internal goals. • To enter high-growth markets. • To help implement the strategy of the organisation. • To take advantage of excess capacity. • To take advantage of a new resource. • To take advantage of advancements in materials technology. • To take advantage of new and emerging manufacturing technologies. • To meet new legislation. • or any other worthy response. **Guidance to Markers** • Incorrect / no answer			0
	• Limited understanding and application of knowledge and understanding of reasons why products are revitalised regularly. • Limited understanding and application of knowledge and understanding of advancement in the engineering design industry. • There is little evidence of appraisal. • Quality of Written Communication is limited, presenting material with limited coherence, many errors of grammar, punctuation and spelling.			1–3
	• Generally good understanding and application of knowledge and understanding of reasons why products are revitalised regularly. • Generally good understanding and application of knowledge and understanding of advancement in the engineering design industry. • There is some evidence of appraisal which is generally coherent and relevant. • Quality of Written Communication is basic, presenting occasional appropriate material with some coherence, some errors of grammar, punctuation and spelling.			4–6

	• Very good understanding and application of knowledge and understanding of reasons why products are revitalised regularly. • Very good understanding and application of knowledge and understanding of advancement in the engineering design industry. • There is clear evidence of appraisal, which is generally coherent, relevant and substantiated. • Quality of Written Communication is good, presenting mainly appropriate material in a coherent manner, few errors of grammar, punctuation and spelling.	7–8
	• Excellent understanding and application of knowledge and understanding of reasons why products are revitalised regularly. • Excellent understanding and application of knowledge and understanding of advancement in the engineering design industry. • There is a clear and detailed evidence of appraisal which is coherent, relevant and substantiated. • Quality of Written Communication is excellent, presenting wholly appropriate material in a coherent and logical manner, hardly any errors of grammar, punctuation and spelling.	9-10
	Total	**10**