

Design and Technology

Advanced GCE

Unit **F524/01**: Product Design: Component 1

Mark Scheme for January 2012

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All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Question		Answer	Mark	Guidance
1	(a)	<ul style="list-style-type: none"> • The wall should have sufficient strength to resist stresses set up by its own weight. • The wall should have sufficient stability to resist buckling by not being too slender in relation to its height. • The wall should provide a measure of fire resistance. • The wall should provide a measure of sound insulation. • The wall should provide a measure of thermal insulation. • The wall should provide ease of routing of services eg. electric cabling etc. • The wall should divide the floor space into smaller compartments. • The wall should resist impact damage from doors closing, people and furniture. • The visual effect of the wall's finish should be aesthetically pleasing. • Allowance made in the design of the wall to cater for future flexibility in the layout of the rooms. 	[4]	<p>Clear statement and justification required for a mark</p> <p>Must be related to product – no marks for generic responses</p> <p>Must be a full response – no marks for identification only.</p> <p>Four justified design requirements. Give one mark if two valid points given but not justified.</p>
	(b)	<p>Measurement of people/human factors applied to the sizing of building elements. Principles include – design for the extreme, design for adjustability and design for the average. Inclusive design to cater for the greatest diversity of human needs as possible.</p> <p>General examples could include:</p> <ul style="list-style-type: none"> • Door openings widths/heights. • Ceiling heights. • Stairways. • Signage. • Furniture. • Baths. 		<p>Answer must relate to anthropometrics (i.e. body measurements) not ergonomics</p> <p>example 1 mark example and related body size 2 marks</p> <p>Two examples clearly described.</p>

Question	Answer	Mark	Guidance
	<ul style="list-style-type: none"> • Shower cubicles. • Height/location of electrical switches and sockets. • Child Care Centre with toilets and basins at lower levels. • Features to satisfy the Disability Discrimination Act (DDA) 	[4]	
(c)	<ul style="list-style-type: none"> • Goods must conform to description given • Goods must be of a reasonable quality to carry out function taking into account age and price • Customers can request money back for unsatisfactory goods (partial refund if product used for some time) • Customers can request a repair or replacement 	[4]	brief description 1 mark detailed description 2 mark Two ways clearly described Allow specific reference to given product.
(d)	<p><u>Descriptions</u></p> <p>Geothermal Cold water pumped underground through heated rocks, steam turns turbines, turbines turn generators, electricity distributed. Ground source heat pumps use the constant temperature of the soil at 1 metre below the surface as their heat source.</p> <p><u>Benefit</u> No pollutants or waste Minimal visual impact Low cost after initial outlay</p> <p>Biomass Fuel (wood pellets, wood chips, wood logs, sugar cane, etc.) is burnt to generate heat, heats water to generate steam,</p>	[4]	<p>Explanation Key points included (may include sketch) up to 2 marks</p> <p>benefit outlined 1 mark benefit explained 2 marks</p>

Question	Answer	Mark	Guidance
	<p>steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> Readily available fuel Can use waste Low cost/resources used</p> <p>Wave Motion of waves forces air up cylinder to turn turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste as no fuel is required Low cost after initial outlay Used in remote areas</p>		
(e)	(i) <ul style="list-style-type: none"> • The material could be a softwood eg. Redwood, Whitewood, Fir or Pine. • Durable • Can be easily cut and fixed • Economic in use • Strength (defined and justified) • Usually sourced from a sustainable source. • Light gauge galvanised cold-rolled steel. • Concrete blockwork. • Paramount partition system • Laminated plasterboard. • Durable (except Paramount partition and laminated plasterboard) 		<p>award mark for other appropriate material not listed</p> <p>1x1 mark</p> <p>Award mark for other appropriate property/characteristic Must relate to the specific material</p> <p>2x1 mark</p>

Question		Answer	Mark	Guidance
		<ul style="list-style-type: none"> Strength (except Paramount partition and laminated plasterboard) Resistance to corrosion Resistance to insect attack Resistance to fire Self finish (except light gauge galvanised cold-rolled steel) 	[3]	
(e)	(ii)	<p>Stud partition;</p> <p>Vertical and horizontal members to accommodate lining material (plasterboard, plywood) Sturdy to resist door, furniture damage Notches for internal services/cablings Insulation (thermal/noise) inserted Timber or metal construction Noggins spacing depends on size of lining Noggings fixed horizontally for extra stability/strength</p> <p>Masonry partition;</p> <p>Lightweight concrete blocks directly off concrete floor (on timber floor, sole plate required at base and head of ceiling) Door frames floor to ceiling to give extra stability</p> <p>Accept Paramount and Laminated partition systems</p>	[9]	<p>Level 3 (5-6 marks) Process fully described, key features and technical details identified, Answer must include detail of specialist tooling for full marks.</p> <p>Level 2 (3-4 marks) Key stages presented, reasonably well described with key features identified</p> <p>Level 1 (0-2 marks) Some stages outlined (up to 2), very limited description</p> <p>Quality of description and communication</p> <p>Basic sketch or chart with limited annotation 1 mark</p> <p>Good sketch/chart with main features identified and labelled 2 marks</p> <p>Detailed sketch/chart with clear annotation 3 marks</p> <p>Max 1 if no sketch/chart used Max 1 if clearly described and logical response given but no sketch/chart used</p> <p>Award credit where possible if response doesn't link to chosen material.</p>

Question	Answer	Mark	Guidance
(f)	<p>issues</p> <ul style="list-style-type: none"> • innovative new products • increased functionality of products • excitement in market • extends range of possibilities for product design • medical/safety advances • increased material cost/product cost • cost of training for designers <p>examples</p> <ul style="list-style-type: none"> • Shape memory alloys (engineering/car industry) • Thermochromic products/pigments – safety (indicating heat) fabrics • Self healing materials • Polymorph for rapid modelling/testing • Conductive thread for Smart textiles 	[8]	<p>Level 3 (6-8 marks) Clear, cogent and well-structured response with two or three issues well explained. Good use of examples and additional evidence to support discussion. Good use of technical vocabulary</p> <p>Level 2 (3-5 marks) One or two issues described with some explanation. Appropriate use of technical vocabulary demonstrating a good understanding of concept. Introduction of one example or supporting evidence</p> <p>Level 1 (0-2 marks) Some issues outlined, bullet points (usually focussed on one issue) no further or very limited explanation, limited use of examples or supporting evidence</p>
Q1 Total Marks 36			

Question		Answer	Mark	Guidance
2	(a)	<ul style="list-style-type: none"> • Must be stable to prevent tipping when in use • Weather-resistant for use outdoors • Seat height to suit target-audience • Easy to move around when needed • Reasonably comfortable to encourage use • Strong enough to take the number of people it can hold • No sharp corners/edges or trap points for safety of users • Durable construction for longevity • Relatively inexpensive construction as it is not a 'show item' 	[4]	<p>Clear statement and justification required for a mark</p> <p>Must be related to product – no marks for generic responses</p> <p>Must be a full response - no marks for identification only.</p> <p>Four justified design requirements. Give one mark if two valid points given but not justified.</p>
	(b)	<ul style="list-style-type: none"> • Height of the seat • Depth of seat (front to back) • Spacing between seat sections <p>Accept reference to length of bench relating to number of users Accept reference to weight of users (max 1 mark each)</p>	[4]	<p>Answer must relate to anthropometrics (i.e. body measurements) not ergonomics</p> <p>example 1 mark example and related body size 2 marks</p> <p>Two examples clearly described.</p>
	(c)	<ul style="list-style-type: none"> • Goods must conform to description given • Goods must be of a reasonable quality to carry out function taking into account age and price • Customers can request money back for unsatisfactory goods (partial refund if product used for some time) • Customers can request a repair or replacement 	[4]	<p>brief description 1 mark detailed description 2 mark</p> <p>Two ways clearly described Allow specific reference to given product.</p>

Question	Answer	Mark	Guidance
(d)	<p><u>Descriptions</u></p> <p>Geothermal Cold water pumped underground through heated rocks, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Minimal visual impact Low cost after initial outlay</p> <p>Biomass Fuel (wood, sugar cane, etc.) is burnt to generate heat, heats water to generate steam, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> Readily available fuel Can use waste Low cost/resources used</p> <p>Wave Motion of waves forces air up cylinder to turn turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Low cost after initial outlay Used in remote areas</p>	[4]	<p>Explanation Key points included (may include sketch) up to 2 marks</p> <p>benefit outlined 1 mark benefit explained 2 marks</p>

Question		Answer	Mark	Guidance
	(e) (i)	<p>Material</p> <ul style="list-style-type: none"> polypropylene; polyethylene; abs; recycled thermoplastic <p>Properties or characteristics</p> <ul style="list-style-type: none"> cleaned easily; easily formed to required shape; corrosion/rot resistant; relatively inexpensive to produce; Colour choice available; Safer in use – no splinters or sharpness 	[3]	<p>Material must be a thermoplastic</p> <p>award mark for other <i>appropriate</i> thermoplastic material not listed</p> <p>1x1 mark</p> <p>Award mark for other appropriate property/characteristic. Must relate to the specific material</p> <p>2x1 mark</p>
	(e) (ii)	<ul style="list-style-type: none"> Material section produced by extrusion <p>Extrusion description to include reference to continuous feed of softened plastic through shaped die, and must include the heating stage.</p> <ul style="list-style-type: none"> Cut to required length for individual sections (may be auto cut-off direct from extrusion machine) QC – check quality of cut-off ends and length. Drill fixing hole Ø10 using jig or CNC machine to position accurately Drill top fixing hole Ø30 – may be done with drilling process on CNC machine QC – check alignment Removal of swarf and cleaning before final visual QC check <p>Accept Injection Moulding to produce the section if well detailed description that includes the forming of the holes is given.</p>		<p>Level 3 (5-6 marks) Process fully described, key features and technical details identified, Answer must include detail of specialist tooling for full marks.</p> <p>Level 2 (3-4 marks) Key stages presented, reasonably well described with key features identified</p> <p>Level 1 (0-2 marks) Some stages outlined (up to 2), very limited description</p> <p>Quality of description and communication</p> <p>Basic sketch or chart with limited annotation 1 mark</p>

Question	Answer	Mark	Guidance
			<p>Good sketch/chart with main features identified and labelled 2 marks</p> <p>Detailed sketch/chart with clear annotation 3 marks</p> <p>Max 1 if clearly described and logical response given but no sketch/chart used</p> <p>Award credit where possible if response doesn't link to chosen material.</p> <p>[9]</p>
(f)	<p>issues</p> <ul style="list-style-type: none"> • innovative new products • increased functionality of products • excitement in market • extends range of possibilities for product design • medical/safety advances • increased material cost/product cost • cost of training for designers <p>examples</p> <ul style="list-style-type: none"> • Shape memory alloys (engineering/car industry) • Thermochromic products/pigments – safety (indicating heat) fabrics • Self healing materials • Polymorph for rapid modelling/testing • Conductive thread for Smart textiles 	[8]	<p>Level 3 (6-8 marks) Clear, cogent and well-structured response with two or three issues well explained. Good use of examples and additional evidence to support discussion. Good use of technical vocabulary</p> <p>Level 2 (3-5 marks) One or two issues described with some explanation. Appropriate use of technical vocabulary demonstrating a good understanding of concept. Introduction of one example or supporting evidence</p> <p>Level 1 (0-2 marks) Some issues outlined, bullet points (usually focussed on one issue) no further or very limited explanation, limited use of examples or supporting evidence</p>
			Q2 Total Marks 36

Question		Answer	Mark	Guidance
3	(a)	<ul style="list-style-type: none"> The carton must be easy to open- used by all ages/elderly/blind etc Be re-sealable-milk will become tainted with other flavor if left open in the refrigerator Easy to pour- can spill everywhere if not Labeled clearly with type of milk—Full fat whole milk/semi skimmed/ skimmed /1% etc Sealed /air tight- to avoid any exposure to bacterial contamination Easy to grip pouring device Suitable for aseptic packaging- to ensure sterile conditions 	[4]	<p>Clear statement and justification required for a mark</p> <p>Must be related to product – no marks for generic responses</p> <p>Must be a full response – - no marks for identification only.</p> <p>Four justified design requirements. Give one mark if two valid points given but not justified.</p>
	(b)	<ul style="list-style-type: none"> Carton width for holding Height of carton for tipping to pour Position of pourer – angle held at Method of opening the pourer 	[4]	<p>Answer must relate to anthropometrics (i.e. body measurements) not ergonomics</p> <p>example 1 mark</p> <p>example and related body size 2 marks</p> <p>Two examples clearly described.</p>
	(c)	<ul style="list-style-type: none"> Goods must conform to description given Goods must be of a reasonable quality to carry out function taking into account age and price Customers can request money back for unsatisfactory goods (partial refund if product used for some time) Customers can request a repair or replacement 	[4]	<p>brief description 1 mark</p> <p>detailed description 2 mark</p> <p>Two ways clearly described</p> <p>Allow specific reference to given product.</p>

Question	Answer	Mark	Guidance
(d)	<p><u>Descriptions</u></p> <p>Geothermal Cold water pumped underground through heated rocks, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Minimal visual impact Low cost after initial outlay</p> <p>Biomass Fuel (wood, sugar cane, etc.) is burnt to generate heat, heats water to generate steam, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> Readily available fuel Can use waste Low cost/resources used</p> <p>Wave Motion of waves forces air up cylinder to turn turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Low cost after initial outlay Used in remote areas</p>	[4]	<p>Explanation Key points included (may include sketch) up to 2 marks</p> <p>benefit outlined 1 mark benefit explained 2 marks</p>

Question		Answer	Mark	Guidance
	(e) (i)	<ul style="list-style-type: none"> • <u>Calcium</u> Needed for normal growth in children Main mineral in bones and teeth formation, gives them strength and hardness Helps blood clot after injury Helps the nervous system and muscles to function properly Production of enzymes • <u>Zinc</u> Essential constituent of over 100 enzymes Protein metabolism Functioning of the immune system Skin and wound healing • <u>Magnesium</u> Constituent of all cells Functioning of some enzymes Nerve, muscle and brain function • <u>Vitamin A</u> Helps the body grow and develop Keeps the lining of the digestive system, lungs and throat moist and free from infection Keeps the skin healthy Makes visual purple for the retina in eyes to see well in the dark It is an anti oxidant • Vitamin B12 Metabolism of fats, proteins and carbohydrates. Cell growth Metabolism of folic acid and maintenance of nervous system Manufacture of red blood cells • B group Vitamins B1 Thiamin- Energy release, converting carbohydrates and fat to energy Nerve transmission 	[3]	<p>1x1 mark Do not accept: iron/vitamin C /vitamin D/protein</p> <p>2x1 mark</p>

Question	Answer	Mark	Guidance
	<p>Normal growth, heart, muscle and digestive system function</p> <p>B2 Riboflavin- Releasing energy Vital for growth and development Production of red blood cells Keeps eyes, skin and nervous system healthy</p> <p>B3 Niacin – essential for metabolism of fats, proteins and carbohydrates Healthy skin Digestive system and nervous system working Production of hormones including insulin and oestrogen</p>		

Question	Answer	Mark	Guidance								
(ii)	<table border="0" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>Pasteurisation Short term heat processing- for 15-25 seconds Held at 72 °C Destroy pathogens(food poisoning bacteria) but not food spoilage bacteria Milk has a short shelf life(7-10 days) Flavour not affected Must be stored chilled but requires chilling after opening</p> </td> <td style="width: 50%; vertical-align: top;"> <p>Sterilisation Long heat process Held for 15 minutes Held at 121°C -132°C Destroys all bacteria Milk has a long shelf life (6 months) Caramel taste due to Can be stored ambient</p> </td> </tr> </table>	<p>Pasteurisation Short term heat processing- for 15-25 seconds Held at 72 °C Destroy pathogens(food poisoning bacteria) but not food spoilage bacteria Milk has a short shelf life(7-10 days) Flavour not affected Must be stored chilled but requires chilling after opening</p>	<p>Sterilisation Long heat process Held for 15 minutes Held at 121°C -132°C Destroys all bacteria Milk has a long shelf life (6 months) Caramel taste due to Can be stored ambient</p>	[9]	<p>Level 1 (0-2 marks) Some stages outlined (up to 2), very limited description</p> <p>Level 2 (3-4 marks) Key stages presented, reasonably well described with key features identified (up to 4 stages)</p> <p>Level 3 (5-6 marks) Processes fully described, key times and temperatures identified, with clear explanation of the differences</p> <p>Quality of description and communication</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 80%;">Basic sketch or chart with limited annotation</td> <td style="text-align: right;">1 mark</td> </tr> <tr> <td>Good sketch/chart with main features identified and labelled</td> <td style="text-align: right;">2 marks</td> </tr> <tr> <td>Detailed sketch/chart with clear annotation</td> <td style="text-align: right;">3 marks</td> </tr> </table> <p>Max 1 if clearly described and logical response given but no sketch/chart used</p>	Basic sketch or chart with limited annotation	1 mark	Good sketch/chart with main features identified and labelled	2 marks	Detailed sketch/chart with clear annotation	3 marks
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Question	Answer	Mark	Guidance
(f)	<p>issues</p> <ul style="list-style-type: none"> • innovative new products • Functional foods sales have tremendous growth in Uk • excitement in market • extends range of possibilities • Demand for healthier choices increases • Nanotechnology gives potential for rapid growth in sales <p>Food examples:</p> <ul style="list-style-type: none"> • Food additives • Modified starches adding stability to products /thickening without heat/used as a low fat substitute • Functional foods with health promoting benefits beyond normal nutritional value eg probiotic drinks, cholesterol lowering spreads, milk with omega 3 oils. • Fortified foods such as breakfast cereals • Nano- emulsions are used to create double emulsions to improve sauce texture • Nano food synthesisers can create or alter food molecules • Nano-capsule protection can deliver a fortifying nutrient to our body to be released slowly or release a flavour slowly • Nano-bots are microbe destroying minute robots that can make food afe 	[8]	<p>Level 3 (6-8 marks) Clear, cogent and well-structured response with two or three issues well explained. Good use of examples and additional evidence to support discussion. Good use of technical vocabulary</p> <p>Level 2 (3-5 marks) One or two issues described with some explanation. Appropriate use of technical vocabulary demonstrating a good understanding of concept. Introduction of one example or supporting evidence</p> <p>Level 1 (0-2 marks) Some issues outlined, bullet points (usually focussed on one issue) no further or very limited explanation, limited use of examples or supporting evidence</p>
Q3 Total Mark 36			

Question		Answer	Mark	Guidance
4	(a)	<ul style="list-style-type: none"> • Cost effective to manufacture e.g material used, tessellated etc • Rigid after construction to protect the perfume and withstand the weight of the bottle • Easy to print onto or emboss to reflect the expensive contents • Can be re-used by the consumer • Easy to recycle • Easy to stack- transportation or display • Durable – ok for frequent open/closing • Justified aesthetic requirement • Suitable dimensions to stop bottle rattling around and to get fingers in to remove bottle 	[4]	<p>Clear statement and justification required for a mark</p> <p>Must be related to product – no marks for generic responses</p> <p>Must be a full response – - no marks for identification only.</p> <p>Four justified design requirements. Give one mark if two valid points given but not justified.</p>
	(b)	<ul style="list-style-type: none"> • Consideration of the ease of use of the operating mechanism /press– related to finger/thumb size • Related hand size – carrying/grip • Finger size – removal of lid 	[4]	<p>Answer must relate to anthropometrics (i.e. body measurements) not ergonomics</p> <p>example 1 mark example and related body size 2 marks</p> <p>Two examples clearly described.</p>
	(c)	<ul style="list-style-type: none"> • Goods must conform to description given • Goods must be of a reasonable quality to carry out function taking into account age and price • Customers can request money back for unsatisfactory goods (partial refund if product used for some time) • Customers can request a repair or replacement 	[4]	<p>brief description 1 mark detailed description 2 mark</p> <p>Two ways clearly described Allow specific reference to given product.</p>

Question	Answer	Mark	Guidance
(d)	<p><u>Descriptions</u></p> <p>Geothermal Cold water pumped underground through heated rocks, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Minimal visual impact Low cost after initial outlay</p> <p>Biomass Fuel (wood, sugar cane, etc.) is burnt to generate heat, heats water to generate steam, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> Readily available fuel Can use waste Low cost/resources used</p> <p>Wave Motion of waves forces air up cylinder to turn turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Low cost after initial outlay Used in remote areas</p>	[4]	<p>Explanation Key points included (may include sketch) up to 2 marks</p> <p>benefit outlined 1 mark benefit explained 2 marks</p>

Question		Answer	Mark	Guidance
	(e) (i)	<ul style="list-style-type: none"> • Card 160 – 300 gsm – (don't accept just 'card' or cardboard) • Solid white board • Corrugated card • Gives the feeling of luxury, high quality • Easy to print on. • Cuts cleanly • Folds crisply without fibre tear • To protect bottle from impact 	[3]	<p>award mark for other appropriate material not listed</p> <p>1x1 mark</p> <p>Award mark for other appropriate property/characteristic Must relate to the specific material</p> <p>2x1 mark</p>
	(ii)	<ul style="list-style-type: none"> • tool prepared for embossing - die (eg brass) and suitable substrate (eg rubber) • material heated (sometimes dampened) and put under pressure in embossing tool • tool released – visual check on quality of embossing • varnish applied by roller or spray • UV curing of varnish • laminate surface applied by heat and pressure • The final product is checked to assure QA 	[9]	<p>Level 3 (5-6 marks) Process fully described, key features and technical details identified, Answer must include detail of specialist tooling for full marks.</p> <p>Level 2 (3-4 marks) Key stages presented, reasonably well described with key features identified</p> <p>Level 1 (0-2 marks) Some stages outlined (up to 2), very limited description</p> <p>Quality of description and communication</p> <p>Basic sketch or chart with limited annotation 1 mark</p> <p>Good sketch/chart with main features identified and labelled 2 marks</p> <p>Detailed sketch/chart with clear annotation 3 marks</p> <p>Max 1 if clearly described and logical response given but no sketch/chart used</p> <p>Award credit where possible if response doesn't link to chosen material.</p>

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(f)	<p>issues</p> <ul style="list-style-type: none"> • innovative new products • increased functionality of products • excitement in market • extends range of possibilities for product design • medical/safety advances • increased material cost/product cost • cost of training for designers <p>examples</p> <ul style="list-style-type: none"> • Shape memory alloys (engineering/car industry) • Thermochromic products/pigments – safety (indicating heat) fabrics • Self healing materials • Polymorph for rapid modelling/testing • Conductive thread for Smart textiles 	[8]	<p>Level 3 (6-8 marks) Clear, cogent and well-structured response with two or three issues well explained. Good use of examples and additional evidence to support discussion. Good use of technical vocabulary</p> <p>Level 2 (3-5 marks) One or two issues described with some explanation. Appropriate use of technical vocabulary demonstrating a good understanding of concept. Introduction of one example or supporting evidence</p> <p>Level 1 (0-2 marks) Some issues outlined, bullet points (usually focussed on one issue) no further or very limited explanation, limited use of examples or supporting evidence</p>
			Q4 Total Mark 36

Question		Answer	Mark	Guidance
5	(a)	<ul style="list-style-type: none"> • Light weight for ease of carrying/moving/storage • Relatively inexpensive • Strong enough to support weight of a large adult • Non-slip 'feet' for safety in use on any surface • Stable in use to prevent user falling • No sharp edges to prevent damage to walls/decorations/furniture • Side sections easy to grip for users safety • Weather resistant to allow for outside use • Reasonably comfortable to stand on for a period of time • Ability to be locked/secured to prevent theft and prevent it being used to break in to a house • 	[4]	<p>Clear statement and justification required for a mark</p> <p>Must be related to product – no marks for generic responses</p> <p>Must be a full response -- no marks for identification only.</p> <p>Four justified design requirements. Give one mark if two valid points given but not justified.</p>
	(b)	<ul style="list-style-type: none"> • Width of ladder suitable for most adult size body width • Space between treads preventing need to 'reach/stretch' • Depth of tread sufficient to support foot size • Width and depth of side sections to fit hand size • Accept reference to body weight (one mark only) 	[4]	<p>Answer must relate to anthropometrics (i.e. body measurements) not ergonomics</p> <p>example 1 mark example and related body size 2 marks</p> <p>Two examples clearly described.</p>
	(c)	<ul style="list-style-type: none"> • Goods must conform to description given • Goods must be of a reasonable quality to carry out function taking into account age and price • Customers can request money back for unsatisfactory goods (partial refund if product used for some time) • Customers can request a repair or replacement 	[4]	<p>brief description 1 mark detailed description 2 mark</p> <p>Two ways clearly described Allow specific reference to given product.</p>

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(d)	<p><u>Descriptions</u></p> <p>Geothermal Cold water pumped underground through heated rocks, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Minimal visual impact Low cost after initial outlay</p> <p>Biomass Fuel (wood, sugar cane, etc.) is burnt to generate heat, heats water to generate steam, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> Readily available fuel Can use waste Low cost/resources used</p> <p>Wave Motion of waves forces air up cylinder to turn turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Low cost after initial outlay Used in remote areas</p>	[4]	<p>Explanation Key points included (may include sketch) up to 2 marks</p> <p>benefit outlined 1 mark benefit explained 2 marks</p>

Question		Answer	Mark	Guidance
	(e) (i)	<p>Material</p> <ul style="list-style-type: none"> • aluminium (alloy) • mild steel • stainless steel <p>Accept GRP (Fibreglass)</p> <p>Not 'wood' – unsuitable for the shape of section shown in diagram.</p> <p>Properties or characteristics</p> <ul style="list-style-type: none"> • good quality finish • cleaned easily • easily formed to required shape • produces rigid structure • Relatively inexpensive / readily available • Good strength to weight ratio 		<p>award mark for other appropriate material not listed</p> <p>1x1 mark</p> <p>Property must relate to the material stated.</p> <p>Award mark for other appropriate property/characteristic Must relate to the specific material</p> <p>[3] 2x1 mark</p>
	(ii)	<p>Aluminium alloy:</p> <ul style="list-style-type: none"> • Material section produced by extrusion • Extrusion description to include reference to continuous feed of molten aluminium alloy through shaped die. • Cut to required length for individual sections (may be auto cut-off direct from extrusion machine) • QC – check quality of cut-off ends and length. • Holes for treads pierced in side section on a press (positive indexing needed to give accurate spacing) or machined on laser cutter/CNC milling machine. 		<p>Level 3 (5-6 marks) Process fully described, key features and technical details identified, Answer must include detail of specialist tooling for full marks.</p> <p>Level 2 (3-4 marks) Key stages presented, reasonably well described with key features identified</p> <p>Level 1 (0-2 marks) Some stages outlined (up to 2), very limited description</p>

Question	Answer	Mark	Guidance
	<p>Steel/Stainless steel</p> <ul style="list-style-type: none"> • Material section produced by rolling – description of process • Cut to required length for individual sections • (may be auto cut-off direct from rolls) • QC – check quality of cut-off ends and length. • Holes for treads pierced in side section on a press (positive indexing needed to give accurate spacing) or machined on laser cutter/CNC milling machine. <p>Or:</p> <ul style="list-style-type: none"> • Side section formed completely by presswork • Description to include description of bending channel shape then piercing tread holes – either as a one-blow operation or individually by positive indexing. <p>In all cases:</p> <ul style="list-style-type: none"> • QC – remove all sharp edges from ends and tread holes prior to visual final inspection 	<p>[9]</p>	<p>Quality of description and communication</p> <p>Basic sketch or chart with limited annotation 1 mark</p> <p>Good sketch/chart with main features identified and labelled 2 marks</p> <p>Detailed sketch/chart with clear annotation 3 marks</p> <p>Max 1 if no sketch/chart used</p> <p>Max 1 if clearly described and logical response given but no sketch/chart used</p> <p>Award credit where possible if response doesn't link to chosen material.</p>
<p>(f)</p>	<p><i>Discuss the implications to the designer of the increasing availability of new and smart materials.</i></p> <p>issues</p> <ul style="list-style-type: none"> • innovative new products • increased functionality of products • excitement in market • extends range of possibilities for product design • medical/safety advances • increased material cost/product cost • cost of training for designers 		<p>Level 3 (6-8 marks) Clear, cogent and well-structured response with two or three issues well explained. Good use of examples and additional evidence to support discussion. Good use of technical vocabulary</p> <p>Level 2 (3-5 marks) One or two issues described with some explanation. Appropriate use of technical vocabulary demonstrating a good understanding of concept. Introduction of one example or supporting evidence</p>

Question	Answer	Mark	Guidance
	examples <ul style="list-style-type: none"> • Shape memory alloys (engineering/car industry) • Thermo-chromic products/pigments – safety (indicating heat) fabrics • Self healing materials • Polymorph for rapid modelling/testing • Conductive thread for Smart textiles 	[8]	Level 1 (0-2 marks) Some issues outlined, bullet points (usually focussed on one issue) no further or very limited explanation, limited use of examples or supporting evidence
Q6 Total Mark			36

Question		Answer	Mark	Guidance
6	(a)	<ul style="list-style-type: none"> The tray must be waterproof and not allow spillage The tray must not degrade or corrode in contact with water The tray must fit comfortably within the space allowed to enable easy removal for emptying The tray handle must allow fingers to fit underneath to easily pull the tray out for emptying The tray must match the aesthetics and style of the water unit The tray must hold a reasonable amount of water to ensure that spillage does not occur and frequent emptying is not required. 	[4]	<p>Clear statement and justification required for a mark</p> <p>Must be related to product – no marks for generic responses</p> <p>Must be a full response – - no marks for identification only.</p> <p>Four justified design requirements. Give one mark if two valid points given but not justified.</p>
	(b)	<ul style="list-style-type: none"> Tray handle length – three or four fingers or both hands used Tray handle width – comfortable finger width Hand grip of tray – finger/thumb to hold whole tray 	[4]	<p>Answer must relate to anthropometrics (i.e. body measurements) not ergonomics</p> <p>example 1 mark</p> <p>example and related body size 2 marks</p> <p>Two examples clearly described.</p>
	(c)	<ul style="list-style-type: none"> Goods must conform to description given Goods must be of a reasonable quality to carry out function taking into account age and price Customers can request money back for unsatisfactory goods (partial refund if product used for some time) Customers can request a repair or replacement 	[4]	<p>brief description 1 mark</p> <p>detailed description 2 mark</p> <p>Two ways clearly described</p> <p>Allow specific reference to given product.</p>

Question	Answer	Mark	Guidance
(d)	<p><u>Descriptions</u></p> <p>Geothermal Cold water pumped underground through heated rocks, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Minimal visual impact Low cost after initial outlay</p> <p>Biomass Fuel (wood, sugar cane, etc.) is burnt to generate heat, heats water to generate steam, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> Readily available fuel Can use waste Low cost/resources used</p> <p>Wave Motion of waves forces air up cylinder to turn turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Low cost after initial outlay Used in remote areas</p>	[4]	<p>Explanation Key points included (may include sketch) up to 2 marks</p> <p>benefit outlined 1 mark benefit explained 2 marks</p>

Question		Answer	Mark	Guidance
	(e) (i)	<p>Material</p> <ul style="list-style-type: none"> • abs; • polypropylene; • pvc; • acrylic; • laminated birch/beech/maple(appropriate finish); • aluminium; • copper; • Stainless steel <p>Properties or characteristics</p> <ul style="list-style-type: none"> • high quality finish; • does not easily degrade/corrode; • easily formed to required shape; • produces rigid structure; 	[3]	<p>award mark for other appropriate material not listed</p> <p>1x1 mark</p> <p>Award mark for other appropriate property/characteristic Must relate to the specific material</p> <p>2x1 mark</p>
	(ii)	<p>Heat formed in plastic using jig/former</p> <ul style="list-style-type: none"> • plastic sheet cut to size • plug and yolk former (male/female former) prepared and finished- consideration of handle shape • plastic evenly heated • pressed in former • edge treatment applied <p>Vacuum formed</p> <ul style="list-style-type: none"> • plastic sheet cut to size of machine • former in place • plastic evenly heated • vacuum applied when plastic lowered • removed and trimmed to shape • edge finished • handle shape thermo-formed 		<p>Level 3 (5-6 marks) Process fully described, key features and technical details identified, Answer must include detail of specialist tooling for full marks.</p> <p>Level 2 (3-4 marks) Key stages presented, reasonably well described with key features identified</p> <p>Level 1 (0-2 marks) Some stages outlined (up to 2), very limited description</p> <p>Quality of description and communication</p> <p>Basic sketch or chart with limited annotation 1 mark</p>

Question	Answer	Mark	Guidance
	<p>Allow a description of line bending a net cut from a plastic sheet</p> <p>Metal shaping/forming</p> <ul style="list-style-type: none"> • net created • sheet metal cut to shape (guillotine, nibbler, fine tooth saw) simple shape pressed/stamped • former/folding jig used to bend to shape • corners joined (soldered/brazed) or riveted • finishing, check for waterproofing <p>Basic press forming using plug and yolk former on softer or annealed metals eg. aluminium or copper</p>	[9]	<p>Good sketch/chart with main features identified and labelled 2 marks</p> <p>Detailed sketch/chart with clear annotation 3 marks</p> <p>Max 1 if no sketch/chart used</p> <p>Max 1 if clearly described and logical response given but no sketch/chart used</p> <p>Award credit where possible if response doesn't link to chosen material.</p> <p>Injection moulding is an inappropriate method for the batch size – award a maximum of 3 marks total.</p>
(f)	<p>issues</p> <ul style="list-style-type: none"> • innovative new products • increased functionality of products • excitement in market • extends range of possibilities for product design • medical/safety advances • increased material cost/product cost • cost of training for designers <p>examples</p> <ul style="list-style-type: none"> • Shape memory alloys (engineering/car industry) • Thermochromic products/pigments – safety (indicating heat) fabrics • Self healing materials • Polymorph for rapid modelling/testing Conductive thread for Smart textiles 	[8]	<p>Level 3 (6-8 marks) Clear, cogent and well-structured response with two or three issues well explained. Good use of examples and additional evidence to support discussion. Good use of technical vocabulary</p> <p>Level 2 (3-5 marks) One or two issues described with some explanation. Appropriate use of technical vocabulary demonstrating a good understanding of concept. Introduction of one example or supporting evidence</p> <p>Level 1 (0-2 marks) Some issues outlined, bullet points (usually focussed on one issue) no further or very limited explanation, limited use of examples or supporting evidence</p>
Q6 Total Mark			36

Question		Answer	Mark	Guidance
7	(a)	<ul style="list-style-type: none"> The screwdriver must be able to be operated with one hand so the other hand is left free, eg to steady the work. The screwdriver must be able to be operated with either hand so that left/right handed users can operate it. The screwdriver can must be designed to allow the user to press hard into the screw without hurting the users hand. The screwdriver must have a forward/reverse function so it can insert and remove screws. The screwdriver must have sufficient torque so it can insert/remove tight screws. There must be a speed control so that the user has full control of the screwing action. The unit must be tough enough to withstand drops from up to 2m so that it can last through normal use. There must be provision to add a lanyard/strap to help prevent accidental drops. The unit should be able to insert a large number of screws before the battery needs recharging so that the product is an aid to the user. 	[4]	<p>Clear statement and justification required for a mark</p> <p>Must be related to product – no marks for generic responses</p> <p>Must be a full response – - no marks for identification only.</p> <p>Four justified design requirements. Give one mark if two valid points given but not justified.</p>
	(b)	<ul style="list-style-type: none"> Dimensions of the human hand would have been used to determine the size and shape of the handle. Finger length – used to help position the trigger. Thumb/finger diameter – used to determine the size of the reversing switch. 	[4]	<p>Answer must relate to anthropometrics (i.e. body measurements) not ergonomics</p> <p>example 1 mark</p> <p>example and related body size 2 marks</p> <p>Two examples clearly described.</p>

Question	Answer	Mark	Guidance
(c)	<ul style="list-style-type: none"> • Goods must conform to description given • Goods must be of a reasonable quality to carry out function taking into account age and price • Customers can request money back for unsatisfactory goods (partial refund if product used for some time) • Customers can request a repair or replacement 	[4]	brief description 1 mark detailed description 2 mark Two ways clearly described Allow specific reference to given product.
(d)	<p><u>Descriptions</u></p> <p>Geothermal Cold water pumped underground through heated rocks, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Minimal visual impact Low cost after initial outlay</p> <p>Biomass Fuel (wood, sugar cane, etc.) is burnt to generate heat, heats water to generate steam, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> Readily available fuel Can use waste Low cost/resources used</p> <p>Wave Motion of waves forces air up cylinder to turn turbines, turbines turn generators, electricity distributed</p>		<p>Explanation Key points included (may include sketch) up to 2 marks</p> <p style="text-align: right;">benefit outlined 1 mark benefit explained 2 marks</p>

Question		Answer	Mark	Guidance
		<u>Benefit</u> No pollutants or waste Low cost after initial outlay Used in remote areas	[4]	
(e)	(i)	Nickel-Cadmium (NiCad) or Nickel Metal Hydride (NMH) or Lithium Ion (L-ion) Properties/characteristics: <ul style="list-style-type: none"> • They are rechargeable, • They can last for several hundred charge/discharge cycles, • They have a high energy/weight ratio, • They are manufactured in various sizes/shapes, • They can be recharged fairly quickly, • They have low internal resistance so can provide a high current. 	[3]	award mark for other appropriate battery not listed 1x1 mark Award mark for other appropriate property/characteristic Must relate to the specific material 2x1 mark
	(ii)	<ul style="list-style-type: none"> • Diagram most likely to show a spur gear system, but also award credit for epicyclic gears, worm gears or bevel gears. • Indication of input shaft (motor) and output shaft (screwdriver bit). • Speed reduction achieved by smaller gear (pinion) on input shaft driving a larger gear. • Reduction ratio required is $6000/250 = 24$ • Reduction achieved by two gears is the ratio of the number of teeth on each gear. • The required reduction ratio (24) is too much to achieve in one stage, so for full marks candidates must split the speed reduction into two stages. • Total reduction ratio = (stage 1 reduction) x (stage 2 reduction) 		Level 3 (5-6 marks) Process fully described, key features and technical details identified, Answer must include detail of specialist tooling for full marks. Level 2 (3-4 marks) Key stages presented, reasonably well described with key features identified Level 1 (0-2 marks) Some stages outlined (up to 2), very limited description Quality of description and communication Basic sketch or chart with limited annotation 1 mark

Question	Answer	Mark	Guidance
	Eg one possible solution is: <ul style="list-style-type: none"> • stage 1 - two gears 12 teeth and 72 teeth giving a reduction ratio of 6 • stage 2 – 10 teeth and 40 teeth giving a reduction ratio of 4 overall reduction ratio = $6 \times 4 = 24$ 	[9]	Good sketch/chart with main features identified and labelled 2 marks Detailed sketch/chart with clear annotation 3 marks Max 1 if clearly described and logical response given but no sketch/chart used
(f)	issues <ul style="list-style-type: none"> • innovative new products • increased functionality of products • excitement in market • extends range of possibilities • medical/safety advances examples <ul style="list-style-type: none"> • Shape memory alloys (engineering/car industry) • Thermo-chromic products – safety (indicating heat) fabrics • Photo-chromic products – indicating (UV) light • Self healing materials • Quantum tunnelling composite (QTC) for sensing forces • Polymorph for rapid modelling/testing • Electroluminescent products for thin film light emission • New advances in LED technology for increased light emission and lower energy consumption. 	[8]	Level 3 (6-8 marks) Clear, cogent and well-structured response with two or three issues well explained. Good use of examples and additional evidence to support discussion. Good use of technical vocabulary Level 2 (3-5 marks) One or two issues described with some explanation. Appropriate use of technical vocabulary demonstrating a good understanding of concept. Introduction of one example or supporting evidence Level 1 (0-2 marks) Some issues outlined, bullet points (usually focussed on one issue) no further or very limited explanation, limited use of examples or supporting evidence
Q7 Total Mark 36			

Question		Answer	Mark	Guidance
8	(a)	<ul style="list-style-type: none"> • Fabric must be shiny/lustrous/ smooth- to give a good aesthetic look • Shape must be long enough to go round an average sized neck – to maximise market potential • Width must be able to tie a knot in without it being too bulky • It must lie flat when worn – to fit under a jacket • It must have a stain resistant finish – ties are not washable • It must have an interesting design printed or weave on the fabric to add interest and appeal to the target market • It must be colourful to have impact when worn • It should be labelled ‘Dry Clean Only’ 	[4]	<p>Clear statement and justification required for a mark</p> <p>Must be related to product – no marks for generic responses</p> <p>Must be a full response - no marks for identification only.</p> <p>Four justified design requirements. Give one mark if two valid points given but not justified.</p>
	(b)	<ul style="list-style-type: none"> • Average size of neck • Average neck to waist • Holding tie to form into knot 	[4]	<p>Answer must relate to anthropometrics (i.e. body measurements) not ergonomics</p> <p>brief description 1 mark detailed description 2 mark</p> <p>Two steps clearly described. Max 2 marks if not related to example</p>
	(c)	<ul style="list-style-type: none"> • Goods must conform to description given • Goods must be of a reasonable quality to carry out function taking into account age and price • Customers can request money back for unsatisfactory goods (partial refund if product used for some time) • Customers can request a repair or replacement 	[4]	<p>brief description 1 mark detailed description 2 mark</p> <p>Two ways clearly described</p>

Question	Answer	Mark	Guidance
(d)	<p><u>Descriptions</u></p> <p>Geothermal Cold water pumped underground through heated rocks, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Minimal visual impact Low cost after initial outlay</p> <p>Biomass Fuel (wood, sugar cane, etc.) is burnt to generate heat, heats water to generate steam, steam turns turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> Readily available fuel Can use waste Low cost/resources used</p> <p>Wave Motion of waves forces air up cylinder to turn turbines, turbines turn generators, electricity distributed</p> <p><u>Benefit</u> No pollutants or waste Low cost after initial outlay Used in remote areas</p>	[4]	<p>Explanation Key points included (may include sketch) up to 2 marks</p> <p>benefit outlined 1 mark benefit explained 2 marks</p>

Question		Answer	Mark	Guidance
		10. Stitch through the tie stitch line (stitch along the seam) 11. Pull through and press	[9]	Max 1 if clearly described and logical response given but no sketch/chart used Award credit where possible if response doesn't link to chosen material.
	f	issues <ul style="list-style-type: none"> • innovative new products • increased functionality of products • excitement in market • extends range of possibilities • medical/safety advances • sense and react – medical/sun protection/military/sportswear • nanotechnology enhancing fabrics at a molecular level examples <ul style="list-style-type: none"> • wearable electronics eg Levi jacket/inbuilt communication system/paramedics • Thermochromic products – safety (indicating heat) fabrics • Phosphorescent glow in the dark – smart dyes • Reflective inks/safety/children/medical wear • Micro encapsulation, yarns or fabrics containing beneficial substances – antiseptics/medical use • Nanotechnology – fabrics resisting spills/repels stains/resist static. 		Level 3 (6-8 marks) Clear, cogent and well-structured response with two or three issues well explained. Good use of examples and additional evidence to support discussion. Good use of technical vocabulary Level 2 (3-5 marks) One or two issues described with some explanation. Appropriate use of technical vocabulary demonstrating a good understanding of concept. Introduction of one example or supporting evidence Level 1 (0-2 marks) Some issues outlined, bullet points (usually focussed on one issue) no further or very limited explanation, limited use of examples or supporting evidence
				Q8 Total Mark 36

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