



GCSE MARKING SCHEME

SUMMER 2025

**GCSE
DESIGN AND TECHNOLOGY –
ENGINEERING DESIGN
3601U10-1**

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.

WJEC GCSE DESIGN AND TECHNOLOGY – ENGINEERING DESIGN
SUMMER 2025 MARK SCHEME

Guidance for examiners

Positive marking

It should be remembered that learners are writing under examination conditions and credit should be given for what the learner writes, rather than adopting the approach of penalising him/her for any omissions. It should be possible for a very good response to achieve full marks and a very poor one to achieve zero marks. Marks should not be deducted for a less than perfect answer if it satisfies the criteria of the mark scheme. For questions that are objective or points-based the mark scheme should be applied precisely. Marks should be awarded as indicated and no further subdivision made.

Banded mark schemes

For band marked questions mark schemes are in two parts, the indicative content and the assessment grid. The indicative content suggests the range of points and issues which may be included in the learner's answers. It can be used to assess the quality of the learner's response. Indicative content is not intended to be exhaustive, and learners do not have to include all the indicative content to reach the highest level of the mark scheme. In order to reach the highest level of the mark scheme a learner need not cover all of the points mentioned in the indicative content but must meet the requirements of the highest mark band. Where a response is not creditworthy, that is, it contains nothing of any significance to the mark scheme, or where no response has been provided, no marks should be awarded. In Design and Technology, each question addresses one assessment objective: either AO3 or AO4. The assessment grid sub-divides the total mark to allocate for a question. These are shown in bands in the mark scheme. For each question, descriptors will indicate the different skills and qualities at the appropriate level. Examiners should first read and place a tick in the learner's answer/s to indicate the evidence that is being assessed in that question; the mark scheme can then be applied. This is done as a two-stage process.

Stage 1 – Deciding on the band

Beginning at the lowest band, examiners should look at the learner's answer and check whether it matches the descriptors for that band. If the descriptors at the lowest band are satisfied, examiners should move up to the next band and repeat this process for each band until the descriptors match the answer. If an answer covers different aspects of different bands within the mark scheme, a 'best fit' approach should be adopted to decide on the band and then the learner's response should be used to decide on the mark within the band. For instance, if a response is mainly in band 2 but with a limited amount of band 3 content, the answer would be placed in band 2, but the mark awarded would be close to the top of band 2 as a result of the band 3 content. Examiners should not seek to mark learners down as a result of small omissions in minor areas of an answer.

Stage 2 – Deciding on the mark

During standardising (marking conference), detailed advice from the Principal Examiner on the qualities of each mark band will be given. Examiners will then receive examples of answers in each mark band that have been awarded a mark by the Principal Examiner.

Examiners should mark the examples and compare their marks with those of the Principal Examiner. When marking, examiners can use these examples to decide whether a learner's response is of a superior, inferior or comparable standard to the example. Examiners are reminded of the need to revisit the answer as they apply the mark scheme in order to confirm that the band and the mark allocated is appropriate to the response provided.

Question 1				
Study the images below of the Dyson hair straighteners.		AO3	AO4	Marks
(a)	Dyson use ' <i>primary research</i> ' to gather important information from the market. Describe two methods of collecting primary research.		✓	2 x [2]
	Answers relating to explaining two primary research methods should be awarded up to 4 marks. <i>Accept other similar answer from below:</i> • Surveys • Questionnaires • Interviews • Focus groups • Observations/User trips • Ethnographic study Guidance for marking: Incorrect/no answer Brief explanation with little detail e.g. A questionnaire could be used. More detailed description e.g. A questionnaire could be used to gather relevant information from the target market user. This information will be current and accurate. NB. Up to 2 marks should be rewarded for each method.			0 1 2
(b)	Describe what is meant by the term ' <i>secondary research</i> '.		✓	[2]
	Answers relating to secondary research should be awarded up to 2 marks. <i>Accept other similar answer from below:</i> • Systematic investigation • Solely on existing data • Internet and/or book use Guidance for marking: Incorrect/no answer Brief explanation with little detail e.g. Secondary research is when the researcher uses the internet. More detailed description e.g. Secondary research is a common approach to a systematic investigation in which the researcher depends solely on <i>existing data</i> from places such as the internet, magazines, book etc.			0 1 2

(c)	Explain the advantages of using anthropometric data when designing and modelling the ergonomics of the Dyson hair straighteners.		✓	[4]
	Answers relating to anthropometric data should be awarded up to 4 marks. <i>Accept other similar answer from below:</i> • Size of the product. • Comfortable to hold in the hand. • Comfortable to use in the varied of positions required to straighten hair. • Ease of accessing buttons and controls and user interaction with these features. • Lead / size / shape of plug • Length of heating elements / blades Guidance for marking Incorrect/no answer Brief explanation with little detail e.g. Anthropometric data can be used to get the correct size and help with comfort to hold in the user's hand. Detailed explanation e.g. Anthropometric data can be used when designing to ensure that the user is able to interact with the product in a comfortable manner. This enables them to hold the hair straighteners in a variety of positions. More detailed explanation e.g. Anthropometric data can be used when designing to ensure that the user is able to interact with the product in a comfortable manner. This enables them to hold the hair straighteners in a variety of positions. Buttons and controls can then also be positioned correctly to allow accessibility. Analytical explanation e.g. Anthropometric data can be used when designing to ensure that the user is able to interact with the product in a comfortable manner. This enables them to hold the hair straighteners in a variety of positions with easy to allow ease when straightening one's hair. Buttons and controls can then also be positioned in the most appropriate areas of the product to optimize the user interaction and accessibility.			0 1 2 3 4
Total				10

Question 2				
The diagram below relates to the 6Rs of sustainability		AO3	AO4	Marks
(a)	Complete the table by filling in the two missing Rs of sustainability.		✓	2 x [1]
	Answers relating to 6Rs of sustainability should be awarded up to 2 marks. One mark for each correct answer in the correct order Guidance for marking Incorrect/no answer • Refuse • Repair			0 1 1
(b)	Explain why 'Recycle' is the lowest priority when designing a product compared to other Rs of sustainability.		✓	[4]
	Answers relating to 6Rs of sustainability considerations should be awarded up to 4 marks. Accept other similar answer from below: • Recycle requires heat to reprocess which uses energy. • Recycling is a manufacturing process and usually needs disassembly. • Recycling requires transportation to recycling centres/factories. • Recycling means that lots of energy / materials have already been used to produce the product. • Reusing requires less/no reprocessing of materials to make another product. • Repairing a part of a broken product can prolong the product life. • Repairing a product results in less product obsolescence. Guidance for marking Incorrect/no answer Brief explanation with little detail e.g. Recycling a product requires it to be re-processed using heat. More detailed explanation e.g. Recycling a product requires it to be re-processed using heat this results on an increase of the products carbon footprint. Detailed explanation e.g. Recycling a product requires it to be re-processed using heat this results on an increase of the products carbon footprint. The material is then reprocessed to form a new product which also requires energy. Fully detailed explanation e.g. Recycling a product requires it to be re-processed using heat this results in an increase of the products carbon footprint. The material is then reprocessed to form a new product which also requires energy. It may be an advantage to repair a broken product or replace a broken part which would have less negative environmental impact. <i>Credit other responses which may be correct.</i>			0 1 2 3 4

(c)	Explain one advantage and one disadvantage of reusing a PCB (printed circuit board) to produce the cover of the notebook shown below.		✓	2 x [2]
	Answers relating to the 6R's and should be awarded up to 4 marks. Advantages: • The circuit board is used in a second product with minimum heat treatment. • The circuit board is used in a second product without disassembly of the whole existing product. • Circuit board does not go to landfill and has another use. • A PCB is a hard, rigid and flat item suitable for a cover of a notebook. Disadvantages: • Precious metals such as gold, copper etc. are not reused in other electrical products. • Some level of machining is required to produce the new product therefore energy is required to manufacture. (e.g. drilling holes for binding) • PCB might need to be trimmed / cut to the specific notebook size. • Cost of repurposing and manufacturing. Guidance for marking Incorrect/no answer. Brief explanation with little detail e.g. A disadvantage is that precious metals such as gold, copper etc. are not reused in other electrical products. More detailed description e.g. A considerable disadvantage is that the precious metals such as gold, copper etc. in the circuit are not reused in other electrical products. Therefore, these metals will be mined to ensure the electrical development of other products. <i>2 marks for one advantage & 2 marks for one disadvantage.</i>			0 1 2
Total				10

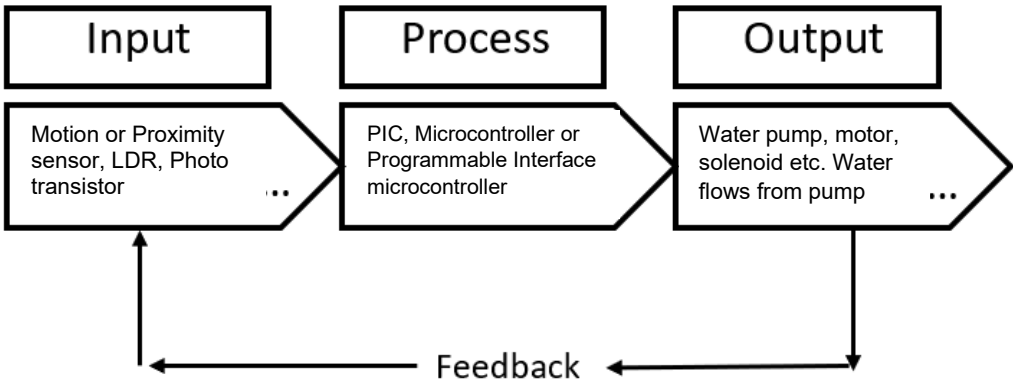
Question 3				
		AO3	AO4	Marks
(a)	Modern and smart materials often provide designers with opportunities to develop innovative products. Describe what is meant by the term 'smart material'.		✓	[2]
Answers relating to two considerations should be awarded up to 2 marks.				
<i>Accept other similar answer from below:</i>				
Smart materials are designed materials that have one or more properties that can be significantly changed in a controlled fashion by external stimuli, such as stress, moisture, electric or magnetic fields, light, temperature, pH, or chemical compounds.				
Guidance for marking				
Incorrect/no answer				0
Brief definition with little detail e.g. Smart materials are materials that change with external stimuli				1
More detailed definition e.g. Smart materials are materials that have one or more properties that can be changed in a controlled fashion by external stimuli, (such as stress, moisture, electric or magnetic fields, light, temperature, pH, or chemical compounds.)				2

(b) (i)	Complete the table below by selecting the two correct names for the smart materials shown in each image.		✓	2x[1]
	Answers relating to smart materials should be awarded up to 4 marks. Guidance for marking Incorrect/no answer • Thermochromic (left) • Polymorph (right)			0 1 1
(ii)	Select one of the smart materials listed above, name a different product and explain how this smart material enhances the product's function.		✓	[1]+[3]
	Answers relating to smart materials should be awarded up to 4 marks. <i>Accept other similar answer from below:</i> SMA (shape memory alloy): example product – Spectacles Shape memory alloys (SMA) undergo phase transformation when the temperature passes certain values. The metallurgical phases involved in this process are the low-temperature martensite and the high-temperature austenite. THERMOCHROMIC: example product – babies' spoon/thermometer Thermochromic is a material undergo changes in colour with the stimuli for temperature. POLYMORPH: example product – modelling handles Polymorph is a thermoplastic material that can be shaped and reshaped any number of times. It can be heated in hot water; when it reaches 62°C, the granules form a mass of 'clear' material. When removed from the hot water it can be shaped into almost any form and on cooling it becomes as solid as other plastics, such as nylon. QTC (quantum tunnelling composite): example product – touch screen smartphones QTC is a flexible polymer that exhibits extraordinary electrical properties. In its normal state it is an insulator but when under compressive force it becomes a conductor. The greater the compression the more current passes through. Guidance for marking Incorrect/no answer Suitable product example. Brief explanation with little detail e.g. Polymorph can be shaped and reshaped in hot water. When removed from the hot water it can be shaped and when cooled it becomes a solid. Detailed description e.g. Polymorph can be shaped and reshaped any number of times. It can be heated in hot water; the granules form a mass of 'clear' material. When removed from the hot water it can be shaped and when cooled it becomes as solid as other plastics. More detailed description e.g. Polymorph is a thermoplastic material that can be shaped and reshaped any number of times. It can be heated in hot water; when it reaches 62°C, the granules form a mass of 'clear' material. When removed from the hot water it can be shaped into almost any form and on cooling it becomes as solid as other plastics, such as nylon.			0 1 1 2 3

(c) (i)	The ski goggles shown below use a magnet to attach the lens. Explain the benefit to the user of using a magnetic fixing.		✓	[3]
	Answers relating to fixings should be awarded up to 3 marks.			
	• More options for the user to interchange different visors. • The function of the product is optimized as the goggles can be used in more conditions. • Ease of changing to a different or more suitable lens. • Magnets are quick and easy to use as a fixing. • Can reduce material use as only the visors require more materials to be manufactured and the user will not require a whole new pair of goggles. • Easier to replace / repair / maintenance of a visor than purchase new ski goggles			
	Guidance for marking			
	Incorrect/no answer			0
(c) (ii)	A photochromic lens is used to replace the existing lens in the ski goggles. Explain how the new photochromic lens will function and how this benefits the user.		✓	[4]
	Answers explaining how photochromic works and benefits the user should be awarded up to 4 marks.			
	Guidance for marking			
	Incorrect/no answer			0
	Up to 2 marks for the function			
• Photochromic lens will react to different level of UV light • In sunny / bright conditions the lens will automatically darken • In darker conditions, the lens will remain transparent / no dimming			1	
Up to 2 marks for the benefits to the user				
• No need to interchange lenses when light levels change • No need to stop skiing to change lens • Less likely to lose / misplace / need to carry spare / alternative lenses • Protect eyes against UV rays (at optimum time)			1	
Must be a balanced response 2 + 2.			1	
Total				15

Question 4				
Study the images below of the successful products from Shigeru Miyamoto and Apple.		AO3	AO4	Marks
(a)	Analyse how the user interface for these products is so successful.	✓		[10]
Marks will be awarded for the content of the answer and the quality of written communication. Answers relating to analysing the work of Shigeru Miyamoto and Apple should be awarded up to 10 marks. <i>Accept other similar answer from below:</i> Shigeru Miyamoto: • Donkey Kong was a designed to transform unsold units of ‘Radar Scope’. • Overall game play remains the same e.g. boss/bad guy at top, hero at bottom climbing to save the princess. • Based around Pop Eye (very popular cartoon of the time). • Miyamoto has used and developed the iconic character into other newer games e.g. Mr. Video, Jumpman to Super Mario. • Very few controls to operate the video game, e.g. Joypad to move character around and a button to jump. • Option for 1-player or 2-player mode. • Video game aesthetics are colourful, bright and eye catching. • The video game platform design is simplistic and repetitive with minimal functions. • High score used to keep players interested. • A wide range of different level layouts used. • Uses extra lives, level up, bonuses and increase speed to keep players motivated and challenged. • The game was designed with a ‘Boss/bad guy’ to build the sense of accomplishment for the user. Later games develop into end of level bosses. • Donkey Kong appeared in Mario games, e.g. Mario cart Apple: • Apple also design using the ‘user centred design’ approach. • The design is simple and straightforward, not complex for the user. • The product functions very well with uncomplicated navigational controls. • Simple elegant designs. • Colour LCD screen used to display album art for music. • Interface operated with minimum controls. • Few buttons and controls. • Use of handheld portable devices for everyday use. • Convenient to use daily. • Apple later developed touch screen /GUI design/ camera made it a market leader in a short space of time. Also, simplified operations for user interface. • High resolution displays. • App’s/music can be downloaded making the product unique for individual users.				

	Guidance for marking Incorrect/no answer Brief analysis with little detail of each of the similarities and differences of Shigeru Miyamoto and Apple's user interfaces and products. Quality of Written Communication is limited, presenting material with limited coherence, many errors of grammar, punctuation and spelling. e.g. One or two points from the above list conveyed in a very simple fashion. See list above. More detailed analysis, with some explanation and detail of the similarities and differences of Shigeru Miyamoto and Apple's user interfaces and products. Quality of Written Communication is basic, presenting occasionally appropriate material with some coherence, some errors of grammar, punctuation and spelling. e.g. Several (3-4 points) conveyed in a simple fashion. See list above. Detailed analysis and explanation of each of similarities and differences of Shigeru Miyamoto and Apple's user interfaces and products. Quality of Written Communication is good, presenting mainly appropriate material in a coherent manner, few errors of grammar, punctuation and spelling. e.g. A good range of points conveyed clearly and well. See list above. Clear and detailed analysis and explanation of similarities and differences of Shigeru Miyamoto and Apple's user interfaces and products. Quality of Written Communication is excellent, presenting wholly appropriate material in a coherent and logical manner, hardly any errors of grammar, punctuation and spelling. e.g. Many points conveyed articulately (8 or more) See list above.	0 1-2 3-4 5-7 8-10
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(b)	The image below shows an automatic water dispenser. The water dispenser uses a PIC (Programmable Interface Controller) IC to control the flow of water from a pump when the bottle is near the sensor.			
(i)	Complete the block diagram by adding the input, process and output components for the automatic water dispenser.		✓	[3]
	Answers relating to block diagrams should be awarded up to 3 marks. <i>Accept other similar answer from below:</i>  Guidance for marking Incorrect/no answer As above <i>1 mark for each correct answer. Any of the Input, Processes and Output displayed in the correct box gain a mark.</i>			0 1-3
(ii)	Describe the use of feedback in the block diagram.		✓	2
	Answers relating to feedback in block diagrams should be awarded up to 2 marks. <i>Accept other similar answer from below:</i> • Feedback uses output data/information/readings of the system. It applies this information to the input signal in order to get the required output causing variation in the system. • Guidance for marking Incorrect/no answer Brief explanation with little detail e.g. Feedback uses readings in the system to control the input signal. More detailed description e.g. Feedback readings and data in the system and applies this information to the input signal in order to get the required output causing variation in the system. NB: Accept responses that are directly related to the previous block diagram.			0 1 2

(c)	Study the circuit diagram below used in the automatic water dispenser.			
(i)	Describe one advantage of using the PIC.		✓	[2]
	Answers relating to one advantage of using PIC should be awarded up to 2 marks. <i>Accept other similar answer from below:</i> • The size of a circuit can be significantly reduced. This is because programming a PIC can replace other physical components that would be required to do the same job. • PICs can be reprogrammed many times. This allows changes to be made without replacing or making different circuits. • PICs have pins for connecting input and output devices, this adds to flexibility when design circuits. • PICs can be purchased in different sizes for more inputs and outputs. • PICs have low power consumption. Guidance for marking Incorrect/no answer0 Brief explanation with little detail e.g. A PIC has a range of pins for connecting input and output devices.1 More detailed description e.g. A PIC has a range of pins for connecting input and output devices. They can also come in different sizes for more inputs and outputs; this adds to flexibility when design circuits.2			
(ii)	Explain the disadvantages of using a PIC in products like the automatic water dispenser.		✓	[3]
	Answers relating to disadvantages of using PIC should be awarded up to 3 marks. <i>Accept other similar answer from below:</i> • They often cost more than traditional integrated circuits. Therefore, may not always be the best option for simple systems/circuit. • Programming software and hardware is required. This can be expensive to buy therefore, there are additional set up costs. • The programming language of the system must be learned, and this adds to training needs and additional costs. • Credit any additional responses worthy of credit Guidance for marking Incorrect/no answer0 Brief explanation with little detail e.g. Programming software and hardware is required.1 Detailed description e.g. Programming software and hardware is required. This can be expensive to buy therefore, there are additional set up costs.2 More detailed description e.g. Programming software and hardware is required. This can be expensive to buy. There is also the need for training and learning the programming language to operate the system. Therefore, there are additional set up and training costs when using Programmable Interface Controllers.3			
Total				20

Question 5

Study the image below of the children's hoverboard Go-Cart.

AO3

AO4

Marks

(a)

Using notes and sketches, explain the process of riveting the polypropylene seat to the steel plate underneath.

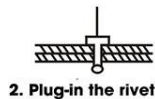
✓

[5]

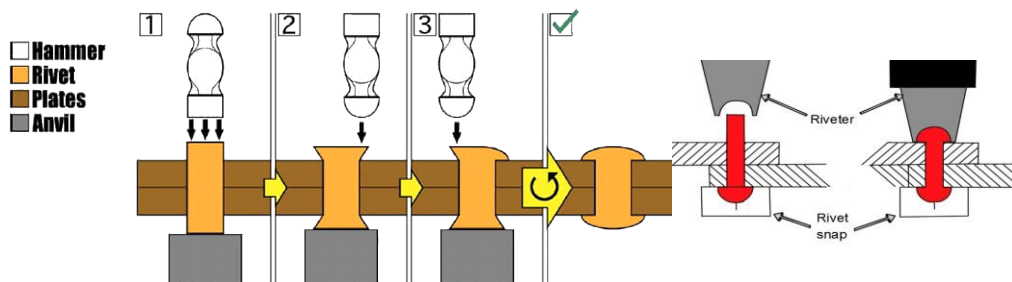
Answers relating to riveting processes should be awarded up to 5 marks.

Accept other similar answer from below:

How to use the rivet gun.



OR



Guidance for marking

Incorrect/no answer

0

Maximum of 3 marks for notes without sketches or sketches without notes

Limited level of understanding and description of the processes. Some stages addressed. Some adequate diagrams.

1-2

Satisfactory level of understanding and description of the processes with most to nearly all stages addressed. Some good communication through diagrams.

3-4

Strong level of understanding and description of the processes with nearly all to all stages addressed. Good communication through diagrams.

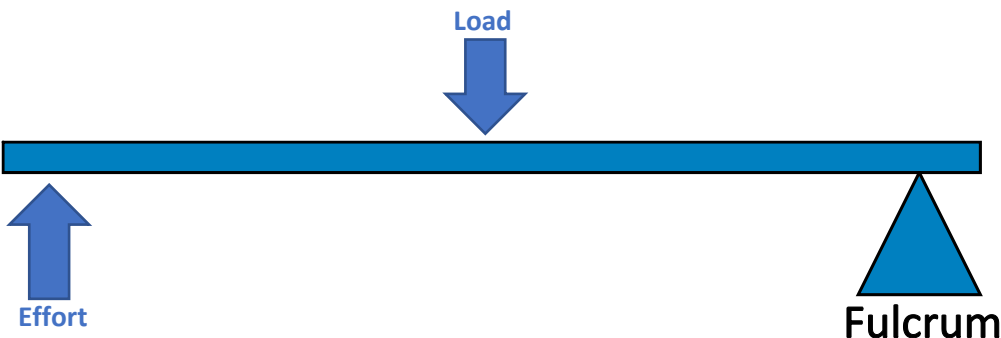
5

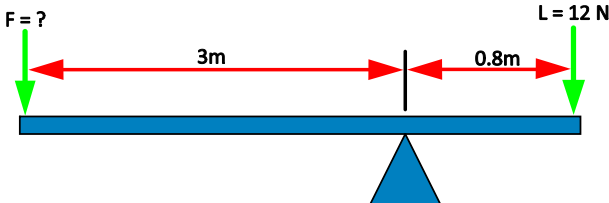
(b) (i)	Describe the reason for painting the mild steel frame.		✓	[2]
	Answers relating to one advantage should be awarded up to 2 marks. <i>Accept other similar answers from below:</i> • Steel is a ferrous metal and will rust with oxygen and H₂O • Steel needs to have a protective coat to ensure it is resistant to rust. • Paint is effective in the protection of steel. • To provide different colours to suit customer preference. Guidance for marking Incorrect/no answer Brief explanation with little detail e.g. Steel is a ferrous metal and will rust with oxygen and water More detailed description e.g. Steel is a ferrous metal and will rust with oxygen and water, therefore, needs to have a protective coat to ensure it is resistant to rust. Paint is effective in the protection of steel.			0 1 2
(ii)	Explain why polypropylene is a suitable material for the seat of the Go-Cart.		✓	[3]
	Answers relating to explaining why polypropylene is a suitable material for the seat of the Go-Cart should be awarded up to 3 marks. <i>Accept other similar answer from below</i> • Polypropylene has elasticity and toughness: elasticity over an early range of deflection, so it is considered a tough plastic. It can deform (plastically, not elastically) without breaking. • Polypropylene is fatigue resistant: retains its shape after a lot of torsion, bending, and/or flexing. This property is especially valuable for a seat. • Polypropylene is a thermoplastic. Polypropylene become liquid at their melting point (roughly 130°C). This temperature is very unlikely to be reached on a child's Go-Cart seat. However, making it easy to mould and re-mould into shape and recycle. • Polypropylene can be moulded (injection moulded) into complex ergonomic shapes. • Can be injection moulded with low levels of waste. • Can be mass produced cheaply and quickly in various colours Guidance for marking Incorrect/no answer Brief explanation with little detail e.g. Polypropylene is able to be moulded (injection moulded) into complex shapes. Detailed description e.g. Polypropylene is able to be moulded (injection moulded) into complex seat shape for comfort for the user. More detailed description e.g. Polypropylene is able to be moulded (injection moulded) into complex seat shape for comfort for the user. It is also a thermoplastic therefore it can be recycled at the end of the product's life cycle.			0 1 2 3

(c)	Evaluate the role of the powder-coated steel spring system.	✓	[5]
	Answers relating to evaluating the powder coating should be awarded up to 5 marks. • The role of the powder coated steel springs is to provide shock absorption. • The springs absorb the impact of a ride for the user • Users can lower the seat / adjust the amount of compression in the spring. • Springs can be replaced once failed. • The adjustable wheel allows you to set the compression in the spring. • Dampers dissipate some of the energy released by the spring making the bounce felt by the user to reduce. • Powder coating reduces the amount of maintenance the steel spring will need. • Including a powder coating there is no need to oil and lubricate the steel spring. • Powder coating adds cost as it is an additional manufacturing process. • Powder coating is very durable, usually last up to 20 years or more. • Powder coatings in aesthetically pleasing and can match any colour go-cart. • Powder coating prevents rusting of string. • Easy to wash if dirty. • Powder coating offers a high standard finish that is hardwearing. Guidance for marking Incorrect/no answer Simplistic evaluation but no reasoning limited understanding evident. E.g. The springs absorb the impact of a ride for the user. Some evaluation evident and limited reasoning. Some understanding evident. E.g. The springs absorb the impact of a ride for the user and the dampers dissipate some of the energy released by the spring making the bounce felt by the user to reduce. Clear evaluations with detailed reasoning. Detailed understanding evident. E.g. The springs absorb the impact of a ride for the user and the dampers dissipate some of the energy released by the spring making the bounce felt by the user to reduce. The user can adjust the amount compression in the spring for different level of firmness when riding. Powder coating reduces the maintenance needed as there is no need to oil the steel spring. The spring system's aesthetics can match the colour for different go-carts which will produce a larger target market to sell the product to.		0 1 2-3 4-5

(d)	Evaluate the use of temporary fixings compared to the welded sections of the Go-Cart.	✓		[5]
	Answers relating to evaluating the temporary fixings and welding should be awarded up to 5 marks. Temporary fixings: Advantages • Temporary fixings such as nuts, washers, bolts, self-tapping screws, and press fittings. • Parts can be assembled and disassembled. • Products can be shipped and stored as flat pack to save space. The users can assemble at home. • Can reduce the manufacturing cost as assembly costs are removed resulting in lower cost products for the customer. • Standardised bought in parts (JIT) • Allows movement / adjustment for performance reasons. • Some temporary joints allow interchangeable parts for sizing reasons this prolongs the product life. Disadvantages • Drilling of the metal is required in most cases. Additional processing increases production line activities. • A high level of accuracy/high tolerances is required to enable fixings to fit easily and correctly. • Machining and/or processing of bars is often needed prior to assembly to enable fixings to sit flush. Welding: Advantages • Welding produces a permanent joint. Once welding is done, it won't be easy to separate the joint unless you dismantle them. • Superior strength– usually, the welded connections are very strong. This is especially when fillers and the right technique are used. • No hole drilling– as opposed to the riveted joint, and other types of joints the welding process does not need holes drilled on its components. Drilled holes can reduce space and strength altogether. • High load-carrying capacity– the load-carrying power remains high even if the parts are welded. • Join various parts of different shapes– welding can join numerous shapes like rods, sheets, plates, among others. This makes the welding process special compared to other jointing methods. Disadvantages • Surface must be prepared prior to welding to ensure a high standard of finish. • Specialist PPE is required for safety when welding. • Considerable energy used. The whole process needs considerable energy, which is dangerous. • A manual job and it is required to be done by a trained person. • Can be difficult and time consuming to master/to become competent/professional.			

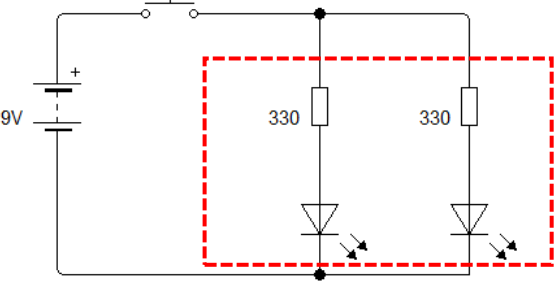
	Guidance for marking	
	Incorrect/no answer	0
	Simplistic evaluation but no reasoning limited understanding evident. E.g. Temporary fixing like nuts and bolts can be used so parts can be taken apart. Welding is permanent therefore, cannot be taken apart.	1
	Some evaluation evident and limited reasoning. Some understanding evident. E.g. Temporary fixing like nuts and bolts can be used so parts can be assembled and disassembled when needed. This makes it easier to ship products to customers. Welding is a strong joining method of metals, however; this makes it more difficult to store products in small spaces.	2-3
	Clear evaluations with detailed reasoning. Detailed understanding evident. E.g. Temporary fixing like nuts, bolts with washers can be used so parts can be assembled and disassembled when needed. This reduces the cost of a product like the go-cart as it prevents assembly costs in a factory it also helps to makes it easier to ship products to customers as the product can be boxed in a smaller space. Although temporary fixing can reduce cost it is essential for the drill/machining of the parts to be accurate with high tolerances to ensure parts fit together. Welding is a very strong joining method of metals which does not require the drilling of the metal to produce the join. However, this method of permanently joining metals is difficult to produce at a high standard and people require training to become professionals to produce high standard welding. Welding also makes it more difficult to store products in small spaces as metal parts are permanently joined into complexed shapes and forms.	4-5
Total		20

Question 6				
The diagram below shows a second-class lever.		AO3	AO4	Marks
(a) (i)	Correctly label the diagram to show the effort and the load.		✓	[2]
Answers relating to the levers should be awarded up to 2 marks. <i>Accept other similar answer from below:</i>  Guidance for marking Incorrect/no answer <i>1 mark for each correct answer up to 2 marks in total.</i>				1 1 0 X2
(ii)	Describe why a third-class lever can be considered the least effective type of lever.		✓	[2]
Answers relating to levers should be awarded up to 2 marks. <i>Accept other similar answer from below:</i> - There is no mechanical advantage because the effort is greater than the load. - Effort moves further than the load. Guidance for marking Incorrect/no answer Brief explanation with little detail e.g. No advantage to the user. More detailed description e.g. There is no mechanical advantage because the effort is greater than the load.				0 1 2

(a) (iii)	Use the principal of moments to calculate the effort needed to balance the seesaw.		✓	[4]	
	Answers relating to calculating moments should be awarded up to 2 marks. <i>Accept other similar answer from below:</i>				
					
	Guidance for marking Incorrect/no answer • Clockwise moments = Anti-clockwise moments OR • Force (F) x Distance (d) = Load (L) x Distance (d) • Force (F) = $\frac{\text{Load (L)} \times \text{Distance (d)}}{\text{Distance (d)}}$ • Force (F) = $\frac{12\text{N (L)} \times 0.8\text{m (d)}}{3\text{m (d)}}$ • Force (F) = 3.2N <i>NB: Give 1 mark for each correct step. If steps are missing only award marks for the step that are present and correct.</i>			0 1 2 3 4	
(b) (i)	The table below shows three tools commonly used in engineering design. Complete the table below by adding the name of each of the tools shown		✓	3 x [1]	
	Answers relating to completing the table should be awarded up to 3 marks. Guidance for marking Incorrect/no answer Engineering square (accept Engineers square, do not accept tri-square) Steel rule, metal rule or rule (no marks for ruler) Centre punch			0 1 1 1 X3	

(b) (ii)	Describe what is meant by the term 'tolerance' in engineered products.		✓	2x[2]
	Answers relating to engineering tolerance should be awarded up to 2 marks. <i>Accept other similar answer from below:</i> Engineering 'tolerance' is the acceptable variation in measurements deriving from the base measurement. Tolerances can apply to many different units. E.g. tolerances for temperature (° C), humidity (g/m³), size (mm), force (N) etc. In mechanical engineering, we are mainly talking about tolerances that apply to linear, angular, and other physical dimensions. Guidance for marking Incorrect/no answer Brief explanation with little detail e.g. Tolerance in engineering is the acceptable variation in measurements agreed from the base measurement. More detailed description e.g. Tolerance in engineering is the acceptable variation in measurements agreed from the base measurement. This means that is a product need to be 100mm long, but the tolerance is +/-0.5mm it is acceptable for it to be between 99.95mm to 100.05mm long.			0 1 2
(c) (i)	Study the two cam and follower mechanisms shown below. In the spaces below, describe what happens to each of the followers when each cam rotates once.		✓	2 x [2]
	Answers relating to cams should be awarded up to 4 marks. <i>Accept other similar answer from below:</i> Pear shaped cam: - The follower will briefly stay at the same level (dwell) based on its position in the question paper. - It will rise at a steady pace. - It will reach the highest point and begin to lower (fall) at the same rate as the rise. - It will finish falling and will reach its lowest point remaining at this height until it completes the rotation (dwell) it then starts again. Square cam: - The follower will fall slightly and quickly. - It will then rise slightly and quickly. - This process is repeated three more times for one complete rotation. Guidance for marking Incorrect/no answer Brief explanation with little detail e.g. describes the rise and fall motion only. More detailed description e.g. describes the whole processes of movement with key words like rise, fall and dwell.			0 1 2 X4

(c) (ii)	The illustration below shows a hurricane sequence. A Science department would like a mechanical visual aid (automata) made to explain the basic principles of a hurricane. Design the cam system for the hurricane automata. Use the 'automata specification' and the diagram below to complete the design.		✓	[3]
	Answers relating to automata design should be awarded up to 3 marks. Guidance for marking Incorrect/no answer • Wheel shape / accept bevel gear arrangement • Wheel position to the side of the follower • A cam with an obvious rise and fall. NB. 1 mark for each correct feature.			0 1 1 1 X3
(iii)	Name a suitable output to illuminate the acrylic back piece. Answers relating to lighting outputs should be awarded up to 1 mark. • LED • Bulb / lamp • Neon light • Fibreoptic • Electro-luminescent wire Guidance for marking Incorrect/no answer Correct answer (as above)		✓	[1]

(c) (iv)	The lightning image will be applied using a laser cutter. Explain why the lightning images are a different colour to the outer shape.		✓	[2]
	Answers relating to laser cutter manufacture should be awarded up to 2 marks. • The black image is to be engraved / rastered. • Engraving / rastering will only go part way through the material. • The red design will be cut the whole way through the acrylic. Guidance for marking Incorrect/no answer Brief explanation with little detail e.g. The red line needs to be cut the whole way through the acrylic. The black image will out be engraved. More detailed description e.g. The red line needs to be cut the whole way through the acrylic where the black lightening image will only be engraved park way through. If they were the same colour the same settings would be carried out to all parts of the design.			0 1 2
(v)	Complete the circuit diagram for the automata below. Answers relating to completing the circuit diagram should be awarded up to 2 marks. • LED with resistor • Bulb  Guidance for marking Incorrect/no answer First LED or bulb output component symbol Second LED or bulb output component symbol A resistor with no LED <i>NB: LEDs would need resistors and be facing the correct way around. Only awarded 1 mark in total if this is missing.</i>		✓	[2] 0 1 1 1 X2
Total				25