Markscheme

November 2022

Design technology

Higher level and standard level

Paper 2

13 pages

General Marking Instructions

Subject Details: Design Technology HL and SL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A (total ***[30 marks]***) ONE question in Section B ***[20 marks]***. Maximum total = ***[50 marks]***.

Markscheme format example:

Question			Answers	Notes	Total
4.	**b**	**ii**	the displacement and acceleration; are in opposite directions;	*Accept* ***force*** *for* ***acceleration****.*	**2**

1. Each row in the "Question" column relates to the smallest subpart of the question.

2. The maximum mark for each question subpart is indicated in the "Total" column.

3. Each marking point in the "Answers" column is shown by means of a semi-colon at the end of the marking point.

4. A question subpart may have more marking points than the total allows. This will be indicated by "**max**" written after the mark in the "Total" column. The related rubric, if necessary, will be outlined in the "Notes" column.

5. An alternative wording is indicated in the "Answers" column by a slash (***/***). Either wording can be accepted.

6. An alternative answer is indicated in the "Answers" column by "***OR***" on the line between the alternatives. Either answer can be accepted.

7. Words in angled brackets ❮ ❯ in the "Answers" column are not necessary to gain the mark.

8. Words that are <u>underlined</u> are essential for the mark.

9. The order of marking points does not have to be as in the "Answers" column, unless stated otherwise in the "Notes" column.

10. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the "Answers" column then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by ***OWTTE*** (or words to that effect).

11. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

12. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script. "ECF acceptable" will be displayed in the "Notes" column.

13. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the "Notes" column.

Section A

Question			Answers	Notes	Total
1.	**a**	**i**	does not need to be refilled; the body/barrel is transparent/can see the amount of ink left; simple to use; cheaper; lightweight (no need to carry the ink bottle);	*Award **[1]** for stating one relative advantage of the BIC® Cristal® ballpoint pen over the fountain pen up to **[1 max]**.*	**1**
1.	**a**	**ii**	mass production; ubiquitous (present/appearing/found everywhere); omnipresent (existed/in circulation for a long time); dominant design; timeless appeal; image (instantly recognisable);	*Award **[1]** for listing each characteristic that makes the BIC® Cristal® ballpoint pen a classic design up to **[2 max]**.* *Award a mark if any of the relevant descriptions in brackets are used.*	**2**
1.	**b**	**i**	0.22 (0.181 + 0.039 total waste in 2019) - 0.212 (0.180 + 0.032 total waste in 2021); = 0.008 tonnes; or 0.039 - 0.032 = 0.007 0.181 - 0.180 = 0.001 0.007 + 0.001 = 0.008 tonnes;	*Award **[1]** for each correct calculation up to **[2 max]**.* *Final answer must show the unit 'tonnes'*	**2**

Question			Answers	Notes	Total
1.	**b**	**ii**	to assess the effect/impact the BIC pen has on the environment; throughout the five stages of its life (pre-production, production, distribution, utilisation and disposal);	*Award **[1]** for identifying a reason how the BIC might use Life Cycle Analysis (LCA) to help reduce waste and **[1]** for a development of that reason up to **[2 max]**.*	**2**
1.	**c**	**i**	texture; test the grip/feel/comfort of the pen in the hand;	*Award **[1]** for identifying one way how BIC may have used psychological factor data in the design of the BIC® Cristal® Soft in **Figure 4** and **[1]** for a development of that impact up to **[2 max]**.*	**2**
1.	**c**	**ii**	when a company produces different models of the same product; to reach a wider audience/offer a wider range; increasing sales/extending market share/meet demand;	*Award **[1]** for identifying how product versioning can help extend the life cycle of a product and **[1]** for each subsequent development of that strategy up to **[3 max]**.*	**3**

Question 1 continued

Question			Answers	Notes	Total
1.	**d**	**i**	automated production/automation; assembly line;	*Award **[1]** for stating the production system used by Zarpens up to **[1 max]**.* *Do not accept mass production*	**1**
1.	**d**	**ii**	multi-task robots can perform more than one complex task; assemble parts with speed/efficiency/no errors/accuracy;	*Award **[1]** for identifying why multi-task robots would be used in the assembly of the Zarpens fountain pen and **[1]** for an appropriate development up to **[2 max]**.*	**2**
1.	**e**	**i**	they help reduce waste; by producing products with greater precision/less error;	*Award **[1]** for identifying why multi-task robots are considered a clean technology and **[1]** for an appropriate development up to **[2 max]**.*	**2**
1.	**e**	**ii**	uses the form/decoration from a particular style/period of time; the pen keeps the styling/function of the original fountain pen; evoking nostalgia/emotional attachment;	*Award **[1]** for identifying a reason why Zarpens have used retro-styling to increase sales of the fountain pen and **[1]** for each subsequent development of that reason up to **[3 max]**.*	**3**

Question			Answers	Notes	Total
2.	**a**		freehand sketches are simple drawings/iterations of ideas; used to communicate quickly/cost effectively.	*Award **[1]** for identifying one reason why the designer produced the freehand sketches in **Figure 11** and **[1]** for an appropriate development of it up to **[2 max]**.*	**2**
2.	**b**		a mock up is used to test the folding mechanism; to gain feedback from the user/improve the design.	*Award **[1]** for identifying why a mock-up in **Figure 12** is used in the development of the bicycle and **[1]** for a development of that characteristic up to **[2 max]**.*	**2**
3.			multidisciplinary approach involves a range of people with different skills/expertise/taking on different roles/perspectives; complex products require knowledge from many disciplines; to be utilised at different stages of product development;	*Award **[1]** for identifying why products would benefit from multidisciplinary approach to innovation and **[1]** for each subsequent development of that physiological benefit up to **[3 max]**.*	**3**
4.			lithium polymer (LiPo) batteries have high energy efficiency/charge capacity; compared to other rechargeable batteries; which provides longer periods between charges; lightweight; does not add to the overall weight (of the bicycle); allowing optimal (motor) performance;	*Award **[1]** for identifying a reason why lithium polymer (LiPo) batteries contribute to efficient energy use and **[1]** for each subsequent development of that reason up to **[3 max]**.*	**3**

Section B

Question			Answers	Notes	Total
5.	**a**		analogy**;** an idea from one context is used to stimulate ideas for solving a problem in another context;	*Award **[1]** for identifying the strategy for innovation for the Eden Project and **[1]** for a reason up to **[2 max]**.*	**2**
5.	**b**		form/image; the domes have an aesthetic quality; that can be transferred to a variety of design products/contexts. form/image; the domes have a distinctive shape; that makes them memorable/recognisable/easy to identify;	*Award **[1]** for explaining one characteristic that make geodesic domes a classic design and **[1]** for each subsequent development of that reason up to **[3 max]**.*	**3**
5.	**c**		**Advantages** geothermal energy is clean and renewable; eliminating the creation of pollution/waste from burning fossil fuels; and provides power/heat to local homes/offices; **Disadvantages** costly/time consuming to set up (the infrastructure); initial building could impact the local environment/animal/habitat/plant life; as it creates visual/noise/water/air pollution.	*Award **[1]** for identifying an advantage to the local area in the development of the geothermal energy project and **[1]** for each development of that way up to **[3 max]**.* *Award **[1]** for identifying a disadvantage to the local area in the development of the geothermal energy project and **[1]** for each development of that way up to **[3 max]**.* *Mark as **[3]** + **[3]***	**6**

Question 5 continued

Question			Answers	Notes	Total
5.	**d**		**Mechanical property** tensile strength**;** the cladding is stretched/pulled over the steel frame/is under tension**;** the material will resist tearing under stress over a period of time/keep the structure stable**;** elasticity**;** the cladding is prone to changing weather conditions (snow/rain/wind)**;** needs to resist permanent deformation/returns to its original shape**;** toughness**;** the cladding will be exposed to snow/hail/heavy rain**;** will absorb impact/energy without fracturing or cracking**;** **Physical property** (Low) thermal conductivity**;** the cladding needs good insulation**;** to maintain the conditions of a tropical biome; thermal resistance/expansion**;** the cladding will be exposed to sunlight**;** and will not deform under high heat**;** hardness**;** the cladding needs to resist scratching/indentation**;** as the dome may come under impact from natural causes; **Aesthetic property** appearance**;** the material is translucent/transparent**;** allows for light to enter the structure/contrasts with the natural environment**;**	*Award **[1]** for explaining one mechanical property of the thermoplastic material that has led to its selection for use in the cladding of the Eden project up to **[3 max]**.* *Award **[1]** for explaining one physical property of the thermoplastic material that has led to its selection for use in the cladding of the Eden project up to **[3 max]**.* *Award **[1]** for explaining one aesthetic property of the thermoplastic material that has led to its selection for use in the cladding of the Eden project up to **[3 max]**.* *Mark as **[3]** + **[3]** + **[3]**.*	**9**

Question			Answers	Notes	Total
6.	**a**		water resistant/waterproof**;** quick drying**;** elasticity/resistant to stretching**;** resistant to abrasion/scratches**;** durable**;** tensile strength/won't tear**;** lightweight/low mass**;**	*Award **[1]** for listing each property of polyester that make it a good choice for the canopy of an umbrella up to **[2 max]**.*	**2**
6.	**b**		constructive discontent**;** the designer was unhappy with the existing umbrella design**;** and designed an umbrella to prevent water dripping on the floor/hands free/easier to get in and out of cars**;**	*Award **[1]** for explaining one driver for the invention of the new umbrella mechanism in **Figure 17** up to **[3 max]**.*	**3**
6.	**c**		study of human movement/mechanics while using the umbrella (operation of muscles, joints, tendons); would consider repetition/duration/posture/pressure points of the user; to improve comfort (when gripping the handle for a period of time); a study of muscle strength required; C-shape handle allows the user to rest the hand/hold without gripping; minimising fatigue (when gripping the handle over time);	*Award **[1]** for identifying how a study of biomechanics in existing umbrella handle designs could have been used to develop the C-shaped handle in **Figure 18** and **[1]** for each subsequent development of it up to **[3 max]**.* *Mark as **[3]** + **[3]**.* *Allow marks to be allocated across clusters.*	**6**

Question 6 continued

Question			Answers	Notes	Total
6.	d		**Solid Modelling** clear representations of the final part/provide a complete set of data for the product to be realised; shows joining tolerances/internal strength/material gauge; to ensure components are fit for purpose/to 3D print components for testing; **Animation** the ability to simulate motion or a process (by linking graphic screens together); to test the process of opening/closing the umbrella; to test**/**demonstrate its operation/function; **FEA** the calculation and simulation of unknown factors in products using CAD systems; to test joints/linkages/mechanics/forces/stresses; to ensure umbrella will perform in under repeated use/harsh weather conditions;	*Award **[1]** for explaining how Solid Modelling could help with the design and development of umbrellas up to **[3 max]**.* *Award **[1]** for explaining how Animation could help with the design and development of umbrellas up to **[3 max].*** *Award **[1]** for explaining how Finite Element Analysis (FEA) could help with the design and development of umbrellas up to **[3 max]**.* *Mark as **[3]** + **[3]** + **[3]**.*	**9**

Question			Answers	Notes	Total
7.	a		results in a material with improved (physical/mechanical) properties; such as greater malleability/elasticity/corrosion resistance/toughness;	*Award **[1]** for identifying one advantage of alloying steel **[1]** for a development of it up to **[2 max]**.*	**2**
7.	b		lamination/shaping/forming; layers of timber (plywood) are glued and clamped in a jig/mould; pressure is applied to set the glue/resin;	*Award **[1]** for explaining the manufacturing process used in the production of the plywood seat and **[1]** for each subsequent development of it up to **[3 max]**.*	**3**
7.	c		**Primary data** primary data is data collected for a specific purpose/that does not already exist; collected through performance testing/user trials (whilst using the seat); to optimise the shape/comfort of the seat; **Secondary data** secondary data is collected from existing sources/someone other than the user; based on web sources/published literature of a range of users/percentile ranges; to optimise the reach/size/height/seating positions;	*Award **[1]** for suggesting how the designer might have collected primary anthropometric data to inform the design and development of the seat and **[1]** for each subsequent development of it up to **[3 max]**.* *Award **[1]** for suggesting how the designer might have collected secondary anthropometric data to inform the design and development of the seat and **[1]** for each subsequent development of it up to **[3 max]**.* *Mark as **[3]** + **[3]**.*	**6**

Question 7 continued

Question			Answers	Notes	Total
7.	**d**		**Materials** timber is renewable; can be replanted and regrown; and replenished within the passage of time/making it sustainable; steel/plywood can be made from recycled materials/is recyclable**;** reduces the need for virgin material**;** lowering the embodied energy/environmental footprint of the product**;** **Energy** seat and frame can be produced from standard materials/components**;** using basic/fewer/common manufacturing methods**;** requiring lower energy in production**;** the chair is stackable**;** more chairs can be transported at once**;** limiting energy used in transportation/distribution**;** **Waste** the chair can be disassembled/taken apart easily; through the use of temporary joining methods/fasteners; which facilitates repair/reuse; steel/timber can be easily separated into their own material groups; for recycling minimising incineration/waste sent to landfill;	*Award **[1]** for explaining* how *the designer has reduced the environmental impact of the seat through consideration of materials up to **[3 max]**.* *Award **[1]** for explaining* how *the designer has reduced the environmental impact of the seat through consideration of energy up to **[3 max]**.* *Award **[1]** for explaining* how *the designer has reduced the environmental impact of the seat through consideration of waste up to **[3 max]**.* *Mark as **[3]** + **[3]** + **[3]**.*	**9**