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# **GCSE MARKING SCHEME**

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**SUMMER 2019**

**DESIGN AND TECHNOLOGY - PRODUCT DESIGN  
3603U10-1**

## **INTRODUCTION**

This marking scheme was used by WJEC for the 2019 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 AND TECHNOLOGY - PRODUCT DESIGN**

**SUMMER 2019 MARK SCHEME**

| Question 1 |  | AO3 | AO4 | Mark        |
|------------|--|-----|-----|-------------|
| (a)        | Explain <b>one</b> aesthetic change used in the new smart watch with activity tracker that will improve the product for the target market.   |     | ✓   | 2           |
|            | <p>Answers relating to one aesthetic change should be awarded up to 2 marks.</p> <p>Guidance:</p> <p>Candidates must identify aesthetic improvements only. Other improvements that are not aesthetic will not gain credit. Responses could include the shape of the new watch which is much more aerodynamic. The new watch is styled in a much more modern way, replacing the circular previous shape and adopting a futuristic slim-line form. The user interface is now completely digital where it was previously analogue. The new watch and strap are now one continuous form / shape unlike the previous watch which were completely independent.</p> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>The new watch is a different shape which is much better than the old one.</p> <p>More detailed response<br/>The new watch is a much more modern shape with no buttons. So it's more minimalistic.</p> |     |     | 0<br>1<br>2 |
| (b)        | When consumers purchase the new smart watch with activity tracker, they are likely to dispose of the existing watch. Explain <b>two</b> ways in which consumers could do this sustainably.   |     | ✓   | 2x[2]       |
|            | <p>Answers relating to the sustainable disposal of the traditional watch should be awarded up to 2 x [2] marks.</p> <p>Guidance:</p> <p>Candidates may use the 6R principle to respond here. Possible answers relating to Reusing the existing watch / selling to another user via e.g. ebay. recycling the exiting watch / and/ or strap which is likely to facelift. Separating the existing watch and strap so that they can be disposed of and recycled effectively. Look for 2 different detailed responses, DO NOT credit repetitive statements.</p> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>Do not throw the existing watch into a rubbish bin / landfill</p> <p>More detailed response<br/>Disassemble the watch and strap and separate materials appropriate for recycling and those that are not.</p>  |     |     | 0<br>1<br>2 |

|   |  |  |   |  |
|---|--|--|---|--|
| (c)   | During the development of the new smart watch with activity tracker, designers used CAD to produce iterations of ideas. Describe in detail the benefits of using CAD to develop the new smart watch with activity tracker. |  | ✓ | 4  |
| <p>Answers relating to benefits of CAD to model, test, analyse, develop and refine the new smart watch should be awarded up to 4 marks.</p> <p>Guidance:</p> <p>Candidates are required to produce a detailed and balanced response demonstrating detailed benefits of using CAD. DO NOT credit repetitive statements.</p> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>It is easier to edit and change ideas using CAD</p> <p>More detailed response<br/>CAD is a quick and effective way to test and develop ideas. Ideas can be simulated and communicated with others / target market / client.</p> <p>Detailed explanation or response<br/>CAD is a quick and effective way to test and develop ideas. Ideas can be simulated and communicated with others / target market / client, changes can be made by editing CAD designs.</p> <p>Highly detailed response with explanation<br/>CAD is a quick and effective way to test and develop ideas. Ideas can be simulated and communicated with others / target market / client, changes can be made by editing CAD designs. CAD designs can be used to generate 3D models using CAM or 3D printing.</p> |  |  |   | <p>0</p> <p>1</p> <p>2</p> <p>3</p> <p>4</p> |
| <b>Total</b>  |  |  |   | <b>10</b>                                    |

**Question 2**

|     |   | AO3 | AO4 | Mark |
|-----|---|-----|-----|------|
| (a) | State the name of a suitable smart material that could be used in the new coffee mug and describe how this material functions appropriately.  |     | ✓   | 2    |
|     | <p>Answers that name an appropriate smart material for the mug can be awarded 1 mark. 2 marks can be awarded for the name of a smart material and a description of how this functions.</p> <p>Guidance:<br/>When mug is empty and no hot contents are present, the mug will appear black with the sleeping face. As hot contents are poured in, the temperature change activates the white coloured finish with alert face.</p> <p>No answer or no relevant information presented or discussed. 0</p> <p>Thermo-chromic paint / pigment / ink / film (accept either) with no description. 1</p> <p>When the mug is empty or has cold contents, the black finish is evident, a hot liquid would change the mug to the white with 'awake' face image. 1</p>   |     |     |      |
| (b) | Explain <b>two</b> advantages of using this material to the user.   |     | ✓   | 4    |
|     | <p>Answers relating to two advantages of this material to the user can be awarded up to 2 marks x 2.</p> <p>Guidance:<br/>Responses may include a fun or entertaining element, to provide the user with immediate information about the liquid content's temperature, there may be his and her male / female designs to suit target market. Accept detailed responses for 2 x 2 marks providing there is clarity and a difference in the responses. DO NOT credit repetitive responses.</p> <p>No answer or no relevant information presented or discussed. 0</p> <p>Simplistic or basic response 1<br/>It is easy to tell whether the contents of the mug are hot or not<br/>Or<br/>It is much safer because the user will know the temperature of the contents. 1</p> <p>More detailed explanation or response 2<br/>The mug will automatically change providing information about the temperature of the contents.<br/>Or<br/>The mug will tell the user when the contents are cold, so the user will know not to drink the contents if they are expected to be hot. 2</p> |     |     |      |

|  |   |  |           |   |
|--|---|--|-----------|---|
| (c)  | (i) State the name of one suitable 3D printing material to make the coloured holders.   |  | ✓         | 1 |
|  | No answer or no relevant information presented or discussed.  |  |           | 0 |
|  | PLA (Polylactic Acid) accept Polylactide or ABS (Acrylonitrile butadiene styrene) accept nylon (there may be others)  |  |           | 1 |
|  | (ii) Explain the advantages to the designer of using 3D printing when rapid prototyping the new mug.  |  | ✓         | 3 |
|  | Answers relating to advantages of 3D printing when rapid prototyping the new mug should be awarded up to 3 marks.   |  |           |   |
|  | Guidance:   |  |           |   |
|  | <ul style="list-style-type: none"> <li>• 3D printing allows design ideas to develop faster, concepts can be produced physically same day</li> <li>• Time to market is reduced – this keeps competitors behind.</li> <li>• 3D printing uses additive manufacturing so reduces waste possible in other methods.</li> <li>• 3D printing builds confidence in product prior to production.</li> <li>• Clear communication of product, for testing, exposing with clients, unveiling new product at launch.</li> <li>• Shapes / forms that are traditionally difficult to manufacture can be produced easily.</li> </ul> |  |           |   |
|  | No answer or no relevant information presented or discussed.  |  |           | 0 |
|  | Simplistic or basic response<br>3D printing provides an accurate outcome of a CAD drawing   |  |           | 1 |
|  | More detailed response<br>3D printing produces a physical model of a CAD idea very quickly.   |  |           | 2 |
| 3D printing allows the designer to realise a physical idea quickly from a CAD drawing. This prototype can then be physically tested and modifications identified and refined very quickly. |   |  | 3         |   |
| <b>Total</b>   |   |  | <b>10</b> |   |

**Question 3**

|     |  | AO3 | AO4 | Mark |
|-----|--|-----|-----|------|
| (a) | (i) State the names of renewable Energy sources <b>A</b> and <b>B</b> .  |     | ✓   | 2    |
|     | No answer or no relevant information presented or discussed.   |     |     | 0    |
|     | Energy Source <b>A</b> : Tidal energy system   |     |     | 1    |
|     | Energy Source <b>B</b> : Geothermal energy system  |     |     | 1    |
|     | (ii) Describe how Energy source B is intended to generate renewable energy.<br>Answers relating to energy production using geothermal sources can be awarded up to 2 marks.<br><br>Guidance:<br><ul style="list-style-type: none"> <li>Water or working fluid is heated (or used directly in case of geothermal dry steam power plants), and then sent through a steam turbine where the thermal energy (heat) is converted to electricity with a generator through a phenomenon called electromagnetic induction.</li> </ul> Accept responses that include negatives such as Geothermal power is cost-effective, reliable, sustainable, and environmentally friendly, but has historically been limited to areas near tectonic plate boundaries.<br><br>No answer or no relevant information presented or discussed.<br><br>Simplistic or basic response<br>Heat from the earth warms up water.<br><br>More detailed response<br>People can capture geothermal energy through Geothermal power plants, which use heat from deep inside the Earth to generate steam to make electricity.<br>Or<br>Geothermal heat pumps, which tap into heat close to the Earth's surface to heat water or provide heat for buildings. |     |     | 2    |
|     | No answer or no relevant information presented or discussed.   |     |     | 0    |
|     | Simplistic or basic response<br>Heat from the earth warms up water.  |     |     | 1    |
|     | More detailed response<br>People can capture geothermal energy through Geothermal power plants, which use heat from deep inside the Earth to generate steam to make electricity.<br>Or<br>Geothermal heat pumps, which tap into heat close to the Earth's surface to heat water or provide heat for buildings.   |     |     | 2    |

|  |                            |
|--|----------------------------|
| <p>(iii) Explain <b>two</b> disadvantages of using energy source A to generate renewable energy.</p>   | <p>2</p>                   |
| <p>Answers relating to disadvantages of tidal power should be awarded up to 2 x 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Look to credit two disadvantages. Tidal systems can change coastal structures, increase silt deposits, affect marine migration, they are prone to damage in high seas / stormy conditions, the suitable locations are highly limited and tidal systems can cut off shipping lanes / access to rivers.</li> <li>• Changing patterns of coastal erosion. Coastal erosion has increased in areas directly around tidal barrage, as wave and tide patterns are interfered with and moved onto different parts of the coastline.</li> <li>• Local eco systems are also affected as the river mouth that sit behind the tidal lagoon see a drop in spawning fish and other marine life, affecting birds, insects and plant life.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>One Simplistic or basic response<br/>Only productive twice per day<br/>Or<br/>Tidal systems are expensive to install</p> <p>More detailed explanation or response<br/>Tidal systems have initial set up costs which are very high.<br/>Tidal turbines can be harmful to wildlife / fish affecting local eco systems.</p> | <p>0</p> <p>1</p> <p>2</p> |
| <p>(iv) Explain why modern manufacturing and production systems now use renewable energy sources where possible.</p>   | <p>2</p>                   |
| <p>Answers relating to reasons why modern manufacturing / production systems use renewable energy where possible should be awarded up to 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Look for detailed understanding of reasons why harnessing ‘green’ energy is increasing.</li> <li>• Government backed schemes with financial incentives, public relations boost for the company as perception will improve, could create more jobs and stimulate the economy, there could be less service disruption / improved supply.</li> <li>• increasing return as energy bills increase, greener sources will continue to provide a healthy return.</li> <li>• there will also be fewer / reduced global warming emissions.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>It’s cheaper to use renewable energy sources</p> <p>More detailed explanation or response<br/>Greener energy sources will reduce energy costs e.g. fossil fuels, and therefore reduce production costs.</p>  | <p>0</p> <p>1</p> <p>2</p> |

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|--|--|--|---|---|---|
| (b)  | (i) Describe why manufacturers must now supply energy labels with many products. |  | ✓ | 2 |   |
| <p>Answers relating to the need for providing information about the product in use should awarded up to 2 marks.</p>   |  |  |   |   |   |
| <p>Guidance:</p>   |  |  |   |   |   |
| <ul style="list-style-type: none"> <li>• Look for detailed understanding.</li> <li>• Energy labels allow consumers to compare products prior to purchasing.</li> <li>• Decisions may be made on an efficiency basis, consumers should ethically / morally be made aware of the running costs of products prior to purchase.</li> <li>• Directive 2010/30/EU “on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products” sets a framework for the adoption of product-specific directives on the proper energy efficiency labelling for each concerned product.</li> <li>• This law is undergoing review; the proposed legislation, simplifying labelling categories and extending the scope will likely be adopted in 2017.</li> <li>• Suppliers are to supply free of charge labels or product fiches containing information about consumption of electric or other energy sources to their dealers. Dealers display labels in a visible and legible way, and make the fiche available in product brochures or other literature.</li> </ul> |  |  |   |   |   |
| <p>No answer or no relevant information presented or discussed.</p>  |  |  |   |   | 0 |
| <p>Simplistic or basic response</p>  |  |  |   |   | 1 |
| <p>Energy labels are needed to give customers information</p>  |  |  |   |   |   |
| <p>Or</p>  |  |  |   |   |   |
| <p>It is a mandatory requirement to have a label</p>   |  |  |   |   | 1 |
| <p>More detailed explanation or response</p>   |  |  |   |   |   |
| <p>Manufacturers are required to provide energy data with new products so that customers / purchasers can clearly see the energy consumption of products.</p>  |  |  |   |   | 2 |

|   |  |   |   |
|---|--|---|---|
| (ii) Explain in detail the benefits of energy labels to the consumer when purchasing products.  |  | ✓ | 5   |
| <p>Answers relating to benefits to the consumer of energy labels should be awarded up to 5 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Consumers can clearly see the energy rating of the product.</li> <li>• Labels simplify running costs, the higher the A rating the more economical / efficient the product is.</li> <li>• Consumers can compare products using the labelling system.</li> <li>• Consumers are made fully aware of running costs of the product.</li> <li>• Consumers can make more informed judgements based on eco factors.</li> <li>• Consumers can also be informed of noise generation of products.</li> <li>• Consumers can judge products on rrp and runnings costs – a cheaper product to purchase may cost more to run in the long term.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Brief or basic explanation, very little detail.<br/>Consumer can see how much energy the product will use</p> <p>Description with some explanation and some detail of the impact on consumer<br/>Consumer can see how much energy will be used and can compare to another product.</p> <p>More detailed explanation with a clear understanding of the impact on consumer.<br/>Consumer can see how much energy is likely to be used and can estimate running costs / bills effectively. The customer can compare similar products to evaluate energy use.</p> <p>A detailed explanation with a clear understanding of impact on the consumer.<br/>Consumer can see how much energy is likely to be used and can manage bills effectively. The consumer can compare similar products and consider their energy rating / efficiency prior to purchasing.</p> <p>A highly detailed and comprehensive explanation of both positive and negative impact on the consumer.<br/>Consumer can see how much energy will be used and can manage bills effectively. The consumer can be confident when purchasing products because all energy ratings are comparable and transparent preventing any surprises regarding energy consumption once products are purchased and used. Energy labels are mandatory in EU and so the consumer is likely to have increasingly efficient products to choose from due to the competitive market established as a result of labelling.</p> |  |   | <p>0</p> <p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p> |
| <b>Total</b>  |  |   | <b>15</b>   |

**Question 4**

|     |  | <b>AO3</b> | <b>AO4</b> | <b>Mark</b> |
|-----|--|------------|------------|-------------|
| (a) | Analyse how the designer would gather information on the target market before starting to generate ideas for the kitchen products.   | ✓          |            | 4           |
|     | <p>Answers relating to researching the target market should be awarded up to 4 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"><li>• The designer would seek to establish the user's needs and wants from the product/s.</li><li>• A questionnaire could be used to gather responses, this would be analysed to give the designer a clear picture of the scenario.</li><li>• Research on anthropometric data would be conducted to establish sizes for products to be ergonomically effective.</li><li>• Interview / speak to parents / children about home cooking, uncover type of products they already use, and what type of cooking activities children undertake.</li><li>• The designer might establish dietary requirements / healthy eating patterns in families.</li><li>• The designer may use a survey to gather opinions on existing products and how they can be improved.</li><li>• The designer could measure children's hands to establish correct sizes for grips, handles, etc.</li><li>• Find out data on carrying objects, weights of items that can be carried safely by children.</li></ul> |            |            |             |

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|  | <p>No answer or no relevant information presented or discussed.</p> <p>Simple understanding of research.<br/>Little, if any, understanding of how the designer could research and gather information to analyse the target market.<br/>Quality of Written Communication is limited, presenting material with limited coherence, many errors of grammar, punctuation and spelling.</p> <p>Conduct a survey of users to make sure the handles are the right size to hold<br/>Or<br/>Find out anthropometric data to make sure the kitchen products are comfortable to hold</p> <p>Some description of research.<br/>Some understanding of how the designer could research and gather information to analyse the target market.<br/>Quality of Written Communication is basic, presenting occasionally appropriate material with some coherence, some errors of grammar, punctuation and spelling.</p> <p>Find out anthropometric data on children so that the circumference / diameter of the handles that the children need to hold are be to be gripped by children using right or left hands.<br/>Or<br/>Measure the children's hand do that the positioning of the blade on the vegetable scraper can be far away from the handle to prevent any injuries.</p>   | <p>0</p> <p>1</p> <p>2</p> |
|  | <p>Description and understanding of research.<br/>Some understanding of the how the designer could research and gather information to analyse the target market, and how this would clarify the user needs and wants.<br/>Quality of Written Communication is good, presenting mainly appropriate material in a coherent manner, few errors of grammar, punctuation and spelling.</p> <p>Carry out a survey on families to find out the type of cooking activities children take part in. Find out hand sizes of users so that the circumference / diameter of the handles that need to be gripped by children using right or left hands are the correct size.</p> <p>Clear and detailed understanding and description of research.<br/>Clear and detailed understanding of how the designer could research and gather information to analyse the target market, and how this would clarify the user needs and wants to form a design specification.<br/>Quality of Written Communication is excellent, presenting wholly appropriate material in a coherent and logical manner, hardly any errors of grammar, punctuation and spelling.</p> <p>Research the target market by using a questionnaire to find out what type of cooking, cutting or preparation children undertake at family meal times.<br/>Interview / ask children what colours / shapes they would like best for the new products. Look up anthropometric sizes to create comfortable ergonomic feature on products including large carrying handles so items can be used and transported. Handles are all coloured differently to items with cutting blades – this allows the user to distinguish between parts of objects and intended use.</p> | <p>3</p> <p>4</p>          |

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|--|--|-----|
| (b)  | The kitchen products are injection moulded using high density polyethylene (HDPE), and finished with a rubberised handle. Evaluate how this impacts on the environmental footprint of the product. | 6   |
| Answers relating to the environmental impact of using injection moulded HDPE should be awarded up to 6 marks.  |  |     |
| <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Candidates could be focussing on the combination of materials</li> <li>• Injection moulding uses power / energy possibly from non-renewable sources.</li> <li>• Processing two different materials and combining them, possibly with glue / adhesive / resin makes separation and reusing difficult.</li> <li>• Disposal issues of the product because polymers and thermosetting materials are difficult to recycle.</li> <li>• Life Cycle Analysis could be used here to consider recycling, reusing, and disposal.</li> <li>• Plastics are bad because they come from finite resources and require significant processing which uses energy, and creates pollution.</li> <li>• HDPE is non-biodegradable and will take centuries to decompose at landfill once products are discarded.</li> <li>• The rubberised handle is made from possibly natural materials (latex) or synthetic rubber which is a by-product of petroleum. Both sources require significant processing.</li> <li>• HDPE and Rubber are long-lasting materials, robust and durable so will not break easily.</li> </ul> |  |     |
| No answer or no relevant information presented or discussed. Quality of Written Communication is limited, presenting material with limited coherence, many errors of grammar, punctuation and spelling.  |  | 0   |
| Brief description, very little detail of environmental footprint. Quality of Written Communication is basic, presenting occasionally appropriate material with some coherence, some errors of grammar, punctuation and spelling.   |  |     |
| The products / materials are difficult to recycle<br>Or<br>The product is difficult to separate for recycling and parts would be difficult to re-use.  |  | 1-2 |
| Some detail with some understanding of environmental footprint. Quality of Written Communication is good, presenting mainly appropriate material in a coherent manner, few errors of grammar, punctuation and spelling.  |  |     |
| <p>The HDPE is not biodegradable and should not be thrown away and go in to landfill.<br/>HDPE is non-biodegradable and can take centuries to decompose, so it is imperative that it is recycled and used again. It is more cost efficient to produce a product from recycled HDPE than it is to manufacture 'virgin' plastic</p> <p>Or</p> <p>Rubber can be produced from natural resources like plants that include latex. This is a non-renewable source and should be avoided.</p> <p>Or</p> <p>Some rubbers are synthetic and do not come straight from natural resources, and are therefore more sustainable.</p>  |  | 3-4 |

|  |  |     |
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|  | <p>A clear and detailed understanding of the environmental footprint of the 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.</p> <p>The sources of the materials are important to consider. HDPE is a non-renewable material coming from finite resources. Heavy processing and energy costs are involved in processing it to product stage. HDPE is a difficult material to re-use or recycle after product disposal. More energy will be required to separate and break down the materials. The rubberised parts would be bonded to products, probably using chemical components. This would not be environmentally friendly. Rubber could be natural or synthetic, but would require heavy processing and bonding to the kitchen products.</p> | 5-6 |
|--|--|-----|

|  |   |   |  |   |
|--|---|---|--|---|
| (c)  | (i) Evaluate the advantages to the student of using blue modelling foam to make the concept model in a school workshop. | ✓ |  | 4 |
| <p>Answers relating to the advantages to the student of using blue modelling foam should be awarded up to 4 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Blue modelling foam is available in a range of sizes (thicknesses) suitable for all projects.</li> <li>• Blue modelling foam is quite cheap and readily available, so easy to access to model with.</li> <li>• Blue foam is soft and easy to work. Commonly cut with hot wire cutters / craft knives, fine coping saw blades.</li> <li>• Less time consuming than using other modelling materials e.g. mdf.</li> <li>• Blue foam is easy to draw / mark lines on in preparation for cutting and shaping.</li> <li>• Blue foam can be cut on bandsaw and shaped using disc sanders which are common in D&amp;T workshops.</li> <li>• Blue foam models can be primed and painted if needed.</li> <li>• Blue foam is rigid and resistant enough to handle / test the torch.</li> <li>• A smooth finish can be achieved fairly easily / quickly to achieve a realistic product.</li> <li>• Blue foam has no grain, the texture and density is consistent throughout its section.</li> <li>• Blue foam is very easy to file after cutting, and glasspaper to smooth finish.</li> </ul> |   |   |  |   |

|  |  |   |
|--|--|---|
|  | <p>No answer or no relevant information presented or discussed.</p>  | 0 |
|  | <p>Simple understanding of advantages to the student of using blue modelling foam. Quality of Written Communication is limited, presenting material with limited coherence, many errors of grammar, punctuation and spelling.</p>  | 1 |
|  | <p>Blue foam is easy to cut and shape to make the model<br/>Or<br/>Blue foam is a quick way of modelling</p>   | 2 |
|  | <p>Some understanding of advantages to the student of using blue modelling foam. Blue modelling foam is an affordable material easy to work when cutting, forming, shaping into the torch design. It can look professional when primed and sprayed.<br/>Or<br/>Blue modelling foam is available in a range of forms and thickness. It has no grain. It will offer a realistic feel for concept models.</p> | 3 |
|  | <p>Description and understanding of advantages to the student of using blue modelling foam.</p>  | 4 |
|  | <p>Blue modelling foam is an affordable material easy to work when cutting, forming, shaping into the torch design. It can look professional when primed and sprayed. Blue modelling foam is available in a range of forms and thickness.</p>  | 3 |
|  | <p>Clear and detailed understanding of advantages to the student of using blue modelling foam.</p>   | 4 |
|  | <p>Blue modelling foam is an affordable material easy to work when cutting, forming, shaping into the torch design. It can look professional when primed and sprayed. Blue modelling foam is available in a range of forms and thickness. It has no grain. It will offer a realistic feel for concept models.</p>  | 4 |

|  |   |   |
|--|---|---|
|  | <p>(ii) Analyse the benefits that modelling will have for the eventual success the concept model of a new handheld torch.</p>   | 6   |
|  | <p>Answers relating to the analysis of modelling on the eventual success of the torch should be awarded up to 6 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Benefits include that ideas can be tested fully prior to production, saving time, money and reducing errors.</li> <li>• Modifications / changes can be identified and implemented as a result of modelling.</li> <li>• Models can be tested by target market, and analysed to improve next iteration.</li> <li>• Modelling will allow the shape, form, aesthetics and ergonomics to be developed fully / perfectly.</li> <li>• During modelling, the designer can ‘feel’ how the idea would work, not a simulation but a real-life test.</li> <li>• Materials and components, sizes and costs can be estimated from the model.</li> <li>• The model could be scanned and CAD to be used to generate CAM files for production.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Brief description, very little detail of analysing the benefits of modelling on the eventual success of the torch.</p> <p>Modelling helps the designer to see if it’s a good idea.</p> <p>Or</p> <p>The product can be tested to see if it works well or needs to change.</p> <p>Some detail with some understanding of the benefits of modelling on the eventual success of the torch.</p> <p>Modelling allows testing of the torch so that good features can be kept and changes identified to improve the torch. The model prevents the product being manufactured with defects or problems.</p> <p>A clear and detailed analysis of the benefits of modelling on the eventual success of the torch.</p> <p>Modelling allows testing of the torch by the designer and the target market so that good features can be kept and changes identified to improve the torch.</p> <p>This will ensure that the final product is successful and meet all of the market’s needs and wants. The model prevents the product being manufactured with defects or problems, which would be costly for the manufacturer.</p> | <p>0</p> <p>1-2</p> <p>3-4</p> <p>5-6</p> |
|  | <b>Total</b>  | <b>20</b>                                 |

**Question 5**

|  |  | AO3 | AO4 | Mark |
|--|--|-----|-----|------|
| (a)  | (i) Give <b>one</b> reason for the stools and chairs being delivered to the customer as a flat-pack. |     | ✓   | 2    |
| <p>Answers relating to reasons for flat-packed box should be awarded up to 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Cheaper for the retailer to ship / lower costs for the customer to pay for delivery</li> <li>• Easier to transport / ship / distribute.</li> <li>• Less prone to damage as it is a flat shape, multiple packs could be held together.</li> <li>• The product is made from a series of flat shapes that fit together, so storing them flat is very appropriate.</li> <li>• The main reasons are the DIY nature, but other factors such as transporting multiple products bought as a bundle are acceptable. Storage at the factory NOT acceptable.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>Cheaper to transport / ship / post.<br/>Or<br/>Will not get damaged as it is flat.</p> <p>More detailed explanation or response.<br/>The range are flat packed products, therefore require self-assembly by the customer.</p> |  |     |     | 0    |
|  |  |     |     | 1    |
|  |  |     |     | 2    |

|  |   |                            |
|--|---|----------------------------|
|  | (ii) Describe how the properties of high quality corrugated cardboard make it suitable for the flat packed stools and chairs.   | 2                          |
|  | <p>Answers relating to the properties of high quality corrugated card being suitable should be awarded up to 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Several areas where candidates could gain credit.</li> <li>• Can withstand the forces applied when user sits down, stiff, rigid structure for posting.</li> <li>• The eco furniture company will want a green material – corrugated card could be made from 100% recycled materials</li> <li>• The products would be 100% recyclable at the end of their useful life.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>The corrugated structure is strong<br/>Or<br/>It will be strong enough to sit on<br/>Or<br/>It is fully recyclable after use<br/>Or<br/>It will hold the weight of the user</p> <p>More detailed explanation or response.<br/>The corrugated cardboard is reinforced and is rigid and can withstand forces applied when placed upright as shown in the products.<br/>Or<br/>It is a cheap sheet material which can be cut as required by CAM machines for the stool and chair designs.<br/>Or<br/>It is a strong and lightweight material which can be shipped flat as shown for the products to be removed and assembled.</p> | <p>0</p> <p>1</p> <p>2</p> |

|  |                            |
|--|----------------------------|
| <p>(iii) The stools and chairs do not require any glue or fixtures during assembly. Explain <b>two</b> advantages this will bring for the consumer.</p>  | 2x[2]                      |
| <p>Answers relating to the advantages to the customer for using no glue or fixtures should be awarded up to 2 x 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Products are cheaper to purchase due to less components / parts.</li> <li>• No specialist tools or equipment needed to assemble products, so this is simpler for the consumer.</li> <li>• Quicker to assemble than products with fixtures and glue.</li> <li>• More environmentally friendly / smaller footprint due to less parts.</li> <li>• Can be fully recycled at the end of its life / disposal.</li> <li>• Instant product once assembled – no need to wait for glue to dry.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>The products are quicker to assemble<br/>Or<br/>No specialist tools or equipment is needed</p> <p>More detailed explanation or response.<br/>The assembly is simple because parts slot together so the product can be used immediately once fully assembled.<br/>Or<br/>The products are completely eco-friendly and use no additional materials or components other than the parts supplied.</p> | <p>0</p> <p>1</p> <p>2</p> |
| <p>(iv) Explain how the designer has used corrugated cardboard in an innovative way.</p>   | 2                          |
| <p>Answers relating to the innovative package idea being re-used as the lamp shade should be awarded up to 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• The eco furniture company has been innovative by giving the packaging a second function – to act as the lamp shade after transporting the bulb safely.</li> <li>• The eco furniture company has been innovative by reducing waste packaging, 100% of this product and packaging is used.</li> <li>• Cutting the shapes in the package is innovative, to allow light to projects through pre-cut holes / gaps.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>The package can be fully recycled once opened<br/>Or<br/>The package is a light shade too.</p> <p>More detailed explanation or response.<br/>The package doubles as a light shade, so there is no waste whatsoever when the product is purchased and opened.</p>  | <p>0</p> <p>1</p> <p>2</p> |

|   |   |                            |
|---|---|----------------------------|
| (b)   | (i) The bicycle rack is made from mild steel. Explain why this material is suitable for the bicycle rack. | 2                          |
| <p>Answers relating to the suitability of mild steel for the bicycle rack should be awarded up to 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Mild steel is a strong rigid material able to support the bicycles.</li> <li>• Mild steel is available in tubular form and can achieve the shapes required.</li> <li>• Mild steel is suitable for outdoor use as it is corrosive resistant when finished appropriately.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>Mild steel won't rust easily if coated.</p> <p>More detailed explanation or response.<br/>The mild steel is suitable for outdoors because it will not corrode easily when finished appropriately.</p> <p>Or<br/>Mild steel is strong, sturdy and robust and will be secure to lock bicycles to.</p> <p>Or<br/>Mild steel tubing can be shaped into the range of bicycle racks pictured.</p>   |   | <p>0</p> <p>1</p> <p>2</p> |
| (ii) The mild steel has been powder coated. Describe the main function of this finish.  |   | <p>✓</p> <p>2</p>          |
| <p>Answers relating to the function of powder coated finish should be awarded up to 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Responses need to address the reasons for powder coating which are related to aesthetic / colour coding the range of racks.</li> <li>• Powder coating provides a protective finishing preventing scratching the bicycles locket to it, making it more durable.</li> <li>• Different colours can be applied to achieve the range required by the manufacturer.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>The make the bicycle rack look nicer</p> <p>Or<br/>The bike lock will be a brighter colour</p> <p>Or<br/>To get a range of colours for user choice</p> <p>More detailed explanation or response.<br/>The powder coating provides aesthetic and mechanical qualities, making the racks look more attractive and become available in a variety of colours, and the powder coating provides a hard wearing, durable and scratch /scuff resistant wearing coat.</p> |   | <p>0</p> <p>1</p> <p>2</p> |

|  |   |   |
|--|---|---|
|  | (iii) Explain how providing a range of bicycle racks might appeal to the consumer and the impact this may have on the manufacturer.   | 6   |
|  | <p>Answers relating to how the range might appeal to consumers and the impact this may have on the manufacturer should be awarded up to 6 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• The range of racks available provide more sales because there will be more choice to suit consumer tastes.</li> <li>• More choice can give consumer more freedom to make personalised shapes / spaces fitted with certain racks. Added flexibility solutions.</li> <li>• This could be related to colour influencing consumer choice, greater freedom over creating a specific solution using one or more of the racks available.</li> <li>• Applying a modular approach where consumer who purchases one initially may return to make further purchases.</li> <li>• The manufacturer may have to increase production as items sell / become more popular.</li> <li>• The manufacturer will have an increase in profit margins as more will sell.</li> <li>• The manufacturer may have returning customers who initially purchase and then re-order a similar of different rack.</li> <li>• The manufacturer may have to semi-automate production / increase workforce to keep up with demand.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response showing little explanation.<br/>Customers might prefer one colour over another<br/>Or<br/>Different colour for different sized racks allows the manufacturer to colour code the options.</p> <p>More detailed explanation or response showing more understanding of appeal to the customer AND impact on manufacturer.<br/>The racks are colour coded as part of a suite of products, so customers can mix and match products, or purchase similar racks for consistency depending on the number users. This means the manufacturer is likely to sell more racks.</p> <p>A clear and detailed explanation showing full understanding towards the consumer AND manufacturer.<br/>The racks are colour coded as part of a suite of products, so customers can mix and match products, or purchase similar racks for consistency depending on the number users. This means the manufacturer is likely to sell more racks and make more profit.<br/>This will give consumers a greater choice providing flexibility for the solutions of storing bicycles, allowing custom bicycle storing arrangements suitable for different spaces and locations.</p> | <p>0</p> <p>1-2</p> <p>3-4</p> <p>5-6</p> |
|  | <b>Total</b>  | <b>20</b>                                 |

**Question 6**

|     |  | AO3 | AO4 | Mark        |
|-----|--|-----|-----|-------------|
| (a) | (i) Describe the properties of PVC that make it a suitable material for the tubes used to create the upright stand.  |     | ✓   | [2]         |
|     | <p>Answers relating to properties of PVC should be awarded up to 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Understanding of PVC including ability to be extruded in tubular form.</li> <li>• Collars / flared end to connect to similar tube components.</li> <li>• Economic to use, able to be manufactured in red (or other colours)</li> <li>• Flexible with good tensile strength to withstand forces as ball rotates around upright.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>PVC is strong and wouldn't break easily.<br/>Or<br/>PVC is a strong stiff material for the stand</p> <p>More detailed explanation or response.<br/>PVC is very dense compared to most plastics, with extremely good tensile strength suitable for the upright stand.<br/>Or<br/>PVC is readily available, fairly cheap to manufacture and easy to colour for the red tubing required.<br/>Or<br/>PVC has good strength weight ratio easy to collapse for portability, and is water / weather resistant for use outdoors.</p> |     |     | 0<br>1<br>2 |
|     | (ii) The tennis game needs to be easily assembled and disassembled. Explain how this has been achieved.  |     |     | [2]         |
|     | <p>Answers relating to how the tennis game can easily assembled and disassembled should be awarded up to 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Responses need to address the quickly erected and collapsed intention.</li> <li>• All joints are push fit, standard identical joints.</li> <li>• No specialist tools, equipment or knowledge needed.</li> <li>• All parts separate to fit inside storage / carry case.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>The PVC parts fit together tightly and quickly<br/>Or<br/>The tennis game is made up from a small number of PVC parts.</p> <p>More detailed explanation or response.<br/>There are individual parts which fit together easily without any fittings or fixtures and dismantle to fit inside in the base which becomes the carry case to be portable.</p>  |     |     | 0<br>1<br>2 |

|  |  |                            |
|--|--|----------------------------|
|  | (iii) Explain <b>two</b> advantages of using injection moulding to make the ABS base and carry case.   | 2x[2]                      |
|  | <p>Answers relating to using injection moulding to make the ABS base and carry case should be awarded up to 2 x 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Look for two different answers.</li> <li>• Avoid double awarding similar responses.</li> <li>• ABS is a strong material, suitable for the injection moulding process to make this case.</li> <li>• Injection moulded ABS will be impact and water resistant, important features for the base / carry case.</li> <li>• Colour changes can easily be added by using different colour granules in the injection moulding process.</li> <li>• These are made in high volume – each is identical.</li> <li>• Economical production method for mass/volume.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>The ABS is a strong material for the base / case<br/>Or<br/>Is water resistant for outdoor use<br/>Or<br/>Can be filled with water to add weight to the base.</p> <p>More detailed explanation or response.<br/>The ABS is a robust, tough, strong and rigid material suitable for the knocks and bangs that the carry case / base might experience<br/>Or<br/>Injection moulding would be a quick and efficient process with no waste. Any defects could be reused in the next moulding.<br/>Or<br/>Due to injection moulding, all joints would be identical standard components with high quality assurance, perfect for large scale production.<br/>Or<br/>The manufacturer could change the colour easily / release special edition with a change in coloured granules using the same die / mould.</p> | <p>0</p> <p>1</p> <p>2</p> |

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|--|---|-------------------------------------|
|  | (iv) Analyse how the physical properties of nylon make it a suitable for the cord attached to the tennis ball.  | [3]                                 |
|  | <p>Answers relating to the physical properties of nylon suitable for the cord should be awarded up to 3 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Look for explanation of nylon’s properties including lightweight for portability,</li> <li>• Woven into cord, flexible and high tensile strength.</li> <li>• Durable for outdoors, washable, synthetic material so does not fail quickly,</li> <li>• Soft on the hand, no sharp edges or hazards.</li> <li>• Abrasion resistant if hit / grazed with a bat.</li> <li>• Low friction.</li> <li>• Resistant to snapping or fraying despite under constant blows from bats.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>The string will need to be strong to take the impact of the ball being hit at high speed or hard. Nylon is a strong material.<br/>Or<br/>Nylon is flexible and not too rigid.</p> <p>More detailed explanation or response.<br/>Nylon has good tensile strength and will not deform or snap / break easily<br/>Or<br/>Nylon has excellent resistance to weathering; it does not corrode in wet conditions.<br/>Or<br/>Nylon if flexible, durable and strong with excellent abrasion resistance</p> <p>A highly detailed explanation or response.<br/>Nylon has good tensile strength and will not deform or snap / break when the impact of the ball being hit occurs. Nylon is lightweight with excellent strength weight ratio.<br/>Or<br/>Nylon has excellent resistance to weathering, it does not corrode in wet conditions. It is sunlight resistant for use outdoors, and abrasion resistant if hit with one of the bats.<br/>Or<br/>Nylon if flexible so easy to fit when erecting the tennis game and folding flat / small into the carry case and is lightweight to carry for portability.</p> | <p>0</p> <p>1</p> <p>2</p> <p>3</p> |

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|  | <p>(v) Different parts of the product are manufactured in different countries and shipped to a central location for assembly.<br/>Describe the winners and losers created by manufacturing in this way.</p>  | [4]  |
|  | <p>Answers related to manufacturing in different countries and shipping to a central location for assembly should be awarded up to 4 marks. Answers must include winner/s and loser/s to achieve maximum 4 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Winners are consumers who get access to a cheaper product due to overseas manufacture.</li> <li>• Winners are local / overseas businesses who get contracted to produce parts, benefitting their economy.</li> <li>• Losers could be environment due to transporting parts from country of manufacture, to assembly and then on to retailer.</li> <li>• Losers could be workers in less economically developed countries who could be exploited</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Description with some explanation and some detail of winners and losers. Winners are local businesses where some parts might be made or sourced.<br/>Or<br/>Losers are the environment / environmentalists because shipping involves energy usable.</p> <p>More detailed explanation with some explanation of winners and losers. Winners are the consumers who will be able to buy a cheaper product because the parts will be made competitively and therefore a lower RRP.<br/>Or<br/>Losers are the local business because some parts are sourced elsewhere therefore trade is lost. Workers / jobs may be less than if all parts were made at same location.</p> <p>A detailed explanation including a number of explanations of impact on winners and losers. Winners would be suppliers who win contracts to provide parts, the country / government economy of the supplier would benefit from this trade. The buyer would get the product for a lower purchase price. Losers would be other suppliers or countries for not securing the trade and missing the opportunity to sell and make profit.</p> <p>A highly detailed and comprehensive explanation of both positive and negative impact on the consumer. The market would be competitive, and supplier would need to bid to secure the contract to supply. This would benefit the manufacturer to secure cheaper parts, and the end user would have to pay a lower purchase price. Losers would be other suppliers or countries for not securing the trade and missing the opportunity to sell and make profit. The environment would also be a loser due to shipping globally. Losers could be workers in one a less economically developed country where there could be workforce issues or poor pay / working conditions.</p> | <p>0</p> <p>1</p> <p>2</p> <p>3</p> <p>4</p> |

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|--|--|-------------------------------------|
|  | <p>(vi) Explain why, initially, the manufacturer of the tennis game would produce a limited number of products using batch production.</p>   | <p>[3]</p>                          |
|  | <p>Answers relating to reasons why a limited number of tennis games would be produced using batch production should be awarded up to 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Credit candidates identifying the reasons for batch production.</li> <li>• A limited edition version might be created, as an anniversary product / collector's item etc.</li> <li>• Testing the market if product is new.</li> <li>• Promoting an event e.g. a tennis tournament, so limited number ordered / made.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Description with some explanation and some detail.<br/>To see if the product would sell / be popular without making too many.</p> <p>More detailed explanation.<br/>The manufacturer will be testing the market to ensure there is sufficient demand for the product.</p> <p>A detailed and full explanation<br/>The manufacturer will be anticipating the likely number of sales and making just enough to supply the demand. If demand is high, further batches or mass production would begin. If sales were low, no more products would be manufactured.</p> | <p>0</p> <p>1</p> <p>2</p> <p>3</p> |

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|--|---|--|---|-----|
| (b)  | (i) Rather than extrude 300mm red PVC tubes for the upright stand, the manufacturer decided to purchase 3.1m lengths of standard 30mm diameter tubing from an external source. Explain how this will benefit the manufacturer when producing the tennis game. |  | ✓ | [3] |
| <p>Answers relating to benefits to the manufacturer of using externally sourced parts should be awarded up to 3 marks.</p>   |   |  |   |     |
| <p>Guidance:</p>   |   |  |   |     |
| <ul style="list-style-type: none"> <li>• Credit candidates understanding that using bought-in parts that are standardised ensures accuracy and consistency.</li> <li>• It also requires less attention from the manufacturer because the quality of the bought-in component will be guaranteed.</li> </ul> |   |  |   |     |
| <p>No answer or no relevant information presented or discussed.</p>  |   |  |   |     |
| <p>Description with some detail.</p>   |   |  |   |     |
| <p>Using a standard bought-in part would speed up the making process.</p>  |   |  |   |     |
| <p>Or</p>  |   |  |   |     |
| <p>Quicker to use a supplier then cut to size than make individual tubes.</p>  |   |  |   |     |
| <p>More detailed explanation</p>   |   |  |   |     |
| <p>The manufacturer would be able to cut 10 tubes from one length from the supplier increasing productivity.</p>   |   |  |   |     |
| <p>A detailed and full explanation</p>   |   |  |   |     |
| <p>The external 3.1m length would be quality assured and identical, allowing manufacturer to efficiently cut 10 lengths required.</p>  |   |  |   |     |

|              |  |                                     |
|--------------|--|-------------------------------------|
| (c)          | (i) Describe the benefits to the manufacturer of using a semi-automated production line.   | [2]                                 |
|              | <p>Answers relating to the benefits of a semi-automated production line should be awarded up to 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Benefits must be related to manufacturer as a result of automation.</li> <li>• Increased reliability, continuous flow production as a result of less workers required,</li> <li>• increased productivity,</li> <li>• increased efficiency less mistakes errors or rejects.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>Automation will replace manual worker with machines<br/>Or<br/>Automation will be more accurate than workers<br/>Or<br/>Semi-automated will be quicker than manual.</p> <p>More detailed explanation or response.<br/>Using semi automation will increase accuracy and less money is spent on workers' wages.<br/>Or<br/>Slight changes can be made easily and quickly by adjusting automated machine set up or operations.</p>   | <p>0</p> <p>1</p> <p>2</p>          |
|              | (ii) Explain why the manufacturer uses manual workers as part of the production process.   | [2]                                 |
|              | <p>Answers relating to the need for some manual workers should be awarded up to 2 marks.</p> <p>Guidance:</p> <ul style="list-style-type: none"> <li>• Manual workers will be need to operate / monitor machinery.</li> <li>• Manual workers will need to oversee production and quality control / check outcomes for defects.</li> <li>• Manual workers would be needed to interrupt production in case of a fault.</li> <li>• Manual workers would need to ensure machinery is running safely and operational.</li> </ul> <p>No answer or no relevant information presented or discussed.</p> <p>Simplistic or basic response<br/>Automation cannot replace all workers<br/>Or<br/>Some workers will still be needed to check machinery<br/>Or<br/>Some workers will need to check quality of product.</p> <p>More detailed explanation or response.<br/>Some manual workers will be required to carry out basic operations and check productivity. Some decisions require humans, machinery cannot operate complete production lines.</p> | <p>0</p> <p>0</p> <p>1</p> <p>2</p> |
| <b>Total</b> |  | <b>25</b>                           |