



GCSE MARKING SCHEME

SUMMER 2019

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

Section A

Answer **all** questions

This question is about the lifecycle of products.

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
1. (a) (i)		1	<p>State the percentage of clothes that are sent to landfill. [1]</p> <p>Only acceptable answer for percentage of clothes sent to landfill: 31% (1)</p>	AO4 1b [1]	1
(ii)	✓	1	<p>Calculate the percentage of clothes that were incinerated and sent to landfill. [1]</p> <p>Only acceptable answer for percentage of clothes that were incinerated and sent to landfill: 38% 7% (incinerated) + 31% (landfill) = 38% (1).</p>	AO4 1c [1]	1
(iii)	✓	2	<p>If all the clothes that were incinerated and sent to landfill were recycled, how much of the £1800 would be spent on recycling. (<i>Show all workings</i>). [2]</p> <p>Award 1 mark for each correct step in the calculation:</p> <p>7% (incinerated) + 31% (landfill) + 14% (recycling) = 52% (1).</p> <p>£1800 / 100 x 52% = £936 (1).</p> <p><i>Credit any appropriate approach to calculating the total cost of clothes that could be recycled.</i></p>	AO4 1c [2]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(iv)	✓		<p>Explain the meaning of the term 'carbon footprint'. [2]</p> <p>1 mark for correct definition of carbon footprint (1), 1 mark for reference to recycling process or product (1).</p> <p>Carbon foot print is the measurement/amount of greenhouse gases produced in the production of products (1). Some recycling products (e.g. plastic bottles), may still require 'activity'/use of energy in production which emits further greenhouse gases (1).</p> <p>A carbon footprint is the CO₂ that ends up in the air/atmosphere because of human activities (1) by recycling, (e.g. clothes in a charity shop) there becomes a reduction in energy used in its disposal (1).</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1b [1] AO4 1c [1]	2
(b) (i)			<p>The diagram below shows a typical product life cycle. Explain what happens during the decline stage.</p> <p>Answers must relate to the 'decline' stage of the Product Lifecycle. 1 mark for each point explained, up to two required.</p> <p>Sales of the product are declining (1). Market demand for the product is not increasing (1). As people will already own the product (1) Investment in the products development is now minimal (or not at all) (1). The product may still be sold (within the market) but it isn't as popular or fashionable as it once was (1). Profit in the company may still be made even though the sales of the product have declined due to increased sales of other, more popular products sold by the company (1). Planned obsolescence (1)</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1b [2]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(ii)			<p>Many products end up in landfill sites. Explain the impact this has on the environment. [2]</p> <p>Answers must relate to sustainability. 1 mark for each point described, up to two or 1 mark for an example and 1 mark for clear reason.</p> <p>Products increase landfill (1) which leads to an increase in greenhouse gases (1), methane gas (and or carbon dioxide (CO₂)) (1). Landfill releases liquids like leachate (1) which can contaminate water sources (1). Many materials that end up as waste contain toxic substances (1) which over time leach into our soil and become a hazard to our eco system/natural life (1). Products are often made from non-renewable sources (e.g. plastics) (1) which do not biodegrade easily (1) and so increase toxic substances entering our food chain (1) and increase greenhouse gases produced in degrading (1). Deforestation (1). Air pollution (1).</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1a [2]	2
				Total	10

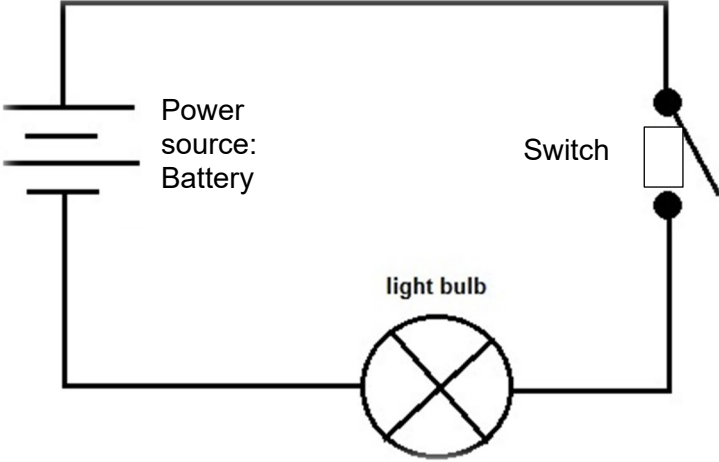
This question is about materials technology.

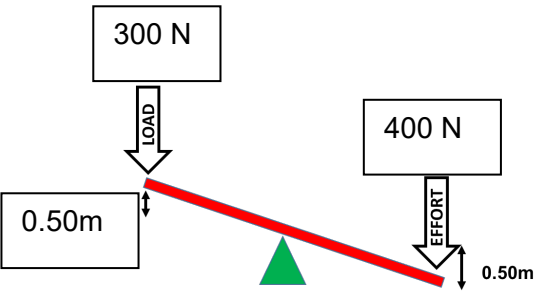
Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
2. (a)	✓		<p>The sportswear images below have been made from a material called Rhovyl.</p> <p>Describe the properties of this material for its use in sportswear. [3]</p> <p>Answers must be related to the Rhovyl material. 1 mark for why a Rhovyl material has been used (property), 1 mark for the explanation, 1 mark for a justification or supporting comment. If two properties have been stated with good justification, full marks can be awarded. NOTE: there are a number of Rhovyl materials that do have a range or properties or a combination of properties.</p> <p>Rhovyl is an anti-bacterial material/fibre (1) which improves the hygiene and comfort of the wearer (1). It is particularly suited to those who play sport or undertake physical exercise (1) as it prevents body smells and minor infections (1). Rhovyl has moisture wicking properties (1) which help keep the wearer dry (1) this increases the comfort of the product (1). Rhovyl is a synthetic fibre that is soft and breathable (1) but it also has good insulation properties (1) keeping the wearer both warm/insulated but allows the skin to breathe maintaining dryness (1). Rhovyl is durable as it can be worn and washed many times (1). Rhovyl dries quickly (1). Rhovyl is a very stretchy material (1).</p> <p><u>Other facts:</u> The antibacterial substance is added to the fibre (1), it does not wash out so the properties of the material are maintained (1). It is good for allergy sufferers (1) as it has proven to remove/kill dust-mite (1).</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1a [1] AO4 1b [2]	3

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(b)	✓		<p>A blend of Nomex and Kevlar is used to manufacture the fabric of a fire-person's uniform as seen in the picture below.</p> <p>Explain the advantages of blending these fibres together. [2]</p> <p>Answers refer to the properties of <i>both</i> fibres and to the outfit to gain full marks. 1 mark for each complementary property that relates to firepersons outfit. Maximum of one mark without any explanation of one property.</p> <p>Nomex is a flame-resistant material needed to protect the user against a fire (1) Kevlar thermally protects the user from the fire (1). Nomex is a durable/tough material to withstand active use (1) Kevlar is tear resistant adding to the durability of the material/product (1). Nomex is a flexible material and Kevlar is light in weight both help the user move quickly and easily (2). <i>Credit any other appropriate response.</i></p>	AO4 1c [2]	2
(c)	✓		<p>The cutlery handle below has been formed using Polymorph pellets.</p> <p>Describe how the Polymorph pellets are used to make the cutlery handle. [2]</p> <p>Two stages describing the processing of Polymorph pellets are required for full marks. 1 mark per stage described.</p> <p>Polymorph granules/pellets are heated in water (only) to over 62°C (1). The granules/pellets soften in the water and they turn transparent (1). The granules/pellets are removed from the water and moulded (by hand) to form a cutlery handle (1). The polymorph is left to cool until solid (1). The moulded polymorph can be re-heated if further moulding is required (1). <i>Credit any other appropriate response.</i></p>	AO4 2c [2]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(d)	✓		<p>Polymorph is classed as a smart material. Analyse how the use of a different smart material in a product, could be a safety or warning feature to the user. [3]</p> <p>The answers should be related to products/materials that improve the safety of people. 1 mark for a product/material example, 1 mark for the analysis and 1 mark for a justification or supporting comment.</p> <p>Plastic thermochromic spoons change colour on heat/temperature (1) which are useful for judging the temperature of baby's food. The change in colour identifies the food is too hot (1) so helps ensure the baby doesn't get a burnt mouth (1).</p> <p><u>Safety examples:</u> thermochromic spoons, plugs, mugs, food bowls, all change colour when they come in to contact with hot foods/liquid; plastic thermometers for forehead use (replacing glass/mercury); food packaging materials to show when a product they contain is cooked to the right temperature (prevents food poisoning), photochromic t-shirt that changes colour when UVA/B/sunlight can burn skin (preventing skin cancer in later life); a 'smart' dressing which illuminates as it releases bug-busting antibiotics into wounds. Students may also refer to <u>interactive textiles</u> for example, fitbit, if related to safety (e.g. indicating when to stop exercising as blood pressure is raised), credit should be given.</p> <p>For example:</p> <p>Plastic thermometers are used to record temperatures on children's foreheads (1), they cannot break, like glass thermometers (don't contain deadly mercury) (1) so are safer to be used with children (1).</p> <p>Photochromic t-shirts are impregnated with a smart dye (1) that changes colour when UVA/B sunrays are at a dangerous level (1) reminding the wearer to add sun cream to their skin, preventing burning (1).</p> <p>Smart dressings/bandages are filled with/encapsulated with antibiotic drugs (1) that are triggered by the presence of bacteria, treating the infection (1) before it can take hold and preventing the person getting seriously ill (1). The bandage changes colour as the medication is triggered alerting medical staff there is an infection in the wound (1).</p> <p><i>Credit any other appropriate response.</i></p>	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)	✓		<p>The following is a diagram of a simple circuit.</p> <p>On the circuit diagram above, label the power source and the switch. [2]</p>  <p>Award 1 mark for each correct answer.</p>	AO4 1b [2]	2
(ii)			<p>The image below shows a modern street light. Explain how LDRs (Light Dependant Resistors) work in modern street lighting. [2]</p> <p>LDRs (light-dependent resistors) are used to detect light levels in the street (1). Their resistance decreases as the light intensity increases (1). In the dark and at low light levels, the resistance of an LDR is high (1), and little current can flow through it (1). In bright light, the resistance of an LDR is low (1) and more current can flow through it (1). Turning on the street light (1).</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1b [1] AO4 1c [1]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(b) (i)	✓	4	<p>This question is about mechanical advantage and velocity ratio calculations. Study the picture below before answering the questions that follow.</p>  <p>Calculate both the mechanical advantage and velocity ratio of the seesaw. <i>(Show all workings)</i> 2x[2]</p> <p>Mechanical Advantage:</p> <p>Load / Effort $300\text{N} / 400\text{N}$ (1) $= 0.75$ (1)</p> <p>Velocity Ratio:</p> <p>Distance moved by effort / Distance moved by load $0.50\text{m} / 0.50\text{m}$ (1) $= 1$ (1)</p> <p><i>Credit any appropriate approach to calculating the MA and VR.</i></p>	AO1 1b [1] AO4 1c [3]	4

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(ii)	✓		<p>Explain what is the role of the fulcrum in the seesaw. [1]</p> <p>Answers must be related to the seesaw. 1 mark for a correct reason.</p> <p>The role of the fulcrum is of a pivoting point around which a lever ‘turns’ (1). The fulcrum is the point where the load is pivoted (1).</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1b [1]	1
(iii)	✓		<p>State what would happen if you changed the position of the fulcrum. [1]</p> <p>Answers must be related to the position of the fulcrum. 1 mark for reference correctly of mechanical advantage and/or velocity ratio.</p> <p>For example: If the fulcrum moves closer to the effort end, the mechanical advantage decreases (1) and more effort (1) is needed to move the same load. If the fulcrum moves closer to the load end, the mechanical advantage increases (1) and less effort (1) is needed to move the same load. Balance point will change (1).</p> <p><i>Credit any other appropriate response.</i></p>	AO4 2b [1]	1

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(c) (i)	✓		<p>Describe the difference between a microprocessor and a microcontroller. [3]</p> <p>Answers must be related to a microprocessor and a microcontroller. Up to three marks can be awarded for a clear description identifying a difference between microprocessors and microcontrollers. Two marks can be awarded if the difference is correct but the description is not clearly written.</p> <p>A microprocessor is at the centre of a computer system whereas a microcontroller is at the centre of an embedded system (3). A microprocessor cannot be used in compact systems and hence is inefficient, a microcontroller can be used in compact systems and hence it is an efficient system (3). Due to external components, the entire power consumption is high in microprocessors whereas the external components in a microcontroller are low, total power consumption is less (3). A microprocessor functions at high speed, and microcontroller functions at low speed (3). A microprocessor has a higher power consumption than a microcontroller which has a lower power consumption (3). Not all microprocessors have power saving features, microcontrollers do have power saving modes to help reduce power consumption (3). The 'designer' or 'user' decides on the amount of ROM, RAM and I/O ports with a microprocessor whereas a microcontroller has a fixed amount on on-chip ROM, RAM and I/O ports (3). A microprocessor has no internal memory whereas a microcontroller does contain internal memory (3). A microprocessor has no interfacing circuits, timer and counters (they are separately interfaced) whereas a microcontroller does, (they are all on a single chip) (3). A microprocessor is used for general purpose applications for example, laptops and P/Cs, whereas a microcontroller is used for specific purpose applications, for example, a digital camera, a washing machine (3)</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1b [1] AO4 2a [2]	3

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(ii)			<p>Explain one disadvantage of using a programmable microcontroller. [2]</p> <p>Answers must be related to the limitations of using a programmable microcontroller. 1 mark for a limitation and 1 mark for a justification or supporting comment.</p> <p>Some microcontrollers, are custom programmed for custom-built machines (1) so can be extremely expensive (1). If custom-built, regular maintenance will be required which can be costly (1).</p> <p>Microcontrollers cannot interface high power devices directly/can't handle a large amount of information (1) performing only a limited number of executions simultaneously (1).</p> <p>A microcontroller can't withstand dust (1) or work in environments with high levels of humidity (1) this limits usage (1).</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1b [2]	2
				Total	15

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
4. (a) (i)			<p>The image below shows corrugated cardboard which is used in packaging.</p> <p>The weight of paper and cardboard is measured in gsm. State the full meaning of gsm. [1]</p> <p><i>Only acceptable answer for gsm is : Grams per Square Metre</i></p>	AO4 1a [1]	1
(ii)			<p>State how the structure of corrugated cardboard makes it suitable for packaging. [1]</p> <p>Award 1 mark for correct answer. A correct factual answer is sufficient to be awarded the 1 mark.</p> <p>For example: The construction of the liners and fluting forms a series of connected arches which become impact resistant (1). Shock absorber (1). Strength (1). Light in weight (1). Corrugated board is made from a combination of two sheets of paper (called liners) glued to a corrugated inner medium called the fluting. These three layers of paper are assembled in a way which gives the overall structure a better strength than that of each distinct layer.</p>	AO4 1a [1]	1

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(iii)			<p>Describe a disadvantage of corrugated cardboard when used to make models. [2]</p> <p>Answers must be related to corrugated board. 1 mark for a disadvantage and 1 mark for a link to its use in model making.</p> <p>For example: It is difficult to create neat folds in corrugated board (1), the inner layers will dictate the shape of the fold (1) which are not always in the direction wished for when modelling (1).</p> <p>Due to its internal structure, corrugated card has a rough, ridged appearance that is prone to wrinkling and bending (1), which is only good for modelling where resilience is not required (1).</p> <p>Corrugated board has a dull appearance; Corrugated board has an untidy appearance when cut, making the model's aesthetic appearance poor; Mass of corrugated board is air, with sideways pressure it will bend and pucker/crumble; Corrugated board will soften and become pulpy in ambient moisture environments; It can be difficult to get the angle perfect when cutting corrugated board because of its layered construction (1). Corrugated board is brown in colour/appearance (1) which is not a desirable aesthetic finish if this is an important criterion of the product modelling (1).</p> <p><i>Credit any other appropriate response.</i></p>	AO4 2b [2]	2
(b) (i)			<p>Label the two most suitable materials used to manufacture the saucepan pictured below. 2 x [1]</p> <p>Answers must be appropriate to the material suitable for the (modern) saucepan and its handle. The saucepan must be a metal/alloy, the handle must state a named thermosetting plastic.</p> <p>Saucepan: stainless steel, copper, aluminium. Handle: PR (polyester resin), Urea formaldehyde, phenol formaldehyde and ER (epoxy resin).</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1a [2]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(ii)			<p>Discuss the working properties of one of the materials identified in (i) above that make it suitable for the saucepan. [2]</p> <p>Answers must be related to the chosen material named. 1 mark for a benefit and 1 mark for a justification of the benefit.</p> <p>For example: Epoxy resin is a thermosetting plastic that resists heat up to 250 degrees centigrade (1) which means it can be used both on the hob and in the oven without deforming (1)</p> <p>Stainless steel – hard and tough, resists wear, corrosion resistant, good conductor of heat, doesn't taint food stuffs. Copper – good conductor of heat, corrosion resistant, polishes well, doesn't taint food stuffs. Polyester resin – good chemical and wear resistance, resists heat to 250C, electrical insulator, takes colour well (aesthetics). Epoxy resin – good chemical and wear resistance, resists heat to 250C, electrical insulator.</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1c [2]	2
(c) (i)	✓		<p>The picture below is of a radiator cover and it is made from MDF. [1]</p> <p>State the full meaning of MDF. [1]</p> <p><i>Only acceptable answer to define MDF: Medium Density Fibreboard (1)</i></p>	AO4 1a [1]	1
(ii)			<p>Name a piece of CAM (Computer Aided Manufacture) equipment that could have been used to create the pattern on the radiator cover. [1]</p> <p>Award 1 mark for a correct answer.</p> <p>Laser Cutter (1) CNC Router Machine (1)</p>	AO4 2a [1]	1

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(iii)			<p>Discuss the reasons why MDF is such a versatile material in the construction of products such as the radiator cover. [4]</p> <p>Answers must relate to two properties of MDF. 1 mark for each property of MDF and 1 mark for justification or supporting comment, up to a total of 4 marks. A maximum of three marks can be awarded if three correct properties are stated without a supporting comment. Note: his question is about construction and not finish, no awarded mark can be given if reference is made to the range of finishing available for MDF.</p> <p>Some examples:</p> <p>MDF in comparison to other timbers is made of fine particles (1) so no recognisable surface grain is visible as with other timbers (1). MDF is thicker, denser and heavier than hardboard (1), can be cut, drilled and machined without damaging the surface (1) which means it has more product versatility than any other timber (1). As MDF is unaffected by humidity (1) it doesn't swell or buckle like other timbers giving it a larger range of uses inside the home.</p> <p><i>Award 1 mark for each correct answer relating to:</i></p> <p>MDF is thicker, denser and heavier than hardboard; MDF has no knots and is therefore easier to machine and finish; MDF is made of fine particles so no recognisable surface grain is visible – has a smooth face; MDF can be cut, drilled, machined and filed without damaging the surface; It is very stable and unaffected by humidity; It is a good electrical insulator; MDF can be dowelled together and traditional woodwork joints can be cut; MDF may be glued together with PVA wood glue; Veneers and laminates may also be used to finish MDF. MDF has good stability when exposed to changes in temperature. MDF is available in a variety of thicknesses. MDF is reasonably cost effective.</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1c [4]	4

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(iv)			<p>Explain, using an example, how the aesthetic qualities of MDF can be improved. [2]</p> <p>Answers must be appropriate for MDF. 1 mark for the example of an appropriated finish and 1 mark for an explanation why the finish is suitable.</p> <p>MDF can be painted with any form of coloured paint (acrylic or enamel) (1), and priming the surface is not necessary a requirement speeding up the finishing process (1)</p> <p>Examples: Paint – brush, roller, spray, glazing, distressing Varnish Natural oils Wood stains Wood veneers</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1c [2]	2
(d) (i)	✓		<p>Below is a picture of a jumper manufactured from a <i>natural animal</i> polymer.</p> <p>Name the natural polymer used to manufacture this jumper. [1]</p> <p>Award 1 mark for a correct answer.</p> <ul style="list-style-type: none"> • Wool (1) • Cashmere (1) <p>Note: Alpaca, camel and mohair are natural animal polymers (listed in the specification) but are not appropriate for the image provided and should not be awarded a mark if stated by the student.</p>	AO4 1b	1

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(ii)	✓		<p>Describe why the jumper has been knitted and made from a natural animal polymer. [3]</p> <p>Answers must relate to the properties of wool/cashmere in the context of a jumper. Candidates need to demonstrate knowledge of wool fibre or knitted structure. Disadvantages of using wool as a fibre for this item of clothing could be referenced as part of the evaluation discussion. 1 mark for each evaluative point up to a total of 3 marks. Two reasons described can be awarded full marks.</p> <p>Wool is an excellent insulation as it keeps heat close to the body trapping (1) it between the fibres which have crimp (1) Wool can easily absorb (up to 30% of its weight) moisture without feeling damp as it wicks moisture away from the body, keeping the person warm and dry (2). Wool functions as a "temperature regulator" so it can protect the body in both cold and warm conditions (2). To a certain degree, wool is considered water repellent. (Small amounts of liquid, such as spills, light rain or snow, will stay on the surface or run off the fabric) and thus continue to keep the wearer warm (2). Wool keeps you "warm when wet" (since it retains 80% of its insulating value even when saturated) (2). Wool does dry slowly which when saturated fully will not be a good insulator as the body will become wet (2).</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1c [3]	3
				Total	20

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
5. (a) (i)			<p>Most products are designed with more than one function in mind.</p> <p>State the main function of your chosen product. [1]</p> <p>Answers must relate to the product selected by the candidate. 1 mark for a correct response.</p> <p>Main function for each product is: Drinks carton – to protect content; to increase shelf life of contents. Bag for Life – to carry shopping securely. Watch with metal strap – to tell the time; to fit a range of users/wrist sizes (easily removable sections). Under bed boxes – to store content safely, to protect contents; to increase storage in the home. LED Head torch – to see - hands free - in the dark; to direct a strong beam of light; energy efficient light. Veneer packaging – to protect contents; to package content in an aesthetic way.</p> <p><i>Credit any other appropriate response.</i></p>	AO4 1a [1]	1
(ii)			<p>Analyse how the material used makes your chosen product sustainable. [2]</p> <p>Answers must be appropriate to the product chosen by the candidate. Up to 2 marks total - 2 reasons given that link to sustainability that are well analysed. Positive and negative effects both accepted.</p> <p>Drinks carton – can be fully recycled; made from recycled materials; can be squashed easily for ease of recycling; uses foil lining which is recyclable, however not all councils recycle this material; Forest Stewardship Council certified; made from waterproofed card which can be reused, for example, cut top off to grow herbs in; only a good sustainable product if recycled by the consumer; will biodegrade faster than many other materials.</p>	AO4 1c [2]	2

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
			<p>Bag for Life – made from plant fibres which are renewable as a material source; last much longer than plastic (HDPE) bags and are not found in the sea/water ways that destroy eco system; can be made from waste fibres; can be made from recycled material; can be recycled; however, produces a lot of carbon waste in production (growing, manufacturing, transportation); only a good sustainable product if used for years; fabric can tear with wear/use resulting in an un-usage product.</p> <p>Watch with metal strap – stainless steel – means it has a long life; lasts longer than, and is more environmentally sound than, rubber/plastic; highly durable; easily recycled; recycling stainless steel uses far less energy than creating new sheets of steel; can be recycled into many other products so is highly versatile for recycling; however, is not a biodegradable material.</p> <p>Under bed boxes – extremely durable so has a long life; can be made from recycled materials; is fully recyclable and can be made into many other products so highly versatile for recycling. Polypropylene has a low density (reduced amount of waste) in manufacture so reduces environmental impact; polypropylene produces lowest CO2 emissions in manufacture than any other plastic; however, any plastic is made from non-renewable a resource which has a negative impact on environmental sources; plastics are not a biodegradable material.</p> <p>LED Head torch – any answer based on the whole product or part of the product is acceptable. LEDs have a long life, (although performance does degrade over time) LEDs are robust; LEDs are efficient as they have low power consumption; LEDs don't produce heat; all of which increases the life of the headtorch, reducing landfill or the need to repurchase. Reference to the head torch strap may refer to synthetic material (e.g. nylon), which is recyclable although uses fossil fuels for its manufacture.</p> <p>Veneer packaging – supported by the FSC; veneers can be made from recycled wood products; no waste is created when producing veneers; using a veneer reduces the quantity of wood, reducing tree felling; can be recycled; wood is a naturally sustainable product as it has less impact on energy, air and water pollution; produces a beautiful product, ensuring consumers do not discard; packaging box has a variety of uses so is easily recycled/reused; not a durable as other materials for packaging/storage.</p> <p><i>Credit any other appropriate response.</i></p>		

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(b) (i)			<p>Collecting primary and secondary source research is required to ensure client and user needs are identified and met when designing.</p> <p>Describe, using examples, the differences between primary and secondary source research. [3]</p> <p>Award 2 marks for identifying clearly the <i>difference</i> between primary and secondary research. 1 mark can be awarded for stating a correct example of a primary and/or secondary research task.</p> <p>Primary research involves gathering new data that has not been collected before (1) for example interviewing groups of people in a focus group (1) whereas, secondary research involves gathering data that already exists having been founded by another party (1), for example researching the internet (1) or newspaper articles.</p> <p><i>Credit any other appropriate response.</i></p>	AO3 2b [3]	3
(ii)			<p>Evaluate how successful your chosen product is in terms of its ergonomic design. [4]</p> <p>Answers can relate to any aspect of ergonomic design to include appearance and anthropometrics but must be appropriate to the product chosen by the candidate and an evaluative response (advantages and disadvantages) about the product is given. Each advantage and/or disadvantages should be awarded 1 mark. Each advantage and/or disadvantage should be justified and linked to the product chosen, 1 mark. A maximum of 2 marks can be gained for just advantages/disadvantages without justification/reasoning.</p> <p>For example: The drinks carton is a suitable shape (1) so that it can fit easily into a fridge for storage (1). It is also the correct size to be held in the hand of a child for ease of use (1) and it has been designed to prevent spillage in use by attaching a straw (although insertion needs good fine motor skills which may be seen as a disadvantage) (1). Colours and design are attractive to appeal to target market (1).</p>	AO3 2b [4]	4

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
			<p>The ergonomic design comments could reference any of the following:</p> <p>Drinks carton – size relevant to fridge compartment for ease of storage; size relevant to ease of handling; straw design to prevent liquid spillage in use; reference may be made to print design (even though not on show) that references contents, for example colours used to identify ingredients, however, it has only been designed for child use and could be seen as a cumbersome shape to be held in the hand securely by an adult, i.e. not a cylinder.</p> <p>Bag for Life – designed to be 3D for more economical storage of shopping; handle length has been calculated based on adult sizing and is suitable for carrying both in hand or on shoulder; colours used are suitable for both genders; the width and length of the bag has been anthropometrically calculated to ensure no strain or back injury occurs with over packing of shopping.</p> <p>Watch with metal strap – strap designed to fit around wrist securely; designed with a number of links which can be removed for a suitable fit; not gender specific; watch face correct size for vision and ease of reading; tells both time and date; however, could be bulky on wrist; strap made from metal which may be heavy for wearer.</p> <p>Under bed boxes – designed to be the correct depth to fit under a bed; designed to be the correct length so more than one can be fitted neatly under a bed; designed with wheels to ensure ease of use; designed with a flap opening for ease of access when in situ; however, may not fit neatly under all bed sizes, for example single and double; although hidden under bed, not aesthetically attractive.</p> <p>LED Head torch – strap adjustable to fit a range of head circumference securely; padded for comfort; anthropometrically designed to not be too big to fit forehead; light in weight; strap stretches for comfort and fit; strap soft to handle for comfort; however is a bulky item.</p> <p>Veneer packaging – fastening has been designed for ease of use (and is aesthetic in design); however, candidates may state it is a fiddly design and is not easy to open and close as a packaging fastening; a range of sizes have been designed to suit a range of users and products; edges have been rounded for safe use; sizes mean they are not stackable, this could be seen as a disadvantage.</p> <p><i>Credit any other appropriate response.</i></p>		

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(c) (i)	✓		<p>Explain why a user-centred design approach is so important for the successful design of your chosen product. [2]</p> <p>Answers must be appropriate to the product chosen by the candidate and related to a user-centred design approach. 1 mark for the correct understanding/definition of a user-centred design approach and 1 mark for relating it to the chosen product.</p> <p>A user-centred design approach ensures end users are consulted throughout the design and development of the product (1). This would ensure the drinks carton contains the information most needed by the consumer (1). This would ensure the bag for life is appealing for both male and female shoppers and not just focusing on the one gender (1). This would ensure the watch with metal strap is easy to fit (with one hand only) and read easily by the consumer (1). This would ensure the under bed box can be tested in situ to test its durability (1). This would ensure the LED head touch is easy to operate without having to look at the switch (1). This would ensure the veneer packaging is not too expensive for the user to purchase (1).</p> <p><i>Credit any other appropriate response.</i></p>	AO4 2b [2]	2
(ii)			<p>All of these products have been manufactured commercially, but in various quantities. Identify which scale of production is being described below: [1]</p> <p>Award 1 mark for each correct response:</p> <p>(I) Mass production; continuous production or repetitive flow. (II) Batch production. (III) One-off production; bespoke; job/jobbing production.</p> <p><i>Credit any other appropriate response.</i></p>	AO4 2a [3]	3

Q	Science	Maths	Question or outline of question / Marking scheme	AO	Total
(d) (i)		1	<p>The pictures and table below show collected anthropometric data from five students' hand measurements. [1]</p> <p>State which student has the shortest hand length.</p> <p><i>Only acceptable answer hand length: Student 3 (90mm) (1)</i></p>	AO4 1a [1]	1
(ii)		2	<p>Calculate the average hand <i>width</i> of all five students. [2]</p> <p>1 mark awarded for correct selection of measurements and addition of total, and 1 mark for correct answer.</p> <p>53mm + 45mm + 48mm + 44mm + 50mm = 240mm (1) 240mm / 5 = 48mm (1)</p> <p><i>Credit any appropriate approach to calculating the average.</i></p>	AO4 1b [2]	2
(iii)		2	<p>The average diameter of the index finger of the five students was found to be 16mm. Calculate the circumference of the index finger so a suitable length of silver wire can be used to make a circular ring. (<i>Show all workings</i>) [2]</p> <p>3.14 x 16mm (1) = 50.24mm (1) (accept 50.3 or nearest).</p> <p><i>Credit any appropriate approach to calculating circumference of the wrist.</i></p>	AO4 1b [2]	2
				Total	20

Q	Science	Maths	Electronic systems and mechanical devices Question or outline of question / Marking scheme	AO	Total
6. (a) (i)			<p>The picture below is a Robotic Vacuum Cleaner.</p> <p>The robotic vacuum cleaner is commercially manufactured in batches. Name a suitable method of construction to make the main body casing.</p> <p><i>Only acceptable answer for the most common method:</i> Injection Moulding</p>	AO4 1a [1]	1
(ii)	✓		<p>Outline two advantages of using the method of manufacture in (i) above</p> <p>Advantages of injection moulding.</p> <ul style="list-style-type: none"> • Good product consistency. • Reduced requirements for finishing. • Good dimensional control • Fast production. • Low labor costs. • Leaves little post-production scrap. • Ability to include inserts. • Good colour control. • Design flexibility. • High-output production. • Multiple materials can be used at the same time. • Can be used to produce very small parts <p><i>Credit any other appropriate response.</i></p>	AO4 1b [1] AO4 2c [1]	2

Q	Science	Maths	Electronic systems and mechanical devices Question or outline of question / Marking scheme	AO	Total
(iii)			<p>Name a suitable thermoplastic used to make the main body casing and give one reason why it is suitable.</p> <p>Suitable thermoplastics</p> <ul style="list-style-type: none"> • Acrylonitrile-Butadiene-Styrene ABS • Polypropylene <p>Any one reason listed below for ABS.</p> <ul style="list-style-type: none"> • light weight • Relatively low cost materials • Good impact resistance • Forms into complex shapes • Good aesthetic qualities <p>Any one reason listed below for Polypropylene</p> <ul style="list-style-type: none"> • Semi-rigid • Good chemical resistance • Tough • Good fatigue resistance • Good heat resistance <p><i>Credit any other appropriate response.</i></p>	AO4 2b [2]	2

Q	Science	Maths	Electronic systems and mechanical devices Question or outline of question / Marking scheme	AO	Total
(iv)			<p>At the end of every use, the robotic vacuum cleaner parks it's self in its charging dock. Complete the flow chart below to show control of its movements.</p> <p>Award one mark for each correct statement within the flow chart.</p> <pre> graph TD Start([START]) --> MotorAB1[/Motor A and B/] MotorAB1 --> Proximity{Proximity Sensor Activated?} Proximity -- No --> Start Proximity -- Yes --> MotorAB2[/Motor A off, motor B forward/] MotorAB2 --> Delay[Delay] Delay --> MotorAB3[/Motor A and motor B forward/] MotorAB3 --> Dust{Dust container sensor activated?} Dust -- N --> MotorAB3 Dust -- Ye --> Start </pre>	AO4 2c [4]	4

Q	Science	Maths	Electronic systems and mechanical devices Question or outline of question / Marking scheme	AO	Total															
(b)		5	<p>The battery life of the robotic vacuum cleaner is equal to 175 revolutions of its wheel shown below. After 150 revolutions, the robotic cleaner returns to the docking station for a recharge. <i>(Show all workings)</i></p> <p>(i) Calculate the diameter of the wheel. $40 \times 2 = 80$ (1)</p> <p>(ii) Calculate the circumference of the wheel. $\pi d(1), 3.14 \times 80 = 251.2$ (1)</p> <p>(iii) Calculate how far the robotic cleaner will have travelled before it returns. 251.2×150 revolutions = 37,680mm (1)</p> <p>(iv) Round off your answer in (iii) above to the nearest metre. 38m (1)</p>	AO4 1b [3] AO4 1c [2]	5															
(c)			<p>A new robotic vacuum cleaner comes with main component parts, accessories and packaging. Undertake a Lifecycle Analysis of this electronic product and its environmental impact on the environment. [5]</p> <p>Band descriptors and mark allocations</p> <table border="1"> <thead> <tr> <th colspan="3">AO3 2a 5 marks</th> </tr> </thead> <tbody> <tr> <td>BAND 3</td> <td>A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the environmental impact of manufacturing on our plant. 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 environmental impact of manufacturing on our plant. 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 environmental impact of manufacturing on our plant. 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> </tbody> </table>	AO3 2a 5 marks			BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to analyse the environmental impact of manufacturing on our plant. 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 environmental impact of manufacturing on our plant. 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 environmental impact of manufacturing on our plant. 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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			<p>Indicative content This content is not prescriptive and candidates are not expected to refer to all the material identified below.</p> <p>The life-cycle analysis is one that looks at the environmental impact from a product beginning with the extraction of raw materials to the products' use and disposal. At each stage the energy used to transport (lorry, ship, aircraft) the part/product has a large environmental impact and should be referenced in the answer. Most electronic products are part and fully manufactured in developing countries and not the UK. There are a minimum of 5 key stages.</p> <p>The environmental impact of the lifecycle of a robotic vacuum cleaner:</p> <ul style="list-style-type: none"> • Raw materials: metals galvanised, stainless steel, aluminium, brass and copper. Plastics: PVC, PP, ABS, HPDE, EVA and cardboard for packaging. • Production: metal stamping and plastic moulding to obtain shape. Energy and resources used in the production of the casing assembly, DC fan assembly, gear assembly, dust container, PCB, battery and power supply. Screen printing, product assembly, packaging and testing and storage produce waste. • Transport: raw materials and packaging to production factory, vacuum cleaner to retailer, and end-of-life waste to waste management facility. • Consumer use: Disposal of packaging, consumption of electricity and replacement of filters. • Disposal, recycle or reuse (plus transportation) – CO₂/methane if landfill used in disposal, water and energy. <p><i>Credit any other appropriate response.</i></p>		

(d)		<p>The robotic vacuum cleaner was manufactured in a factory that uses a batch production system. Evaluate the benefits of this method of production. [6]</p> <p>Band descriptors and mark allocations</p> <table border="1" data-bbox="474 288 1742 785"> <thead> <tr> <th colspan="3" data-bbox="474 288 1742 336">AO3 2b 6 marks</th> </tr> </thead> <tbody> <tr> <td data-bbox="474 336 629 488">BAND 3</td> <td data-bbox="629 336 1653 488">A coherent answer demonstrating detailed, relevant knowledge and understanding, to evaluate the benefits of mass production. There will be evidence of relevant examples and well-developed substantiated judgements in a response which is logically structured.</td> <td data-bbox="1653 336 1742 488">5-6</td> </tr> <tr> <td data-bbox="474 488 629 628">BAND 2</td> <td data-bbox="629 488 1653 628">Answer has some coherence, demonstrating partial knowledge and understanding, to evaluate the benefits of mass production. There will be some evidence of mostly relevant examples and partly-substantiated judgements in a response which is generally well structured.</td> <td data-bbox="1653 488 1742 628">3-4</td> </tr> <tr> <td data-bbox="474 628 629 738">BAND 1</td> <td data-bbox="629 628 1653 738">Answer demonstrates only basic knowledge and understanding, to evaluate benefits of mass production. There will be limited evidence of relevant examples or judgements in a response which demonstrates little structure.</td> <td data-bbox="1653 628 1742 738">1-2</td> </tr> <tr> <td colspan="3" data-bbox="474 738 1742 785">Award 0 marks for incorrect or irrelevant answers</td> </tr> </tbody> </table> <p>Indicative content This content is not prescriptive and candidates are not expected to refer to all the material identified below.</p> <p><u>Advantages of batch production:</u></p> <ul data-bbox="501 943 1682 1326" style="list-style-type: none"> • It is cheaper to produce a whole batch instead of single, machines can be used more effectively. • It is more accurate and consistent since machines replicate the exact same product leaving less faulty products. • It has the flexibility to produce a variety of different product variations. This gives the customer a larger choice and hence a larger possibility of sales for the company. • The company reduces its risk on simply concentrating on one product; it produces a variety of different ones of the same type. • Materials can be bought in bulk which reduces cost • It works well when small product runs are needed • It is ideal for custom or seasonal, or trial runs of new products • It reduces inventory. This can be critical when space is an issue. • Allows workers to specialise and to use specialist machinery <p><i>Credit any other appropriate response.</i></p>	AO3 2b 6 marks			BAND 3	A coherent answer demonstrating detailed, relevant knowledge and understanding, to evaluate the benefits of mass production. 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 the benefits of mass production. 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 benefits of mass production. 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]
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