



GCSE MARKING SCHEME

AUTUMN 2021

**DESIGN AND TECHNOLOGY – COMPONENT 1
C600U10-1**

INTRODUCTION

This marking scheme was used by WJEC for the 2021 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GCSE DESIGN & TECHNOLOGY
COMPONENT 1: PRODUCT DESIGN
AUTUMN 2021 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 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 levels 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 it contains nothing of any significance to the mark scheme, or where no response has been provided, no marks should be awarded. 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.

Section A

Answer **all** questions

This question is about Design and Technology and our world.

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
1. (a) (i)		1	Give one reason why the size of the product is designed to be compact. [1] • Easy to store – ergonomic design can fit into a person's hand/pocket • Easy to carry – portable • Small in size – lightweight <i>Credit any other appropriate response.</i>	AO4 1b [1]	1
(ii)	✓	1	Using the sizes provided calculate the diameter of the Power Bank. [1] Dia. = $r \times 2$ $12 \times 2 = 24\text{mm}$ Only acceptable answer for the calculated diameter of the Power Bank is 24mm.	AO4 1c [1]	1
(iii)	✓	1	The Power Bank has a label wrapped around the outside. Calculate the missing size 'X' of the label. <i>Show all workings.</i> [1] Award 1 mark for each correct step in the calculation. 3.142 x diameter $3.142 \times 24 = 75.408\text{mm}$ Accept answers that are within 1 or 2 decimal points. <i>Credit any appropriate approach to calculating the missing size 'X'</i>	AO4 1c [2]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(iv)	✓		Explain one disadvantage to the consumer of using a Power Bank. [2] 1 mark for identifying a disadvantage and one for clear explanation. For example: The Power Bank does always need to be carried (1) even though it may only need to be used infrequently (1). When it does need to be used, the consumer may have left it charging at home (1). • The Power Bank has to be fully or partially charged for use. • The Power Bank will require appropriate cables to be carried. • The Power Bank may not be compatible with all devices. Do not accept cost – question relates to use of Power Bank <i>Credit any other appropriate response.</i>	AO4 1c [2]	2
(b) (i)			Explain the meaning of the term ‘technology push’. [2] Award up to two marks for a clear explanation. Technology Push is when a new product/component/material has been developed based on new research and technological advancement. Technological developments are the driving force behind the design. <i>Credit any other appropriate response.</i>	AO4 1b [2]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(ii)			Mobile phone screens have been influenced by technology push. Discuss how technology push has influenced the design of a mobile phone screen. [2] Answers must relate to technology push and reference a mobile phone screen. For example: Mobile phone screens are/were easily scratched and damaged (1). This does not affect the general day-to-day use of a phone but can affect the applications available such as the use of the camera (1). Replacing the screen with a scratch resistant material ensures long-life and fully operational usage (1). The technological development made the screens more flexible and allowed for touch screen technology. - key boards became part of the screen. <i>Credit any other appropriate response.</i>	AO4 1a [2]	2
				Total	10

This question is about materials technology.

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
2. (a) (i)	✓		The image shows a protective glove which is made from a technical material. State the name of the technical material used. [1] Only acceptable answer is Kevlar.	AO4 1a [1]	1
(ii)			Describe why this technical material is used to make protective clothing. [2] 1 mark for correct reason and 1 mark for relating to clothing. For example: The material is woven forming a lattice structure (1) which provides resistance to impacts/force (1) which offers protection. Acceptable answers may relate to protection and/or clothing: • Strong/tough synthetic fibre • Flexible • Lightweight • Durable • Resistance to heat • Resistance to chemicals • Comes in a range of colours and can be colour coded for specific uses. <i>Credit any other appropriate response.</i>	AO4 1b [2]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(b)	✓		The image below shows sportswear manufactured from an interactive fabric. Explain the term 'interactive fabric'. [2] 1 mark for correct understanding of the term interactive fabric and 1 mark for relating to sportswear and/or clear explanation. For example: An interactive fabric is a fabric that has a circuit or electronic device built into it/integrated/embedded into it (1) that will respond to or benefit the user by communicating the effectiveness of physical activity. (1) <i>Credit any other appropriate response.</i>	AO4 1c [2]	2
(c)	✓		Describe one benefit to the user when wearing interactive sportswear. [2] 1 mark for example of benefit and 1 mark for describing with clarity. For Example: To improve performance an athlete could monitor their heart rate to see if they are performing to their maximum capacity. Other examples: • Measure heart rate • Blood pressure • Tracking performance • Comparing performances • Monitoring body temperature/sweat etc. <i>Credit any other appropriate response.</i>	AO4 2c [2]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(d)	✓		Analyse the disadvantages of using interactive fabrics in sportswear. [3] A maximum of two marks for stating appropriate disadvantages without analysis. Two disadvantages need to be analysed to be awarded 3 marks. Examples of correct responses include: • Devices can look unattractive on sports wear • Position of the device is critical so that they are not damaged, and they can record performance accurately (e.g. rugby shirts – placed behind collar) • Maintenance/care of the fabric is essential to ensure a longer life, and this can be challenging • Cost – too expensive for most people to be able to afford • Availability – is improving but fit of outfit is essential so effective results mean custom made is preferred • Portable power supply is required - possibility that new batteries or rechargeable batteries will be required. <i>Credit any other appropriate response.</i>	AO3 2a [3]	3
				Total	10

This question is about electronic systems, programmable components and mechanical devices.

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
3. (a) (i)	✓		Read the following two statements and circle if they are True or False. A pulley is a wheel with a groove running around the outside. True or False [1] The drone does not need an energy source to fly. True or False [1] <i>Award 1 mark for each correct answer.</i>	AO4 1b [2]	2
(ii)	✓		The diagram below shows the pulley system used in the drone. Explain why the driven pulley rotates slower than the driver pulley. [2] Two marks can be awarded for a short but clear explanation. For example: • one revolution of the driver is half the revolution of the driven pulley. • The driver pulley is half the size of the driven pulley. • If the driven pulley rotates one revolution per minute, this means that the driven pulley can only rotate half a rotation in one minute. <i>Credit any other appropriate response.</i>	AO4 1b [1] AO4 1c [1]	2
(iii)	✓		The pulley system has a velocity ratio of 1:2. The speed of the driver pulley is 20 revolutions per minute. Calculate the speed of the driven pulley. <i>Show all workings.</i> [2] Velocity ratio = 1:2 Speed of driven pulley = A/? Speed of driver pulley is 20 (1) Speed of driven pulley = $\frac{20 \times 1}{2} = 10$ revs / minute (1) <i>Credit any other appropriate method of calculation.</i>	AO4 1b [1] AO4 1c [1]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(iv)		✓	Calculate the length of the pulley belt required for the system. <i>Show all workings.</i> [3] $3.142 \times 20 = 62.84$ (1) (this gives you the circumference of the circle) $2 \times 50 = 100$ (1) (this gives you the length between the centres of the pulleys) Total length off the cable $(100 + 62.84) = 162.84$ (1) <i>Credit any other appropriate method of calculation.</i>	AO4 1b [1] AO4 1c [2]	3
(v)			Explain one advantage of using a pulley system when developing the design of the drone. [2] Two marks can be awarded for a short but clear explanation of one disadvantage. • Pulleys are readily available and in different sizes. • Pulleys are readily available and in different forms – i.e flat pulleys, V pulleys etc. • Easy to change the size of the pulleys. • Easy to change belts. • Pulleys can be designed to be lightweight essential for the drone to fly. <i>Credit any other appropriate response.</i>	AO4 1b [2]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(b)			Discuss in detail the social and moral issues of flying drones in public spaces. [4] One mark for each social and/or moral issue identified up to a maximum of three. Two issues discussed well should be awarded full marks. Answers must relate to social or moral issues. Examples of factors could include: • Noise pollution. • Invasion of a persons privacy. • Appropriate licences maybe required. • Environmental issues – flying drones in inappropriate places. • Advantages – if appropriately discussed should be credited. <i>Credit any other appropriate response.</i>	AO4 1b [1] AO4 2a [2] AO4 2b [1]	4
				Total	15

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total						
4. (a) (i)			Complete the table shown below, by correctly placing a tick (✓) in the box. [1] <table><tr><td>Description</td><td>True</td><td>False</td></tr><tr><td>Natural polymers come from plants or animals.</td><td>✓</td><td></td></tr></table>	Description	True	False	Natural polymers come from plants or animals.	✓		AO4 1a [1]	1
Description	True	False									
Natural polymers come from plants or animals.	✓										
(ii)			Name a suitable synthetic textile material for the body of the storage bag. [1] Polyester Nylon Polypropylene <i>Credit any other appropriate response.</i>	AO4 1a [1]	1						
(iii)			Describe one property of the synthetic textile material that makes it suitable for outdoor use. [2] One mark for correct property identified and one mark for relating the property to outdoor use/contents. Examples of properties: • Good tensile strength to withstand weight of contents • Water repellent or can be waterproofed for all weather conditions if left outside • Hard wearing and durable to withstand regular use and change in contents • Is able to be dyed a range of colours so can be easily. <i>Credit any other appropriate response.</i>	AO4 1c [2]	2						

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(b) (i)			Explain the term thermoforming. [2] Up to 2 marks for showing a clear understanding of the term thermoforming. For example: Thermoforming is where a plastic is able to be softened by heating and reformed or shaped into complex shapes, such as the safety glasses; this can be achieved multiple times. <i>Credit any other appropriate response.</i>	AO4 1a [1] AO4 1b [1]	2
(ii)			Name a thermoforming plastic that could be used to make the safety glasses and explain a characteristic or property that makes it suitable. [3] One mark for naming a correct characteristic/property and up to two marks for clarity of explanation. Normally this plastic is a polycarbonate/polypropylene. Typical properties/characteristics include: • Good resistance to scratching • Good resistance to impact • Light in weight • Clear in colour so can be seen through • Easily cleaned. - sterilisation. <i>Credit any other appropriate response.</i>	AO4 1a [1] AO4 2b [2]	3

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total									
(c) (i)	✓		Explain one property that makes Teak a suitable material for the outdoor bench. [2] One mark for identifying a correct property of Teak and one mark for relating the property to the outdoor bench. Examples of properties: • Teak is a hard wood and has good wearing qualities. • Teak is a hard wood and has natural oils which makes it resistant to water ideal for outdoor use. • Teak is timber and has good resistant to all forms of weather. <i>Credit any other appropriate response.</i>	AO4 1c [2]	2									
(ii)			State two suitable finishes that could be used to protect the outdoor Teak bench. [2] Two finishes required, one mark for each. For example: Danish oil. Teak oil. Polyurethane varnish. Beeswax <i>Credit any other appropriate response.</i>	AO4 2a [1] AO4 1c [1]	2									
(d) (i)	✓		Complete the table shown below, by correctly placing one tick (✓) in either box. [2] <table border="1"><thead><tr><th>Description</th><th>True</th><th>False</th></tr></thead><tbody><tr><td>A hardwood comes from a coniferous tree.</td><td></td><td>✓</td></tr><tr><td>A hardwood tree loses its leaves during Autumn and Winter.</td><td>✓</td><td></td></tr></tbody></table>	Description	True	False	A hardwood comes from a coniferous tree.		✓	A hardwood tree loses its leaves during Autumn and Winter.	✓		AO4 1c [2]	2
Description	True	False												
A hardwood comes from a coniferous tree.		✓												
A hardwood tree loses its leaves during Autumn and Winter.	✓													

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(ii)	✓		Describe the difference between deciduous and coniferous trees. [2] Award one mark for each difference that references deciduous and coniferous. Two marks can only be awarded if the answer provided is described and not just stated. Examples: • Deciduous trees take longer to grow. • Deciduous trees have broad leaves which fall off during winter/autumn seasons. • Coniferous trees have needle like leaves which are very thin and narrow. • Generally coniferous trees are softer compared to deciduous trees. <i>Credit any other appropriate response.</i>	AO4 1c [2]	2

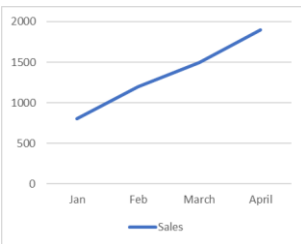
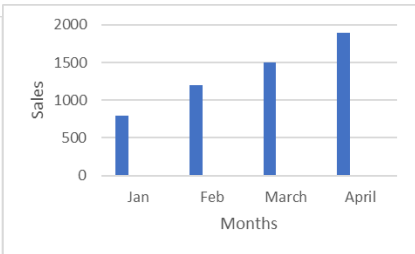
Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(e) (i)			State the difference between ferrous and non-ferrous metals. [1] Ferrous metal has iron in it and non-ferrous metal does not contain iron.	AO4 1a [1]	1
(ii)			Name one ferrous and one non-ferrous metal suitable for the manufacture of the weighing scales. [2] One mark for each example correctly given. Ferrous metal: cast iron – mild steel – wrought iron – stainless steel – tool steel etc. Non-ferrous metal: brass – aluminium – bronze – silver etc. <i>Credit any other appropriate response.</i>	AO4 1c [2]	2
				Total	20

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
5. (a) (i)			The products shown could be categorised into the following material groups: WOOD METAL PLASTIC TEXTILE ELECTRONIC CARD Circle the most appropriate category above for the product you have chosen. [1]	AO4 1a [1]	1
(ii)			Explain and discuss one essential anthropometric requirement of your chosen product [2] One mark for appropriate anthropometric requirement and one mark for explanation within context of product chosen. • Mountain bike: legs wheel size, distance between seat and handlebars etc • Sports vest: chest size, arm length, waist circumference, hip circumference, neck circumference etc • Skateboard: foot size, hand size • Egg box: hand size, finger size, egg size • Sports watch: wrist size/circumference (adjustability), finger size • Plastic shoe: foot size, ankle circumference (to allow for different foot sizes) For example: One essential anthropometric requirement of the egg box would be the finger sizes where the user must be able to hold or remove the egg with their fingers. <i>Credit any other appropriate response.</i>	AO4 1c [2]	2

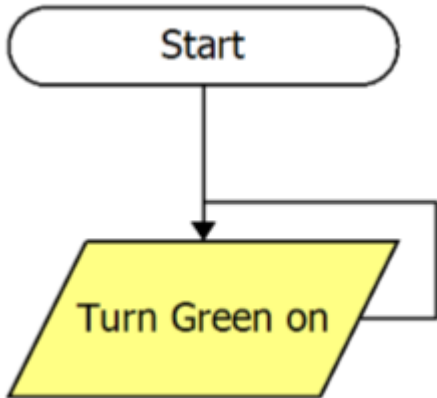
Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(b) (i)			Discuss the importance of prototyping your chosen product prior to its manufacture. [2] The importance of prototyping is to test or see how a product will look or function, be an indicator of size and can help with sizes before production. <i>Credit any other appropriate response.</i>	AO3 2b [2]	2
(ii)			Evaluate your chosen product against each specification point in the table below. [4]x1 Award one mark for each appropriate specification point for the product chosen, up to 4 marks. • Function – evaluative point should relate to how the product works. • Quality – evaluative point should relate to either the quality of manufacture/finish or appropriateness of material used. • Target market – evaluative point should relate to who the product is aimed at (appropriate choice of target market) • Materials- evaluative point should relate to appropriate/suitable characteristics and properties for the product's use. <i>Credit any other appropriate response.</i>	AO3 2b [4]	4

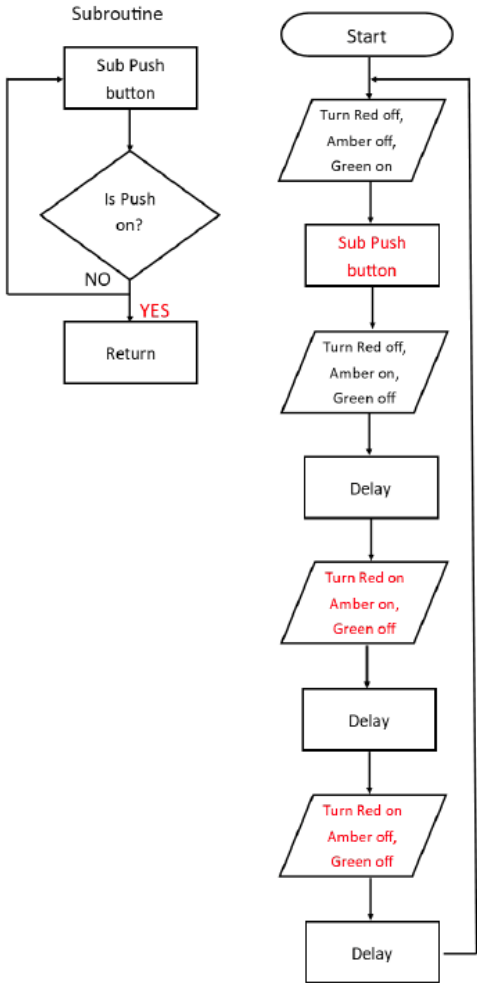
Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(c)			Discuss how any two of the 6Rs could have been used to influence the design of your chosen product. [4] A maximum of two marks can be awarded for candidates who state two of the 6Rs that are appropriate for their chosen product. An additional two marks can be awarded if related with clarity to product selected. Accept answers that are related to the 6 Rs: Rethink - use in a different way/does the product do its job/function well? Reduce – less materials/components used saves on energy during manufacture/are they needed? Recycle – can the materials/components be manufactured from recyclable materials? Can the materials be separated from the components and then be reused to make new products? Reuse - changing the use of a product from its original use. For example: egg boxes can be used to grow seedlings from. Repair - can the product be easily repaired to extend its life? Can it be redesigned so servicing means repair is less likely? <i>Credit any other appropriate response.</i>	AO4 2a [2] AO4 2b [2]	4

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(d)			Analyse why it is essential for designers to consider the ecological footprint of a product. [2] For two marks to be awarded a clear reason/explanation is required. Designers need to consider material and component choices when designing a product and the impact these choices have on our fragile ecosystem. For example, manufacturing products abroad increases fuel consumption which is derived from non-renewable fossil fuels. • The extinction of natural resources – eco-fibre, make it last and enhance recyclability. • Manufacturing • Transportation • Waste disposal at the end of life <i>Credit any other appropriate response.</i>	AO4 1a [1] AO4 2a [1]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(e) (i)		✓	Using the information in the table below complete the graph shown above. [4] One mark for each correctly plotted point. One mark for joining up the points or drawing in a block form.   Straight line graph Block/bar graph	AO4 1c [1] AO4 1b [3]	4
(ii)		✓	State the name of the type of graph you have drawn. [1] Straight line graph or block/bar graph.	AO4 1b [1]	1
				Total	20

Q6	Science	Maths	Electronic systems, programmable components and mechanical devices Question or outline of question / Marking scheme	AO	Total
6. (a) (i)			State the type of lights used in the pedestrian crossing unit. [1] The only acceptable answer is LED (Light emitting diode)	AO4 1a [1]	1
(ii)	✓		Using the image below describe the part of the control system which is the input and the output. [2] Award one mark each for simply stating the button as input and walk or halt symbol as outputs. Two marks can only be awarded if the answer provided is described and not just stated. For example: The button is the input. When the button is activated, it alerts the system to the presence of a pedestrian and requests a "WALK" signal. The pedestrian walk and halt/stop are the outputs. The system still needs to complete its cycle before displaying the walk or halt symbols. Accept answers that refer to the green man and red man as the output. <i>Credit any other appropriate response.</i>	AO4 1b [1] AO4 2c [1]	2

Q6	Science	Maths	Electronic systems, programmable components and mechanical devices Question or outline of question / Marking scheme	AO	Total
(iii)			The image below shows another active pedestrian crossing unit. Using the space provided, draw a simple flow chart to continuously keep the green light on. [2]  <pre> graph TD Start([Start]) --> TurnGreen[/Turn Green on/] TurnGreen --> TurnGreen </pre> <i>Credit any other appropriate response.</i>	AO4 2b [2]	2

Q6	Science	Maths	Electronic systems, programmable components and mechanical devices Question or outline of question / Marking scheme	AO	Total
(iv)			Complete the flow chart below to show the sequence of the pedestrian crossing unit. [4]  <pre> graph TD Start([Start]) --> Out1[/Turn Red off, Amber off, Green on/] Out1 --> SubPush1[Sub Push button] SubPush1 --> Out2[/Turn Red off, Amber on, Green off/] Out2 --> Delay1[Delay] Delay1 --> Out3[/Turn Red on, Amber on, Green off/] Out3 --> Delay2[Delay] Delay2 --> Out4[/Turn Red on, Amber off, Green off/] Out4 --> Delay3[Delay] Delay3 --> SubPush1 </pre> Subroutine <pre> graph TD SubPush[Sub Push button] --> IsPush{Is Push on?} IsPush -- NO --> SubPush IsPush -- YES --> Return[Return] </pre>	AO4 2c [4]	4

Q6	Science	Maths	Electronic systems, programmable components and mechanical devices Question or outline of question / Marking scheme	AO	Total
(b)		5	Calculate how many PCBs would be cut in an 8-hour shift using 25 CNC machines. [5] 1 hr = 60 mins (1) 8 x 60 = 480 mins (1) $\frac{480}{5} = 96$ PCBs (1) 96 x 25 (1) = 2400 PCBs in 8 hours (1) <i>Credit any other appropriate calculation.</i>	AO4 1b [3] AO4 1c [2]	5
(c)			Analyse the quality control checks that need to be performed when using a CNC machine to engrave a circuit board. [5] • Make sure the auto-levelling process is set up in software before engraving. • Run a computer simulation to detect flaws/errors before milling. • Check the tools diameter before the next manual tool change. This will ensure that correct bits are used for engraving and for drilling though-holes. • The engraving bit needs to be sharp enough to cut and not tear the copper. • The engraving bit needs to be fine enough to engrave any tiny footprints or traces. • Check the sharpness of the engraving tools/bits. • Engraving bit gets blunt and tend to tear rather than cut. To clear off stray copper filings, give the PCB a scrub, first with think bristle brush and followed by the finer abrasive paper. • Has the copper clad board been securely fastened to CNC support base? • Experiment with a variety of test cuts to compensate for any variations in the height across the clad board.	AO3 2a [5]	5

Q6	Science	Maths	Electronic systems, programmable components and mechanical devices Question or outline of question / Marking scheme	AO	Total															
			Band descriptors and mark allocations <table><tr><td></td><td colspan="2">AO3 2a 5 marks</td></tr><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding of the quality control checks that need to be performed on a CNC machine before and during the manufacturing process. There will be evidence of relevant examples and a well-developed logical chain of reasoning, sustained throughout.</td><td>4-5</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding of the quality control checks that need to be performed on a CNC machine before and during the manufacturing process. There will be some evidence of mostly relevant examples and a logical chain of reasoning, but this may not be sustained throughout.</td><td>2-3</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding of the quality control checks that need to be performed on a CNC machine before and during the manufacturing process. There will be limited evidence of relevant examples or a logical chain of reasoning.</td><td>1</td></tr><tr><td></td><td colspan="2">Award 0 marks for incorrect or irrelevant answers</td></tr></table> <i>Credit any other appropriate response.</i>		AO3 2a 5 marks		BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding of the quality control checks that need to be performed on a CNC machine before and during the manufacturing process. There will be evidence of relevant examples and a well-developed logical chain of reasoning, sustained throughout.	4-5	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding of the quality control checks that need to be performed on a CNC machine before and during the manufacturing process. There will be some evidence of mostly relevant examples and a logical chain of reasoning, but this may not be sustained throughout.	2-3	BAND 1	Answer demonstrates only basic knowledge and understanding of the quality control checks that need to be performed on a CNC machine before and during the manufacturing process. There will be limited evidence of relevant examples or a logical chain of reasoning.	1		Award 0 marks for incorrect or irrelevant answers			
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	Award 0 marks for incorrect or irrelevant answers																			

Q6	Science	Maths	Electronic systems, programmable components and mechanical devices Question or outline of question / Marking scheme	AO	Total
(d)			Evaluate the benefits of using a CNC machine to make the circuit boards instead of constructing them by hand. [6] Examples of the benefits of using a CNC vs hand tools include A CNC machine is designed and programmed to perform the same task repetitively (1 mark), the accuracy (1 mark), and quality (1 mark), of circuit boards can be better and more consistent (1 mark), than hand-circuit boards. A CNC machine can reduce the production time (1 mark), and costs of printed circuit boards (1 mark). It takes a long time to fabricate a single circuit board by hand (1 mark), the entire production cycle will be stalled every time an error occurs (1 mark), delaying a project's overall time. CNC milling can be used for multiple purpose i.e. milling, drilling and cutting (1 mark). Hand-made PCBs are excellent for testing simple ideas. However, for a solution with longevity, or for prototyping, the accuracy and durability provided by machines can be very valuable.	AO3 2b [6]	6

Q6	Science	Maths	Electronic systems, programmable components and mechanical devices Question or outline of question / Marking scheme	AO	Total															
			Band descriptors and mark allocations <table><tr><td></td><td colspan="2">AO3 2b 6 marks</td></tr><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding of the benefits of using a CNC machine to manufacture PCBs compared to making the PCBs by hand. There will be evidence of relevant examples and well-developed substantiated judgements in a response which is logically structured.</td><td>5-6</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding of the benefits of using a CNC machine to manufacture PCBs compared to making the PCBs by hand. There will be some evidence of mostly relevant examples and partly substantiated judgements in a response which is generally well structured.</td><td>3-4</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding of the benefits of using a CNC machine to manufacture PCBs compared to making the PCBs by hand. There will be limited evidence of relevant examples or judgements in a response which demonstrates little structure.</td><td>1-2</td></tr><tr><td></td><td colspan="2">Award 0 marks for incorrect or irrelevant answers</td></tr></table> <i>Credit any other appropriate response.</i>		AO3 2b 6 marks		BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding of the benefits of using a CNC machine to manufacture PCBs compared to making the PCBs by hand. There will be evidence of relevant examples and well-developed substantiated judgements in a response which is logically structured.	5-6	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding of the benefits of using a CNC machine to manufacture PCBs compared to making the PCBs by hand. There will be some evidence of mostly relevant examples and partly substantiated judgements in a response which is generally well structured.	3-4	BAND 1	Answer demonstrates only basic knowledge and understanding of the benefits of using a CNC machine to manufacture PCBs compared to making the PCBs by hand. There will be limited evidence of relevant examples or judgements in a response which demonstrates little structure.	1-2		Award 0 marks for incorrect or irrelevant answers			
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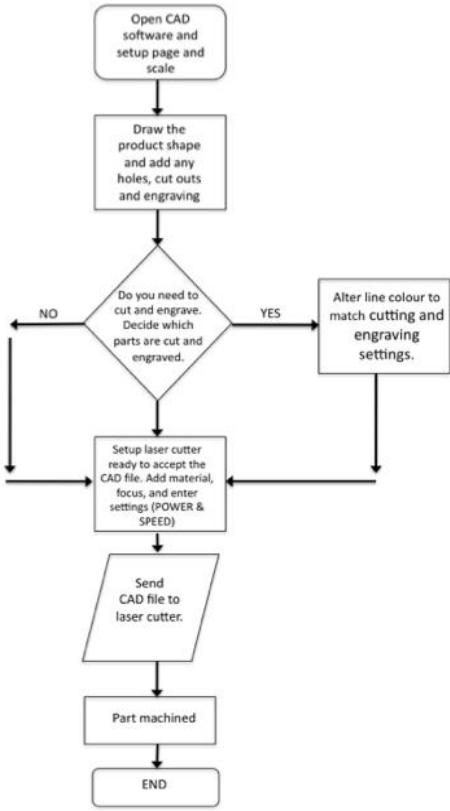
Q6	Science	Maths	Papers and Boards Question or outline of question/Marking scheme	AO	Total
6. (a) (i)			State the name of a suitable CAD (Computer Aided Design) software package used to create the 3D beetles. [1] Accept any appropriate software package. - pro-engineer, solid works, 2D design Coral draw, Illustrator, ProDesk top, Google draw/sketch up, Auto-cad etc.	AO4 1a [1]	1
(ii)			The 3D beetles have been designed on a CAD system. Describe one reason why a CAD system has been used to design the 3D beetles. [2] Can be edited easily. The image can be easily manipulated to create a new design. The image can be connected to a CAM machine for prototyping. Can be copied and resized quickly. Credit any other appropriate responses	AO4 1b [1] AO4 2c [1]	2
(iii)			The 3D beetles have been manufactured on a CAM (Computer Aided Manufacture) system. Describe one advantage of using CAM. [2] Answers must relate to the advantages of CAM. 1 mark for one correct advantage and 1 mark for clear description. For example: CAM machines will ensure large quantities of 3D beetles can be produced in a short amount of time due to the speed of processing (as opposed to more traditional methods). (2) CAM machines ensure that every product manufactured will be the same with little or no difference. (2)	AO4 2b [2]	2

Q6	Science	Maths	Papers and Boards Question or outline of question/Marking scheme	AO	Total
			<i>Responses could be based on:</i> - Fewer errors are made in production due to the effectiveness of software. - CAM ensures consistency in outcome bringing about reliability for both client and consumer. (2) - Accuracy brings less waste in raw materials. (2) - CAM ensures changes to size, shape, colour can be made with very little down time (2) broadening the scope of product development. - Certain numbers of the product can be manufactured, ensuring that the correct number of products are manufactured easily.		
(iv)			In the space below, draw a simple flow diagram describing the main stages of producing a CAD drawing suitable for laser cutting. [4]	AO4 2c [4]	4
(b)		5	A manufacturer who laser cuts the 3D card beetle sets owns 25 laser cutting machines. Each set of 3D card beetles takes 5 minutes to laser cut. Calculate how many 3D card beetle sets would be cut in an 8-hour shift using 25 laser cutting machines. [5] 1 hr = 60 mins (1) 8 x 60 = 480 mins (1) $\frac{480}{5} = 96$ lady beetles (1) 5 96 x 25 (1) = 2400 Sets in 8 hours (1) <i>Credit any other appropriate calculation.</i>	AO4 1b [3] AO4 1c [2]	5

Q6	Science	Maths	Papers and Boards Question or outline of question/Marking scheme	AO	Total												
(c)			Analyse the quality control checks that need to be performed when using a laser to cut the 3D card beetles. [5] <table><tr><th colspan="3">AO3 2a 5 marks</th></tr><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the quality control checks that need to be carried out before and during laser cutting. There will be evidence of relevant examples and a well-developed logical chain of reasoning. Candidates will have exemplified many of the processes listed below and the descriptions of each process will demonstrate a very clear understanding of the processes needed.</td><td>4-5</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding, to analyse the quality control checks that need to be carried out during laser cutting. The candidate need not exemplify all of the processes listed below There will be some evidence of mostly relevant examples and a logical chain of reasoning, but this may not be sustained throughout. Responses will not be as clearly defined as those in band 3</td><td>2-3</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding, to analyse the quality control checks that are needed. There will be limited evidence of relevant examples or a logical chain of reasoning demonstrated. Responses may be very limited in detail showing a lack of real understanding of the reasons behind a more sustainable ethos but does reference one of the issues mentioned in band 2 or 3.</td><td>1</td></tr></table> Responses make refer to the points below. Quality Control Checks - Laser cutter focused (auto or manual forms) - Laser cuttings settings for cutting or engraving. - Power and speed settings for the materials being used. - Extractor on for fume extraction. - Compressor on to prevent risk of fire.	AO3 2a 5 marks			BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the quality control checks that need to be carried out before and during laser cutting. There will be evidence of relevant examples and a well-developed logical chain of reasoning. Candidates will have exemplified many of the processes listed below and the descriptions of each process will demonstrate a very clear understanding of the processes needed.	4-5	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding, to analyse the quality control checks that need to be carried out during laser cutting. The candidate need not exemplify all of the processes listed below There will be some evidence of mostly relevant examples and a logical chain of reasoning, but this may not be sustained throughout. Responses will not be as clearly defined as those in band 3	2-3	BAND 1	Answer demonstrates only basic knowledge and understanding, to analyse the quality control checks that are needed. There will be limited evidence of relevant examples or a logical chain of reasoning demonstrated. Responses may be very limited in detail showing a lack of real understanding of the reasons behind a more sustainable ethos but does reference one of the issues mentioned in band 2 or 3.	1	AO3 2a [5]	5
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Q6	Science	Maths	Papers and Boards Question or outline of question/Marking scheme	AO	Total									
(d)			Evaluate the benefits of using a laser cutter to make the 3D card beetle sets instead of cutting out by hand. AO3 2b 6 marks <table><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding of how using a laser cutter will benefit the designer when manufacturing the card. Candidates will exemplify most of the reasons listed and the level of detail will demonstrate a clear working understanding of the benefits. Responses will be well developed containing substantiated judgements in a response, which is logically structured and well written.</td><td>5-6</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding of how using a laser cutter will benefit the designer when manufacturing the card. Candidates will exemplify some of the reasons listed. There will be some evidence of mostly relevant examples and partly substantiated judgements in a response, which is generally well structured. Responses will not be as detailed as band 3.</td><td>2-4</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding, to evaluate why the laser cutter has been used. There will be limited evidence of relevant examples or judgements in a response, which demonstrates little structure. Responses will be less developed and detailed than band 2 and 3</td><td>1</td></tr></table> Responses make refer to the points below: Benefits of a laser cutter • Accuracy of manufacturer • Identical parts can be made • Tolerance to within 0.1mm • Speed of manufacture • Multiple cards can be cut at the same time. • No labour costs. • Less chance of human error	BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding of how using a laser cutter will benefit the designer when manufacturing the card. Candidates will exemplify most of the reasons listed and the level of detail will demonstrate a clear working understanding of the benefits. Responses will be well developed containing substantiated judgements in a response, which is logically structured and well written.	5-6	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding of how using a laser cutter will benefit the designer when manufacturing the card. Candidates will exemplify some of the reasons listed. There will be some evidence of mostly relevant examples and partly substantiated judgements in a response, which is generally well structured. Responses will not be as detailed as band 3.	2-4	BAND 1	Answer demonstrates only basic knowledge and understanding, to evaluate why the laser cutter has been used. There will be limited evidence of relevant examples or judgements in a response, which demonstrates little structure. Responses will be less developed and detailed than band 2 and 3	1	AO3 2b [6]	6
BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding of how using a laser cutter will benefit the designer when manufacturing the card. Candidates will exemplify most of the reasons listed and the level of detail will demonstrate a clear working understanding of the benefits. Responses will be well developed containing substantiated judgements in a response, which is logically structured and well written.	5-6												
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Q6	Science	Maths	Natural and manufactured timber Question or outline question / Marking scheme	AO	Total
6. (a) (i)			State the name of a suitable CAD (Computer Aided Design) software package used to create the structure of the light. [1] Accept any appropriate software package. - pro-engineer, solid works, 2D design Coral draw, Illustrator, ProDesk top, Google draw/sketch up, Auto-cad etc.	AO4 1a [1]	1
(ii)	✓		The light has been designed on a CAD (Computer Aided Design) system. Describe one reason why a CAD system has been used to design the plywood light. [2] • Accuracy of the software to create complex shapes • Files can be edited easily • Can be used to produce/manufacture identical parts of the plywood light e.g. laser cut or machined using a CNC router from the CAD file • Can be e mailed to different locations <i>Credit any other suitable response.</i>	AO4 1b [1] AO4 2c [1]	2
(iii)			The plywood light has been manufactured on a CAM (Computer Aided Manufacture) system. Describe one advantage of using CAM. [2] <i>Responses could be based on:</i> • CAM machining is faster than cutting the birch plywood out by hand, so therefore takes less time. (1) • CAM machining ensures the accuracy of cutting out the birch plywood every time. (1) • CAM machining requires less labour to manufacture the product, so therefore can be manufactured at a reduced cost. (1) • CAM machining can allow for pilot holes, slots and screw holes to be precut to allow for easy assembly of the stool by the customer. (1)	AO4 2b [2]	2

Q6	Science	Maths	Natural and manufactured timber Question or outline question / Marking scheme	AO	Total
(iv)			In the space below, draw a simple flow diagram describing the main stages of producing a CAD drawing suitable for laser cutting. [4] Flow Chart Example:  <pre> graph TD A([Open CAD software and setup page and scale]) --> B[Draw the product shape and add any holes, cut outs and engraving] B --> C{Do you need to cut and engrave. Decide which parts are cut and engraved.} C -- YES --> D[Alter line colour to match cutting and engraving settings.] C -- NO --> F[Setup laser cutter ready to accept the CAD file. Add material, focus, and enter settings (POWER & SPEED)] D --> F F --> G[/Send CAD file to laser cutter./] G --> H[Part machined] H --> I([END]) </pre> Credit any other appropriate response that describes the main stages up to a total of 4 marks.	AO4 2c [4]	4

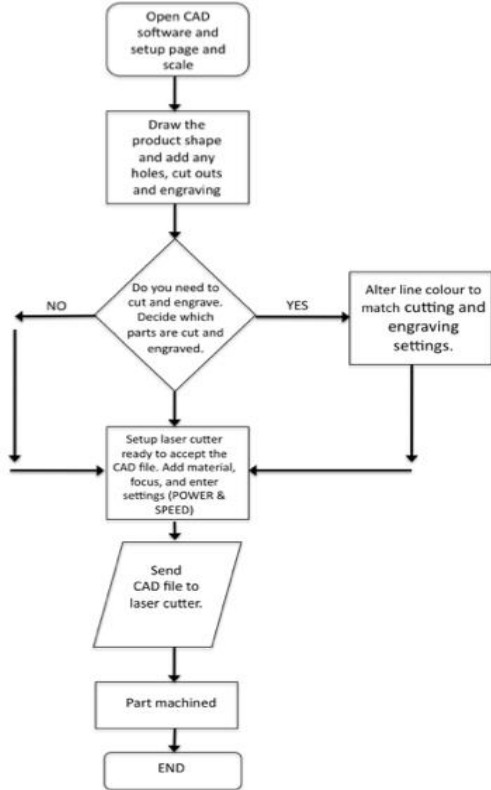
Q6	Science	Maths	Natural and manufactured timber Question or outline question / Marking scheme	AO	Total
(b)		5	A manufacturer who laser cuts the plywood for the light owns 25 laser cutting machines. Each plywood light takes 5 minutes to laser cut the shapes. [5] Calculate how many plywood lights the manufacturer makes in an 8-hour shift, using 25 laser cutting machines. 1 hr = 60 mins (1) $8 \times 60 = 480$ mins (1) $\frac{480}{5} = 96$ PCBs (1) 96×25 (1) $= 2400$ lights in 8 hours (1) <i>Credit any other appropriate calculation.</i>	AO4 1b [3] AO4 1c [2]	5

Q6	Science	Maths	Natural and manufactured timber Question or outline question / Marking scheme	AO	Total															
(c)			Analyse the quality control checks that need to be performed when using a laser to cut the plywood shapes. [5] Band descriptors and mark allocations <table><tr><td></td><td>AO3 2a 5 marks</td><td></td></tr><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the quality control checks that need to be carried out in the process of laser cutting. There will be evidence of the relevant checks that need to be carried out. Examples of products may be linked to the response of the candidate throughout.</td><td>4-5</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding, to analyse some quality control checks that need to be carried out in the process of laser cutting. There will be some evidence of the relevant checks that need to be carried out.</td><td>2-3</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding, to analyse the relevant checks that need to be carried out. There will be limited understanding of the relevant checks that need to be carried out.</td><td>1</td></tr><tr><td></td><td>Award 0 marks for incorrect or irrelevant answers.</td><td>0</td></tr></table> Quality Control Checks • Laser cutter focused (auto or manual forms) • Laser cuttings settings for cutting or engraving. • Power and speed settings for the materials being used. • Extractor on for fume extraction. • Compressor on to prevent risk of fire.		AO3 2a 5 marks		BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the quality control checks that need to be carried out in the process of laser cutting. There will be evidence of the relevant checks that need to be carried out. Examples of products may be linked to the response of the candidate throughout.	4-5	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding, to analyse some quality control checks that need to be carried out in the process of laser cutting. There will be some evidence of the relevant checks that need to be carried out.	2-3	BAND 1	Answer demonstrates only basic knowledge and understanding, to analyse the relevant checks that need to be carried out. There will be limited understanding of the relevant checks that need to be carried out.	1		Award 0 marks for incorrect or irrelevant answers.	0	AO3 2a [5]	5
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Q6	Science	Maths	Natural and manufactured timber Question or outline question / Marking scheme	AO	Total															
(d)			Evaluate the benefits of using a laser cutter to make the parts of the plywood light instead of cutting out each part by hand. [6] Band descriptors and mark allocations <table><tr><td></td><td>AO3 2b 5 marks</td><td></td></tr><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding, to evaluate the benefits of using a laser cutter to make the parts of the plywood light instead of cutting out each part by hand. There will be evidence of relevant benefits evaluated with well-developed substantiated judgments in a response that is logically structured.</td><td>5-6</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding, to evaluate the benefits of using a laser cutter to make the parts of the plywood light instead of cutting out each part by hand. There will be some evidence of relevant benefits evaluated with partly substantiated judgments in a response that is generally structured.</td><td>3-4</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding, to evaluate the benefits of using a laser cutter to make the parts of the plywood light instead of cutting out each part by hand. There will be limited evidence of relevant benefits evaluated with judgments in a response that demonstrates little structure.</td><td>1-2</td></tr><tr><td></td><td>Award 0 marks for incorrect or irrelevant answers.</td><td>0</td></tr></table>		AO3 2b 5 marks		BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to evaluate the benefits of using a laser cutter to make the parts of the plywood light instead of cutting out each part by hand. There will be evidence of relevant benefits evaluated with well-developed substantiated judgments in a response that is logically structured.	5-6	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding, to evaluate the benefits of using a laser cutter to make the parts of the plywood light instead of cutting out each part by hand. There will be some evidence of relevant benefits evaluated with partly substantiated judgments in a response that is generally structured.	3-4	BAND 1	Answer demonstrates only basic knowledge and understanding, to evaluate the benefits of using a laser cutter to make the parts of the plywood light instead of cutting out each part by hand. There will be limited evidence of relevant benefits evaluated with judgments in a response that demonstrates little structure.	1-2		Award 0 marks for incorrect or irrelevant answers.	0	AO3 2b [6]	6
	AO3 2b 5 marks																			
BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to evaluate the benefits of using a laser cutter to make the parts of the plywood light instead of cutting out each part by hand. There will be evidence of relevant benefits evaluated with well-developed substantiated judgments in a response that is logically structured.	5-6																		
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	Award 0 marks for incorrect or irrelevant answers.	0																		

Q6	Science	Maths	Natural and manufactured timber Question or outline question / Marking scheme	AO	Total
			Indicative content: This content is not prescriptive, and the candidates are not expected to refer to all the material identified below. Indicative content: • Accuracy of manufacture – shapes, slots and holes machined accurately. • Identical parts can be made. • Manufactured to a tolerance of 0.1mm using CAM. • Quicker – speed of manufacture is faster than producing parts by hand. • The same CAD drawing can be used on multiple machines at a time. • Less room for human error. • Less labour required to manufacture the plywood lights. <i>Credit any other appropriate responses given.</i>		

Q6	Science	Maths	Ferrous and non-ferrous metals Question or outline question / Marking scheme	AO	Total
6. (a) (i)			State the name of a suitable CAD (Computer Aided Design) software package used to create the light shade. [1] Accept any appropriate software package. - pro-engineer, solid works, 2D design Coral draw, Illustrator, ProDesk top, Google draw/sketch up, Auto-cad etc.	AO4 1a [1]	1
(ii)	✓		The light shade has been designed on a CAD (Computer Aided Design) system. Describe one reason why a CAD system has been used to design the light shade. [2] • Accuracy of the software to create complex shapes • Files can be edited easily • Can be used to produce/manufacture identical parts of the light shade e.g. laser cut or machined using a CNC milling machine from the CAD file • Can be e mailed to different locations <i>Credit any other suitable response</i>	AO4 1b [1] AO4 2c [1]	2
(iii)			The light shade has been manufactured on a CAM (Computer Aided Manufacture) system. Describe one advantage of using CAM. [2] • <i>Responses could be based on:</i> • CAM machining is faster than cutting the light shade out by hand, so therefore takes less time. (1) • CAM machining ensures the accuracy of cutting out the light shade every time. (1) • CAM machining requires less labour to manufacture the product, so therefore can be manufactured at a reduced cost. (1) • CAM machining can allow for pilot holes, slots and screw holes to be pre-cut to allow for easy assembly. (1)	AO4 2b [2]	2

Q6	Science	Maths	Ferrous and non-ferrous metals Question or outline question / Marking scheme	AO	Total
(iv)			In the space below, draw a simple flow diagram describing the main stages of producing a CAD drawing suitable for laser cutting. [4] Flow Chart Example:  <pre> graph TD A([Open CAD software and setup page and scale]) --> B[Draw the product shape and add any holes, cut outs and engraving] B --> C{Do you need to cut and engrave. Decide which parts are cut and engraved.} C -- YES --> D[Alter line colour to match cutting and engraving settings.] C -- NO --> F[Setup laser cutter ready to accept the CAD file. Add material, focus, and enter settings (POWER & SPEED)] D --> F F --> E[/Send CAD file to laser cutter./] E --> G[Part machined] G --> H([END]) </pre> Credit any other appropriate response that describes the main stages up to a total of 4 marks.	AO4 2c [4]	4

Q6	Science	Maths	Ferrous and non-ferrous metals Question or outline question / Marking scheme	AO	Total
(b)		✓ 5	A manufacturer who laser cuts the light shade owns 25 laser cutting machines. Each light shade takes 5 minutes to laser cut. [5] Calculate how many light shades the mnaufacturer makes in an 8-hour ahift using 25 laser cutters. <i>Show all workings.</i> 1 hr = 60 mins (1) 8 x 60 = 480 mins (1) $\frac{480}{5} = 96$PCBs (1) 96 x 25 = (1) 2400 light shades in 8 hours (1) <i>Credit any other appropriate calculation.</i>	AO4 1b [3] AO4 1c [2]	5

Q6	Science	Maths	Ferrous and non-ferrous metals Question or outline question / Marking scheme	AO	Total															
(c)			Analyse the quality control checks that need to be performed when using a laser to cut the various complex shapes. [5] Band descriptors and mark allocations <table><tr><th colspan="3">AO3 2a 5 marks</th></tr><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the quality control checks that need to be carried out in the process of laser cutting. There will be evidence of the relevant checks that need to be carried out. Examples of products may be linked to the response of the candidate throughout.</td><td>4-5</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding, to analyse some quality control checks that need to be carried out in the process of laser cutting. There will be some evidence of the relevant checks that need to be carried out.</td><td>2-3</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding, to analyse the relevant checks that need to be carried out. There will be limited understanding of the relevant checks that need to be carried out.</td><td>1</td></tr><tr><td></td><td>Award 0 marks for incorrect or irrelevant answers.</td><td>0</td></tr></table> Quality Control Checks • Laser cutter focused (auto or manual forms) • Laser cuttings settings for cutting or engraving. • Power and speed settings for the materials being used. • Extractor on for fume extraction. • Compressor on to prevent risk of fire. • Accept answers that could mention water coolant. Credit any other appropriate responses given.	AO3 2a 5 marks			BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the quality control checks that need to be carried out in the process of laser cutting. There will be evidence of the relevant checks that need to be carried out. Examples of products may be linked to the response of the candidate throughout.	4-5	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding, to analyse some quality control checks that need to be carried out in the process of laser cutting. There will be some evidence of the relevant checks that need to be carried out.	2-3	BAND 1	Answer demonstrates only basic knowledge and understanding, to analyse the relevant checks that need to be carried out. There will be limited understanding of the relevant checks that need to be carried out.	1		Award 0 marks for incorrect or irrelevant answers.	0	AO3 2a [5]	5
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	Award 0 marks for incorrect or irrelevant answers.	0																		

Q6	Science	Maths	Ferrous and non-ferrous metals Question or outline question / Marking scheme	AO	Total															
(d)			Evaluate the benefits of using a laser cutter to make the light shade instead of cutting out the light shade by hand. [6] Band descriptors and mark allocations <table><tr><td></td><td>AO3 2a 5 marks</td><td></td></tr><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding, to evaluate the benefits of using a laser cutter to make the light shade instead of cutting out the light shade by hand. There will be evidence of relevant benefits evaluated with well-developed substantiated judgments in a response that is logically structured.</td><td>5-6</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding, to evaluate the benefits of using a laser cutter to make the light shade instead of cutting out the light shade by hand. There will be some evidence of relevant benefits evaluated with partly substantiated judgments in a response that is generally structured.</td><td>3-4</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding, to evaluate the benefits of using a laser cutter to make the parts of the light shade instead of cutting out the light shade by hand. There will be limited evidence of relevant benefits evaluated with judgments in a response that demonstrates little structure.</td><td>1-2</td></tr><tr><td></td><td>Award 0 marks for incorrect or irrelevant answers.</td><td>0</td></tr></table> Benefits of a laser cutter • Accuracy of manufacturer • Identical parts can be made • Tolerance to within 0.1mm. • Speed of manufacture. • No labour costs. • Less chance of human error. <i>Credit any other appropriate responses given.</i>		AO3 2a 5 marks		BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to evaluate the benefits of using a laser cutter to make the light shade instead of cutting out the light shade by hand. There will be evidence of relevant benefits evaluated with well-developed substantiated judgments in a response that is logically structured.	5-6	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding, to evaluate the benefits of using a laser cutter to make the light shade instead of cutting out the light shade by hand. There will be some evidence of relevant benefits evaluated with partly substantiated judgments in a response that is generally structured.	3-4	BAND 1	Answer demonstrates only basic knowledge and understanding, to evaluate the benefits of using a laser cutter to make the parts of the light shade instead of cutting out the light shade by hand. There will be limited evidence of relevant benefits evaluated with judgments in a response that demonstrates little structure.	1-2		Award 0 marks for incorrect or irrelevant answers.	0	AO3 2b [6]	6
	AO3 2a 5 marks																			
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	Award 0 marks for incorrect or irrelevant answers.	0																		

Q6	Science	Maths	Thermoforming and thermosetting polymers Question or outline question / Marking scheme	AO	Total
6. (a) (i)			State the name of a suitable CAD (Computer Aided Design) software package used to create the key ring. Accept any appropriate software package. - pro-engineer, solid works, 2D design Coral draw, Illustrator, ProDesk top, Google draw/sketch up, Auto-cad etc. [1]	AO4 1a [1]	1
(ii)			The key ring has been designed on a CAD system. Describe one reason why a CAD system has been used to design the key ring. [2] Answers must relate to CAD. 1 mark for reason and 1 mark for a clear description that relates to the key ring. For example: Using a CAD system to design the key ring would ensure an accurate representation (1) as opposed to a design hand-drawn. (1) <i>Responses could be based on:</i> • Designs can be amended and edited quickly and easily during design development which would otherwise take much longer by hand (2) • Colour trials for different plastics can be tested visually (1) • Designs don't need to be simplified they can be intricate as the software supports detailed designs. (2) • Design of the key ring can be viewed by the client instantly enabling changes to be made easily if the client's wishes change. (2) • Lead-time from design to manufacture will be quicker enabling product to reach the market sooner. (2) Credit any other appropriate responses	AO4 1b [1] AO4 2c [1]	2

Q6	Science	Maths	Thermoforming and thermosetting polymers Question or outline question / Marking scheme	AO	Total
(iii)			The key ring has been manufactured on a CAM system. Describe one advantage of using CAM. [2] Answers must relate to the advantages of CAM. 1 mark for one correct advantage and 1 mark for clear description. For example: CAM machines will ensure large quantities of key rings can be produced in a short amount of time due to the speed of processing (as opposed to more traditional methods). (2) <i>Responses could be based on:</i> • Less errors are made in production due to the effectiveness of software. (2) • CAM ensures consistency in outcome bringing about reliability for both client and consumer. (2) • Accuracy brings less waste in raw materials. (2) • CAM ensures changes to size, shape, colour can be made with very little down time (2) broadening the scope of product development. • Using CAM means there is no problem with using complicated patterns or designs. (2) Credit any other appropriate responses	AO4 2b [2]	2

Q6	Science	Maths	Thermoforming and thermosetting polymers Question or outline question / Marking scheme	AO	Total
(iv)			In the space below, draw a simple flow diagram describing the main stages of producing a CAD drawing suitable for laser cutting. [4] <pre> graph TD A([Open CAD software and setup page and scale]) --> B[Draw the product shape and add any holes, cut outs and engraving] B --> C{Do you need to cut and engrave. Decide which parts are cut and engraved.} C -- NO --> E[Setup laser cutter ready to accept the CAD file. Add material, focus, and enter settings (POWER & SPEED)] C -- YES --> D[Alter line colour to match cutting and engraving settings.] D --> E E --> F[/Send CAD file to laser cutter./] F --> G[Part machined] G --> H([END]) </pre> Credit any other appropriate response that describes the main stages up to a total of 4 marks.	AO4 2c [4]	4

Q6	Science	Maths	Thermoforming and thermosetting polymers Question or outline question / Marking scheme	AO	Total
(b)			A manufacturer who laser cuts the key rings owns 25 laser cutting machines. Each key ring takes 5 minutes to laser cut. Calculate how many key rings the manufacture makes in an 8-hour shift using 25 laser cutting machines. [5] 1 hr = 60 mins (1) $8 \times 60 = 480$ mins (1) $\frac{480}{5} = 96$ key rings (1) $96 \times 25 = 2400$ key rings in 8 hours (1) <i>Credit any other appropriate calculation.</i>	AO4 1b [3] AO4 1c [2]	5

Q6	Science	Maths	Thermoforming and thermosetting polymers Question or outline question / Marking scheme	AO	Total												
(c)			Analyse the quality control checks that need to be performed when using a laser cut to out the key rings.[5] <table><tr><th colspan="3">AO3 2a 5 marks</th></tr><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the quality control checks that need to be carried out before and during laser cutting. There will be evidence of relevant examples and a well-developed logical chain of reasoning. Candidates will have exemplified many of the processes listed below and the descriptions of each process will demonstrate a very clear understanding of the processes needed.</td><td>4-5</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding, to analyse the quality control checks that need to be carried out during laser cutting. The candidate need not exemplify all of the processes listed below. There will be some evidence of mostly relevant examples and a logical chain of reasoning, but this may not be sustained throughout. Responses will not be as clearly defined as those in band 3</td><td>2-3</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding, to analyse the quality control checks that are needed. There will be limited evidence of relevant examples or a logical chain of reasoning demonstrated. Responses may be very limited in detail showing a lack of real understanding of the reasons behind a more sustainable ethos, but does reference one of the issues mentioned in band 2 or 3.</td><td>1</td></tr></table> Responses make refer to the points below. • Run a computer simulation to detect flaws/errors before cutting or engraving. • Laser cutter focused (auto or manual forms) to ensure there is no possibility of damage to the laser head • Laser cuttings settings for cutting or engraving are correct. • Power and speed settings for the plastic materials being used and the thickness. • Extractor on for fume extraction for Health and Safety. • Compressor on to prevent risk of fire during cutting process	AO3 2a 5 marks			BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the quality control checks that need to be carried out before and during laser cutting. There will be evidence of relevant examples and a well-developed logical chain of reasoning. Candidates will have exemplified many of the processes listed below and the descriptions of each process will demonstrate a very clear understanding of the processes needed.	4-5	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding, to analyse the quality control checks that need to be carried out during laser cutting. The candidate need not exemplify all of the processes listed below. There will be some evidence of mostly relevant examples and a logical chain of reasoning, but this may not be sustained throughout. Responses will not be as clearly defined as those in band 3	2-3	BAND 1	Answer demonstrates only basic knowledge and understanding, to analyse the quality control checks that are needed. There will be limited evidence of relevant examples or a logical chain of reasoning demonstrated. Responses may be very limited in detail showing a lack of real understanding of the reasons behind a more sustainable ethos, but does reference one of the issues mentioned in band 2 or 3.	1	AO3 2a [5]	5
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Q6	Science	Maths	Thermoforming and thermosetting polymers Question or outline question / Marking scheme	AO	Total												
(d)			Evaluate the benefits of using a laser cutter to make the key ring instead of cutting it out-by hand. [6] <table><tr><th colspan="3">AO3 2a 6 marks</th></tr><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding of how using a laser cutter will benefit the designer when manufacturing the key ring. Candidates will exemplify most of the reasons listed and the level of detail will demonstrate a clear working understanding of the differences benefits of CAM over manufacturing by hand. Responses will be well developed containing substantiated judgements in a response, which is logically structured and well written.</td><td>4-6</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding of how using a laser cutter will benefit the designer when manufacturing the key ring. Candidates will exemplify some of the reasons listed above. There will be some evidence of mostly relevant examples and partly substantiated judgements in a response, which is generally well structured. Responses will not be as detailed as band 3.</td><td>2-3</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding, to evaluate why the laser cutter has been used over hand manufacturing. There will be limited evidence of relevant examples or judgements in a response, which demonstrates little structure. Responses will be less developed and detailed than band 2 and 3</td><td>1</td></tr></table> Responses make refer to the points below.	AO3 2a 6 marks			BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding of how using a laser cutter will benefit the designer when manufacturing the key ring. Candidates will exemplify most of the reasons listed and the level of detail will demonstrate a clear working understanding of the differences benefits of CAM over manufacturing by hand. Responses will be well developed containing substantiated judgements in a response, which is logically structured and well written.	4-6	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding of how using a laser cutter will benefit the designer when manufacturing the key ring. Candidates will exemplify some of the reasons listed above. There will be some evidence of mostly relevant examples and partly substantiated judgements in a response, which is generally well structured. Responses will not be as detailed as band 3.	2-3	BAND 1	Answer demonstrates only basic knowledge and understanding, to evaluate why the laser cutter has been used over hand manufacturing. There will be limited evidence of relevant examples or judgements in a response, which demonstrates little structure. Responses will be less developed and detailed than band 2 and 3	1	AO3 2b [6]	6
AO3 2a 6 marks																	
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Q6	Science	Maths	Thermoforming and thermosetting polymers Question or outline question / Marking scheme	AO	Total
			Indicative content This content is not prescriptive, and candidates are not expected to refer to all the material identified below. <u>Advantages:</u> - Any design, however intricate, can be manufactured - A variety of CAD packages are available to increase creativity of designs - Once set up, machines can be left to produce numerous key rings - Laser cutting machines are faster than trying to make products by hand. <u>Disadvantages:</u> - Set-up costs – cost of machines to purchase, cost of training/making mistakes while learning - Down-time needed to re-thread for colour changes if required - Although quicker than hand-embroidery, it is still a time-consuming manufacturing process. Not a cost-effective decorative effect in comparison to other options. <u>Advantages of cutting out by hand:</u> - Enjoyment and relaxation - Changes can be made during cutting or filing processes <u>Disadvantages of cutting out by hand:</u> - Time consuming - Care must be taken to achieve a good finish - Plastic could be easily broken during the different stages of manufacture - You would need a work shop environment to achieve a good quality product		

Q6	Science	Maths	Fibres and textiles Question or outline of question / Marking scheme	AO	Total
6. (a) (i)			State the name of the decorative process used to create the badge. [1] <i>Only acceptable answer for decorative process: Machine embroidery or CAM embroidery</i>	AO4 1a [1]	1
(ii)	✓		The badge has been designed on a CAD (Computer Aided Design) system. Describe one reason why a CAD system has been used to design the badge. [2] Answers must relate to CAD. 1 mark for reason and 1 mark for a clear description that relates to the badge design. For example: Using a CAD system to design the badge would ensure an accurate representation (1) as opposed to a design hand-drawn. (1) <i>Responses could be based on:</i> • Designs can be amended and edited quickly and easily during design development which would otherwise take much longer by hand (2) • Colour trials can be tested (1) • Designs don't need to be simplified they can be intricate as the software supports detailed designs. (2) • Design of the badge can be viewed by the client instantly enabling changes to be made easily if the client's wishes change. (2) • Lead-time from design to manufacture will be quicker enabling product to reach the market sooner. (2) <i>Credit any other appropriate response.</i>	AO4 1b [1] AO4 2c [1]	2

Q6	Science	Maths	Fibres and textiles Question or outline of question / Marking scheme	AO	Total
(iii)			The badge has been manufactured on a CAM (Computer Aided Manufacture) system. Describe one advantage of using CAM. [2] Answers must relate to the advantages of CAM. 1 mark for one correct advantage and 1 mark for clear description. For example: CAM machines will ensure large quantities of badges can be produced in a short amount of time due to the speed of processing (as opposed to more traditional methods). (2) <i>Responses could be based on:</i> • Less errors are made in production due to the effectiveness of software. (2) • CAM ensures consistency in outcome bringing about reliability for both client and consumer. (2) • Accuracy brings less waste in raw materials. (2) • CAM ensures changes to size, shape, colour can be made with very little down time (2) broadening the scope of product development. • Using CAM means there is no problem with using complicated patterns or designs. (2) <i>Credit any other appropriate response.</i>	AO4 2b [2]	2

Q6	Science	Maths	Fibres and textiles Question or outline of question / Marking scheme	AO	Total
(iv)			In the space below, using notes and sketches, describe the decorative process of appliqué. Award up to 3 marks for answers that demonstrate a clear understanding of the stages needed to produce the decorative process of applique without sketches. Award a maximum of 2 marks for clear sketching of processes even if written communication is missing. <i>Responses could be based on:</i> 1. Iron bond-a-web onto (the wrong side of) fabric. (1) 2. Draw around template/pattern/shape. (1) 3. Cut out shape. (1) 4. Position cut shape onto fabric (bond-a-web side down) with right side facing. (1) 5. Iron in position (to melt bond-a-web). (1) 6. Machine stitch in place. Note: Although using bond-a-web to fix applique is common practice, do not penalise candidates for not including in the process described. <i>Credit any other appropriate response.</i>	AO4 2c [4]	4

Q6	Science	Maths	Fibres and textiles Question or outline of question / Marking scheme	AO	Total
(b)		5	A manufacturer who forms the badges owns 25 specialist machines. Each badge takes 5 minutes to manufacture. Calculate how many badges the manufacture makes in an 8-hour shift using all 25 specialist machines. [5] <i>Show all workings.</i> 1 hr = 60 mins (1) $8 \times 60 = 480$ mins (1) $\frac{480}{5} = 96$ badge (1) $96 \times 25 = 2400$ badges in 8 hours (1) <i>Credit any appropriate approach to calculating the number of badges made in one 8-hour shift.</i>	AO4 1b [3] AO4 1c [2]	5

Q6	Science	Maths	Fibres and textiles Question or outline of question / Marking scheme	AO	Total															
(c)			Analyse the quality control checks that need to be carried out during the decorative process of applique. [5] Band descriptors and mark allocations <table><tr><td></td><td colspan="2">AO3 2a 5 marks</td></tr><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the quality control checks that need to be carried out during the decorative process of appliqué. There will be evidence of relevant examples and a well-developed logical chain of reasoning, sustained throughout.</td><td>4-5</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding, to analyse the quality control checks that need to be carried out during the decorative process of appliqué. There will be some evidence of mostly relevant examples and a logical chain of reasoning, but this may not be sustained throughout.</td><td>2-3</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding, to analyse the quality control checks that need to be carried out during the decorative process of appliqué. There will be limited evidence of relevant examples or a logical chain of reasoning.</td><td>1</td></tr><tr><td colspan="3">Award 0 marks for incorrect or irrelevant answers</td></tr></table>		AO3 2a 5 marks		BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the quality control checks that need to be carried out during the decorative process of appliqué. There will be evidence of relevant examples and a well-developed logical chain of reasoning, sustained throughout.	4-5	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding, to analyse the quality control checks that need to be carried out during the decorative process of appliqué. There will be some evidence of mostly relevant examples and a logical chain of reasoning, but this may not be sustained throughout.	2-3	BAND 1	Answer demonstrates only basic knowledge and understanding, to analyse the quality control checks that need to be carried out during the decorative process of appliqué. There will be limited evidence of relevant examples or a logical chain of reasoning.	1	Award 0 marks for incorrect or irrelevant answers			AO3 2a [5]	5
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BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the quality control checks that need to be carried out during the decorative process of appliqué. There will be evidence of relevant examples and a well-developed logical chain of reasoning, sustained throughout.	4-5																		
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BAND 1	Answer demonstrates only basic knowledge and understanding, to analyse the quality control checks that need to be carried out during the decorative process of appliqué. There will be limited evidence of relevant examples or a logical chain of reasoning.	1																		
Award 0 marks for incorrect or irrelevant answers																				

Q6	Science	Maths	Fibres and textiles Question or outline of question / Marking scheme	AO	Total
			Indicative content This content is not prescriptive and candidates are not expected to refer to all the material identified below. Quality control checks are put into place/identified at each stage of manufacture to ensure the applique being produced and sewn is accurate (with no fault) and as intended. Quality control checks should take place during the input, process and output of applique manufacture. Quality control checks that may be referenced in answer provided include: • Fabric being used for applique is checked for evenness of colour/pattern/flaws/faults in woven structure • Bond-a-web (or similar) is used to ensure applique shape remains flat prior to sewing • Bond-a-web is ironed onto the wrong side of the fabric • Iron temperature suits fabric being appliqued (i.e. not too hot for synthetic fabrics that melt) and/or fabric is protected to withstand high iron temperatures • Templates are used to ensure all shapes being cut are equal in size and shape • Any marking resource used is applied to the wrong side of the fabric • Appliqué is cut accurately (using suitable equipment e.g. fabric scissors) • Appliqué is positioned in the correct place as intended • Sewing machine (prior to use) is threaded correctly • Tension of sewing machine is correct for fabric being sewn • Needle selected is suitable for the fabric/thread being used • Pressure/presser foot selected is suited to the stitch being used to sew applique into place • Correct stitch length and width is selected for shape/fabric chosen • Correct thread colour is chosen to match/complement appliqué • Stitching is secured. <i>Credit any other appropriate response.</i>		

Q6	Science	Maths	Fibres and textiles Question or outline of question / Marking scheme	AO	Total															
(d)			Evaluate the benefits of using a CAM embroidery machine instead of embroidering by hand. [6] Band descriptors and mark allocations <table><tr><td></td><td colspan="2">AO3 2b 6 marks</td></tr><tr><td>BAND 3</td><td>A coherent answer demonstrating detailed, relevant knowledge and understanding, to evaluate how cell production benefits the workforce. There will be evidence of relevant examples and well-developed substantiated judgements in a response which is logically structured.</td><td>5-6</td></tr><tr><td>BAND 2</td><td>Answer has some coherence, demonstrating partial knowledge and understanding, to evaluate how cell production benefits the workforce. There will be some evidence of mostly relevant examples and partly substantiated judgements in a response which is generally well structured.</td><td>3-4</td></tr><tr><td>BAND 1</td><td>Answer demonstrates only basic knowledge and understanding, to evaluate how cell production benefits the workforce. There will be limited evidence of relevant examples or judgements in a response which demonstrates little structure.</td><td>1-2</td></tr><tr><td></td><td colspan="2">Award 0 marks for incorrect or irrelevant answers</td></tr></table> Indicative content This content is not prescriptive and candidates are not expected to refer to all the material identified below. Advantages of CAM embroidery: Any design, however intricate, can be manufactured There are pre-installed designs that don't need the time to design or programme CAD packages are available to increase creativity of designs Once set up, machines can be left to embroider without needing to be constantly watched Machine embroidery is far faster than hand-embroidery.		AO3 2b 6 marks		BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to evaluate how cell production benefits the workforce. There will be evidence of relevant examples and well-developed substantiated judgements in a response which is logically structured.	5-6	BAND 2	Answer has some coherence, demonstrating partial knowledge and understanding, to evaluate how cell production benefits the workforce. There will be some evidence of mostly relevant examples and partly substantiated judgements in a response which is generally well structured.	3-4	BAND 1	Answer demonstrates only basic knowledge and understanding, to evaluate how cell production benefits the workforce. There will be limited evidence of relevant examples or judgements in a response which demonstrates little structure.	1-2		Award 0 marks for incorrect or irrelevant answers		AO3 2b [6]	6
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	Award 0 marks for incorrect or irrelevant answers																			

Q6	Science	Maths	Fibres and textiles Question or outline of question / Marking scheme	AO	Total
			<u>Disadvantages of CAM embroidery:</u> • Set-up costs – cost of machines to purchase, cost of training/making mistakes while learning • End results look commercially manufactured which takes away some of the aesthetic qualities of the embroidery • Although many threads/colours can be used, this is still limited when comparing with hand-embroidery options • Down-time needed to re-thread for colour changes if required • Although quicker than hand-embroidery, it is still a time-consuming manufacturing process. Not a cost-effective decorative effect in comparison to other options. <u>Advantages of hand embroidery:</u> • It's a creative hobby that brings enjoyment and relaxation • Changes can be made during the process of hand embroidery which may result in a better aesthetic outcome, for example, thread colour or design (this happens during couture manufacture) • Additional decorative effects can be added during the process, such as beads or applique • Problems/errors can be identified and corrected immediately mid-process • It's an intuitive process • There are many available stitches to the hand embroiderer that not all CAM programmes can produce/manufacture. • The end result has a 'hand-made' finish that adds to the aesthetic qualities of the embroidery. <u>Disadvantages of hand embroidery:</u> • Extremely time consuming • Not cost effective – the length of time it takes to hand-embroider would make the retail cost too high for most retailer/consumers • Experience required to ensure stitch tensions are equal throughout the process so stitching is even. <i>Credit any other appropriate response.</i>		
				Total	25