Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2020

Design technology

Higher level and standard level

Paper 2

16 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	planned obsolescence; allows for new technologies to be introduced; allows for continues sales; allows for improved safety in later generations;	*Award **[1]** for stating **one** reason why the product was designed to only last two years.*	**1 max**
1.	a	ii	less material is wasted (through errors); by re-introducing excess plastic/high accuracy/consistency; injection moulding is suitable for shaping plastic material; ABS is an inexpensive material; high volume/high speed/continuous flow/24/7/ method of production; takes advantage of economies of scale;	*Award **[1]** for identifying a reason why the use of injection moulding has resulted in a low estimated material unit cost and **[1]** for a development of that reason up to **[2 max]**.*	**2 max**
1.	b	i	FEA is used in the calculation/simulation of unknown factors of flow/thermal/stress analysis; to optimize the mould/change the thickness (of the material/wall);	*Award **[1]** for identifying a reason why FEA could be used to further develop the process during the component's manufacture by injection moulding and **[1]** for a development of that reason up to **[2 max]**.*	**2**

Question			Answers	Notes	Total
1.	b	ii	solid models contain data regarding mass/volume; this data is required for virtual prototyping/FEA/design for the environment software to generate accurate results; solid models provide a complete set of data allowing the product to be realized/tested/virtually prototyped/undergo FEA; surface models contain no data about wall thickness/interior (components) of the part;	*Award **[1]** for identifying a reason why solid modelling rather than surface modelling would have been used in the CAD development of the component designed in Figure 1 and **[1]** for a development of that reason up to **[2 max]**.*	**2 max**
1.	c	i	increases landfill/reduces recycling rate; as thermoset plastics are difficult to recycle (due to their stronger bonds); increases duration of use; as thermoset plastics are generally harder/stronger/more heat/creep resistant than thermoplastics; changes the manufacturing process (to compression moulding); as thermoset plastics are more difficult to injection mould;	*Award **[1]** for identifying one possible impact on the sustainability report in Figure 2 if the material of the component is changed from a thermoplastic to a thermosetting plastic and **[1]** for a development of that impact up to **[2 max]**.*	**2 max**

Question			Answers	Notes	Total
1.	**c**	**ii**	recycle; material labelling the component; which allows for easy material sorting/separation; dematerialization; reduction of volume of material/ABS used in each component; which reduces processing/energy/waste;	*Award **[1]** for identifying a waste mitigation strategy the designer could use to reduce the percentage of ABS sent to landfill at end of the products life and **[1]** for each subsequent development of that strategy up to **[3 max]**.*	**3 max**
1.	**d**	**i**	the component does not consume energy during utilization; the software cannot predict/know how often/how long/the way in which the product is used;	*Award **[1]** for listing a reason why the design for environment software does not generate a result for energy consumed at the utilization stage of the product lifecycle up to **[1 max]**.*	**1 max**
1.	**d**	**ii**	a) 0.933 + 0.224 + 0.004 + 0.004 = 1.1655; *or* b) 0.933 + 0.224 = 1.157; = 1.2 MJ;	*Award **[1]** for a correct answer.* *Award **[1]** for the correct workings.* *Embodied Energy refers to either:* *a) Total energy consumed throughout the lifecycle of a product (cradle-to-grave)* *or* *b) Total energy consumed in production (cradle-to-[factory] gate)* *The unit MJ must be included to award the second mark*	**2 max**

Question			Answers	Notes	Total
1.	e	i	aluminium requires mining/extraction from ore/bauxite; which is energy-intensive;	*Award **[1]** for identifying why the energy consumed at the pre-production stage is greater for aluminium than for ABS and **[1]** for an appropriate development up to **[2 max]**.* *Do not award a mark for only stating mining/extraction. Response must also include a reference to ore/bauxite.*	**2**
1.	e	ii	end of pipe technologies reduces pollutants/waste at the end of a process; using filters; to prevent contamination of soil/air/water;	*Award **[1]** for how each distinct point in an explanation of how end of pipe technologies can reduce the environmental impact of manufacturing up to **[3 max]**.* *Do not accept 'reduces environmental impact'*	**3**

Question			Answers	Notes	Total
2.	**a**		form: angled body/minimalist style/curved shade; function: adjustable/light can be focused on different work areas;	*Award **[1]** for identifying how the designer of the modern Anglepoise Lamp in Figure 4. has achieved a compromise between form and function and **[1]** for an appropriate development of it up to **[2 max]**.* *Do not accept 'Aesthetics' without context or reference.*	**2 max**
2.	**b**		appearance/visual appeal/attractive; wood grain/colour/quality; texture; hardwood has a natural/warm feel;	*Award **[1]** for identifying one aesthetic characteristic of hardwood that makes it suitable for use in the redesigned Anglepoise Lamp and **[1]** for a development of that characteristic up to **[2 max]**.* *Do not accept 'Has a nice aesthetic'*	**2 max**
3.			reduced fatigue/improved biomechanics; as interface requires less physical effort/less force; allowing greater productivity/less risk of harm to the user (when working over long periods of time); enhanced comfort; as the software maps the size of the user's hand (and physical environment); to automatically scale the interface/reduce reach;	*Award **[1]** for identifying a physiological benefit to the user of interactions through a mixed reality interface instead of a physical interaction with the product and **[1]** for each subsequent development of that physiological benefit up to **[3 max]**.*	**3 max**

Question			Answers	Notes	Total
4.			innovators take risks; by actively seeking/being the first to adopt the most up to date technologies; despite the fact the innovation/product/technology may not be a success; innovators tend to set fashions/trends; by purchasing/being seen with products containing new technologies; to increase social status;	*Award **[1]** for identifying a reason why consumers of first-to market technologies are likely to be innovators and **[1]** for each subsequent development of that reason up to **[3 max]**.*	**3 max**

Section B

Question			Answers	Notes	Total
5.	**a**		5th-95th percentile; the watch strap is adjustable to fit a wide range of users;	*Award **[1]** for identifying the percentile range that would have been used for the Mondaine watch strap and **[1]** for a reason for that percentile range up to **[2 max]**.*	**2**
5.	**b**		the watch body is made from (castor oil) bio-plastic/the strap is made from (additive-free, durable) natural rubber; which will return to the earth as nutrients/decompose/naturally break down/ regenerate; helping eliminate waste; the pouch is made from (recovered) PET bottles; which can be recycled/made to be made again; keeping the material in a closed loop system;	*Award **[1]** for explaining why the reason the Mondaine 'Essence' watch is an example of the circular economy and **[1]** for each subsequent development of that reason up to **[3 max]**.*	**3 max**
5.	**c**		**Image:** the (iconic) red seconds hand/numberless face is instantly recognizable; which provokes an emotional response in the user/nostalgia; increasing the desirability of the product; the (iconic) red seconds hand/numberless face have become standard; and the shape/colour/format are a dominant design; making the product instantly recognizable; **Omnipresence:** the clock design has been in existence for a long time/since 1952; and is now being used/seen in smartphones and fashion products; with very little change from the original design/by exposing the design to different generations;	*Award **[1]** for identifying a way how image contributed to the Swiss railway clock achieving classic design status and **[1]** for each development of that way up to **[3 max]**.* *Award **[1]** for identifying a way how ubiquity contributed to the Swiss railway clock achieving classic design status and **[1]** for each development of that way up to **[3 max]**.* *Mark as **[3]** + **[3]**.*	**6**

Question			Answers	Notes	Total
5.	d		**Market analysis:** an appraisal of the economic viability/pricing of the proposed product; from the potential users/market perspective; to evaluate the feasibility of introducing a green design wrist watch; **Competition:** the wristwatch market is competitive/saturated/at its peak; Mondaine would have analysed similar products in the market; to identify a unique selling point (USP)/market gap for a green design watch; **Target audience:** Mondaine identified a specific group of people/market segment of users; by considering consumer values/behaviour; aiming a green design/marketing message to the users' requirements for the product;	*Award **[1]** for explaining the importance of market analysis in the development of a marketing specification for the Mondaine 'Essence' watch up to **[3 max]**.* *Award **[1]** for explaining the importance of competition in the development of a marketing specification for the Mondaine 'Essence' watch up to **[3 max]**.* *Award **[1]** for explaining the importance of the target audience in the development of a marketing specification for the Mondaine 'Essence' watch up to **[3 max]**.* *Mark as **[3]** + **[3]** + **[3]**.*	**9**

Question			Answers	Notes	Total
6.	a		international/government legislation/target; aimed at reducing global emissions from shipping; reduce fuel/energy consumption; conserving natural resources/to be more cost effective;	*Award **[1]** for identifying one driver for the development of the clean technology for the modern rotor sail and **[1]** for a development up to **[2 max]**.*	**2 max**
6.	b		carbon glass fibre is a composite; providing high strength to weight ratio/tensile and compressive strength; requiring less electricity to drive the rotation of the sails/allowing sails to resist deformation; carbon glass fibre is corrosion resistant; reducing maintenance/repair; as sails are exposed to salt water; carbon glass fibre can be used to make complex/large shapes; using a matrix and fibre composite (hand lay-up/spray lay-up/pultrusion) with a mould; to manufacture the large scale sail mechanism;	*Award **[1]** for explaining why carbon glass fibre was chosen for the modern rotor sail and **[1]** for each subsequent development of it up to **[3 max]**.*	**3 max**

Question			Answers	Notes	Total
6	c		environmental issues/energy-efficiency were not major concerns in the early 20th century; using fossil fuels to power ships was more efficient; even though fossil fuels create carbon emissions/rotor sails minimise carbon emissions; the technology did not exist in the 1920s; that required advanced manufacturing/materials to allow it to be mass produced; rotor sails are large in size; some countries have legislation regarding the maximum height of ships; to allow ships to pass under bridges safely; the sail adds height to the ship; resistance to clean technology from fossil fuel producers; may have put pressure on governments to legislate (against the technology); limiting the adoption of the invention; the high cost of retrofitting existing ships/buying new ships; may have been prohibitive for the shipping industry; running existing ship models was cheaper in the short term;	*Award **[1]** for each of two reasons identifying why the original rotor sail was a shelved technology in the 1920s and **[1]** for each subsequent development of that reason up to **[3 max]**.* *Mark as **[3]** + **[3]**.*	**6 max**

Question			Answers	Notes	Total
6	d		**Rapid prototyping** the sail mechanism has internal moving parts; designers 3D print the sail to test the function/modify the interior mechanism; by creating a physical model/3D prototype using CAD; **Instrumented physical models** (air tunnels allow designers) to analyse the air flow/structural integrity; providing accurate quantitative feedback for analysis/with the ability to take measurements; and use the data to improve the efficiency of the mechanism; **Computer Aided Design (CAD)** utilizes software to create surface/solid models/FEA/virtual prototypes; to communicate/share information (between engineers, manufacturers, clients); and gain feedback for further development (of the mechanism);	*Award **[1]** for explaining the role of rapid prototyping in the design of the modern rotor sail up to **[3 max]**.* *Award **[1]** for explaining the role of instrumented physical models in the design of the modern rotor sail up to **[3 max]**.* *Award **[1]** for explaining the role of computer aided design (CAD) in the design of the modern rotor sail up to **[3 max]**.* *Mark as **[3]** + **[3]** + **[3]**.*	**9**

Question			Answers	Notes	Total
7.	a		patent; would offer the designer legal protection of the concept from imitation; registered design; protects the shape of the flask cap;	*Award **[1]** for identifying the type of intellectual property required for the protection of the JuNiki flask cap design and **[1]** for a development up to **[2 max]**.*	**2 max**
7.	b		(extrusion) blow moulding; hot air is blown into the mould to inflate the glass to take shape; and then set/cooled/removed from mould;	*Award **[1]** for identifying the mass production method used for the body of the borosilicate glass flask and **[1]** for each subsequent development of it up to **[3 max]**.*	**3 max**
7.	c		transparency; allows for the contents to be visible; to determine the volume/type of liquid; high hardness; will resist scratching; retains an attractive appearance for longer; thermal shock resistance/low thermal expansion; minimises risk of breaking/fracturing; when exposed to sudden change/hot/cold temperatures; non-porous/chemical resistance; provides good protection against acidic beverages/harsh cleaning products; will not degrade the material over time; high melting point; allows for sterilization/hygienic high temperature cleaning; to avoid contamination by microorganisms/bacteria/germs;	*Award **[1]** for each of two reasons identifying why the properties of borosilicate glass make it suitable for the body of the flask and **[1]** for each subsequent development of that reason up to **[3 max]**.* *Mark as **[3]** + **[3]**.*	**6 max**

Question			Answers	Notes	Total
7.	d		**Static anthropometric data** deals with body measurements when the user is not in motion/still; collected by measuring a range/percentile of user's hands or mouths sizes (primary data)/from books/manuals/software databases (secondary data); to determine the size of the body/spout of the flask; **Physiological data** relates to physical characteristics to optimize comfort/biomechanics/performance; collected by user trials/observation of a range of users interacting with the bottle (opening the caps/filling/holding/drinking from the flask/carrying it); to ensure it is easy to open/grip/drink from/has an appropriate weight; **Psychological data** relates to psychological interpretations from a range of sensory inputs; by collecting data through user trials/focus groups on taste/smell/texture/temperature; to determine optimum materials/finishes used;	*Award **[1]** for explaining how the designer may have collected static anthropometric data to aid the development of the JuNiki flask up to **[3 max]**.* *Award **[1]** for explaining how the designer may have collected physiological data to aid the development of the JuNiki flask up to **[3 max]**.* *Award **[1]** for explaining how the designer may have collected psychological data to aid the development of the JuNiki flask up to **[3 max]**.* *Mark as **[3]** + **[3]** + **[3]**.*	**9**