

Markscheme

May 2021

Design technology

Higher level and standard level

Paper 2

16 pages

© International Baccalaureate Organization 2021

All rights reserved. No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without the prior written permission from the IB. Additionally, the license tied with this product prohibits use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, whether fee-covered or not, is prohibited and is a criminal offense.

More information on how to request written permission in the form of a license can be obtained from <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organisation du Baccalauréat International 2021

Tous droits réservés. Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite préalable de l'IB. De plus, la licence associée à ce produit interdit toute utilisation de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, moyennant paiement ou non, est interdite et constitue une infraction pénale.

Pour plus d'informations sur la procédure à suivre pour obtenir une autorisation écrite sous la forme d'une licence, rendez-vous à l'adresse <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organización del Bachillerato Internacional, 2021

Todos los derechos reservados. No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin la previa autorización por escrito del IB. Además, la licencia vinculada a este producto prohíbe el uso de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales—, ya sea incluido en tasas o no, está prohibido y constituye un delito.

En este enlace encontrará más información sobre cómo solicitar una autorización por escrito en forma de licencia: <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

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;	<i>Accept force for acceleration.</i>	2

- Each row in the “Question” column relates to the smallest subpart of the question.
- The maximum mark for each question subpart is indicated in the “Total” column.
- Each marking point in the “Answers” column is shown by means of a semi-colon (;) at the end of the marking point.
- 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.
- An alternative wording is indicated in the “Answers” column by a slash (/). Either wording can be accepted.
- An alternative answer is indicated in the “Answers” column by “**OR**” on the line between the alternatives. Either answer can be accepted.
- Words in angled brackets < > in the “Answers” column are not necessary to gain the mark.
- Words that are underlined are essential for the mark.
- The order of marking points does not have to be as in the “Answers” column, unless stated otherwise in the “Notes” column.
- 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).
- Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- 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.
- 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	a (finite) resource that does not naturally re-form at a rate that makes its use sustainable/over time;	<i>Award [1] for a definition of the term non-renewable resource.</i> <i>Also accept re-made/re-grown/replenished/re-generated</i>	1
1.	a	ii	recycle/reduce/recover waste; by lowering emissions/use of materials/use of energy;	<i>Award [1] for each distinct point that describes the characteristics of a waste mitigation strategy up to [2 max].</i> <i>Also accept dematerialisation</i>	2
1.	b	i	to meet emission standards/legislative targets; by reducing oil consumption/air pollution/increasing energy efficiency;	<i>Award [1] for identifying why the US is using CAFE to encourage car makers to improve fuel efficiency and carbon emissions and [1] for a brief explanation up to [2 max].</i>	2
1.	b	ii	more efficient engines (fuel additives); lighter materials; decrease vehicle weight; new/clean technologies (e.g. hybrid/driving modes/stop-start); aerodynamics;	<i>Award [1] for listing each way that car manufacturers can improve fuel efficiency up to [2 max].</i>	2
1.	c	i	imposing legislation/taxes/providing incentives or subsidies; to encourage switching to eco-friendly vehicles/using alternative transport;	<i>Award [1] for identifying one way a government can encourage a reduction in oil consumption and [1] for a brief explanation up to [2 max].</i>	2

Question			Answers	Notes	Total
1.	c	ii	<p>some countries cannot afford to enact the legislation/are dependent on oil revenues; which may hinder (or promote) economic growth; due to their (low) level of economic development;</p> <p>companies may be reluctant to invest in a country; as legislation could result in the reduction of profits; leading to reduced income for governments/employers;</p> <p>investment in existing infrastructure; may become redundant/require modification/updating; which can be expensive/economically unfeasible;</p>	<p><i>Award [1] for each of three distinct points in an explanation of why governments of some countries will be reluctant to enact environmental legislation up to [3 max].</i></p> <p><i>Do not award marks across different clusters.</i></p>	3
1.	d	i	<p>the ability of a material to withstand being pushed/squashed/squeezed/compressed;</p>	<p><i>Award [1] for a definition of the term compressive strength.</i></p> <p><i>Do not accept pressure or force.</i></p>	1

Question			Answers	Notes	Total
1.	d	ii	aircraft operate under high pressure/forces (extreme conditions); components with high compressive strength will resist failure/damage under these conditions;	<i>Award [1] for identifying why aircraft require components of high compressive strength and [1] for a brief explanation up to [2 max].</i>	2
1.	e	i	carbon fibre sheets are placed in a mould; and combined with resin to form the shape (of the component);	<i>Award [1] for each distinct point that describes how a carbon reinforced plastic component could be manufactured up to [2 max].</i>	2
1.	e	ii	composites are a mixture of materials which have different properties; such as improved thermal/corrosion resistance; which enhances durability/reduces maintenance cost; composites are lightweight; which reduces the amount of fuel needed; and allows for greater load capacity/reduces the cost of transportation; composites have high strength (in relation to their weight); ensuring aircraft are safer to operate; under various different environmental conditions/loads/stresses;	<i>Award [1] for each of three distinct points in an explanation of why composites are used in aircraft up to [3 max].</i> <i>Do not award marks across different clusters.</i>	3

Question		Answers	Notes	Total
2.	a	<p>ability to be moulded; into the shape of the case;</p> <p>toughness; ability to withstand impact/protects the mobile phone if dropped;</p> <p>lightweight; has little effect on the overall weight (of the phone);</p> <p>elasticity; ease of putting the case on and off the mobile phone;</p> <p>recyclability; as it is a thermoplastic;</p> <p>available in a range of colours/textures/styles; to provide customer choice;</p> <p>low cost; making it affordable/easy to replace;</p> <p>mass production; making suitable for economies of scale;</p>	<p><i>Award [1] for identifying why polypropylene (PP) would be used as a material for a cell/mobile phone case and [1] for a brief explanation up to [2 max].</i></p> <p><i>Do not award marks across different clusters.</i></p>	2
2.	b	<p>a thermoplastic has weak secondary bonds/can be heated and shaped repeatedly/can be recycled/cannot withstand high temperatures;</p> <p>a thermosetting plastic has strong secondary bonds/can be shaped only once/cannot be recycled/can withstand high temperatures;</p>	<p><i>Award [1] for a definition of a thermoplastic and [1] for a definition of a thermosetting plastic up to [2 max].</i></p>	2

Question		Answers	Notes	Total
3.		<p>multidisciplinary teams have a number of members with different skills/expertise; which can cause conflict/issues with communication; leading to delays/additional costs;</p>	<p><i>Award [1] for each of three distinct points in an explanation of a disadvantage of using multidisciplinary teams in the design and development of a new product up to [3 max].</i></p>	3
4.		<p>dematerialization is the reduction of (total) material and energy throughput (of any product and service); life cycle analysis is the assessment of the effect a product has on the environment (through five stages); dematerialization can minimise environmental impact at a number of stages* of the product's life cycle;</p>	<p><i>Award [1] for each of three distinct points in an explanation of the impact of dematerialization on a product's life cycle analysis (LCA) up to [3 max].</i></p> <p><i>* Award a mark for the third point if reference is made to two or more of the following stages: pre-production; production; distribution; utilization and disposal;</i></p>	3

Section B

Question		Answers	Notes	Total
5.	a	<p>a patent protects a new product/invention/process/idea; lasts for a number of years/set period of time; prevents others from imitating intellectual property; can be used within geographical boundaries; is recognised by governments/protected by law;</p>	<p><i>Award [1] for listing each characteristic of a patent up to [2 max].</i></p>	2
5.	b	<p>innovators adopt an invention and take risks; innovation is the successful diffusion of an invention in the marketplace; Edison created the necessary changes/improvements for the light globe to be diffused into the market/commercially viable/adopted by consumers;</p>	<p><i>Award [1] for each of three distinct points in an explanation of the impact of innovators and innovation with relation to Edison's light globe up to [3 max].</i></p>	3

Question		Answers	Notes	Total
5.	c	<p>Transparency: transparency is the ability of a material to allow light to pass through; creating a functional need for the product for different uses; which allows the (amount of) light to be consistent/controlled;</p> <p>transparency refers to a material that is clear/able to be seen through; creating a pleasing aesthetic; which allows the internal filament to be seen;</p> <p>Strength: the strength of the light globe depends on the ability of the glass to withstand failure; allowing it to support its own shape/by utilising a shell structure; which would prevent it breaking if a force is applied when handling the light globe;</p> <p>the strength of the light globe depends on the ability of the glass to withstand thermal expansion; resisting internal forces and displacements; which would prevent it breaking from the heat generated;</p>	<p><i>Award [1] for each of three distinct points in an explanation of how the transparency of the glass in Edison's light globe have contributed to its success up to [3 max].</i></p> <p><i>Award [1] for each of three distinct points in an explanation of how the strength of the glass in Edison's light globe have contributed to its success up to [3 max].</i></p> <p><i>Mark as [3] + [3].</i></p>	6

Question		Answers	Notes	Total
5.	d	<p>Style: style obsolescence occurs when a trend no longer is fashionable; the light globe can be designed in a particular style of the time; and becomes unpopular when a new style replaces it;</p> <p>Function: over time, products wear out/break down/stop working; the lightbulb can be designed with materials/components which will fail over a set period of time; requiring a new light globe to be purchased as a replacement;</p> <p>Sustainability: lightbulbs have become available which are easier to recycle/use less energy; and reduce the overall impact on the environment; consumers reject traditional light globes in favour of more efficient alternatives;</p>	<p><i>Award [1] for each of three distinct points in an explanation of how the style in the design of the light globe can lead to planned obsolescence up to [3 max].</i></p> <p><i>Award [1] for each of three distinct points in an explanation of how the function in the design of the light globe can lead to planned obsolescence up to [3 max].</i></p> <p><i>Award [1] for each of three distinct points in an explanation of how the sustainability in the design of the light globe can lead to planned obsolescence up to [3 max].</i></p> <p><i>Mark as [3] + [3] + [3].</i></p>	9

Question		Answers	Notes	Total
6.	a	a prototype is built to test the concept with a range of visually impaired/blind users; to gather feedback/data/communicate information to the designers;	<i>Award [1] for identifying why a prototype might be used to evaluate the accessibility of the user interface on the DOT Braille Smartwatch and [1] for a brief explanation up to [2 max].</i>	2
6.	b	form is the shape of a product and its aesthetic qualities; function is how well the product fulfils its task that it has been designed to do; form follows function as visually impaired users may not be so concerned about the aesthetics of the watch;	<i>Award [1] for each of three distinct points in an explanation of how the form relates to the function for the DOT Braille Smartwatch up to [3 max].</i>	3
6	c	the braille is designed to raise up; so the user can feel what the time is; to provide feedback to the user through touch. the watch uses vibration; to inform the user of a notification/when interacting with the side buttons; without the need for visual/audible feedback;	<i>Award [1] for each of two ways that explains how haptic technology is used in the function of the DOT Braille Smartwatch and [1] for each subsequent development of that explanation up to [3 max].</i> <i>Do not award marks across different clusters.</i> <i>Mark as [3] + [3].</i>	6

Question		Answers	Notes	Total
6	d	<p>Anthropometric data: anthropometric data deals with body measurements (of the user); dimensions of the wrist; to make the watch band adjustable/fit a wide range of users (5th-95th).</p> <p>anthropometric data deals with body measurements (of the user); dimensions of fingers; to define the size/layout of the braille bumps;</p> <p>Psychological factors: psychological factors relate to interpretations caused by textures/sounds (of the DOT Smartwatch); the material of the strap/interface would be an important consideration in the design; to heighten the sense of touch for blind/visually impaired users;</p> <p>Physiological factors: physiological factors are human factors related to physical characteristics (of the DOT Smartwatch); which optimise the user’s general comfort/health/performance; by allowing them to communicate and receive information with ease;</p>	<p><i>Award [1] for each of three distinct points in an explanation of how anthropometric data is addressed in the design of the DOT Braille Smartwatch up to [3 max].</i></p> <p><i>Award [1] for each of three distinct points in an explanation of how psychological factors are addressed in the design of the DOT Braille Smartwatch up to [3 max].</i></p> <p><i>Award [1] for each of three distinct points in an explanation of how physiological factors are addressed in the design of the DOT Braille Smartwatch up to [3 max].</i></p> <p><i>Mark as [3] + [3] + [3].</i></p>	9

Question		Answers	Notes	Total
7.	a	part drawings use 2D/orthographic drawings to communicate dimensions of an individual part; assembly drawing are 3D/isometric/exploded drawings to communicate how a number of parts fit with each other into a complete unit;	<i>Award [1] for a definition of a part and [1] for a definition of an assembly drawing up to [2 max].</i>	2
7.	b	production rate is increased; as workers specialise in one area on the assembly line; which reduces unit costs/makes the car more affordable/results in higher profits;	<i>Award [1] for each of three distinct points in an explanation of the advantages of using assembly line production up to [3 max].</i> <i>Do not accept cost efficient.</i>	3

Question		Answers	Notes	Total
7.	c	<p>image; instantly recognizable aesthetics of the product; as the Model T Ford has a unique/identifiable shape;</p> <p>mass production; made the Model T Ford more affordable/many units were produced/to meet demand; so the product was widely seen/ubiquitous;</p> <p>culture; the Model T Ford reflected a particular time in America; making it iconic/accessible to many families;</p> <p>omnipresent; the Model T Ford was in circulation for a long time/became embedded in people's lives; making it timeless/a standard of its time;</p>	<p><i>Award [1] for each of two reasons why the Model T Ford is considered to be a design classic and [1] for each subsequent development of that suggestion up to [3 max].</i></p> <p><i>Do not award marks across different clusters.</i></p> <p><i>Mark as [3] + [3].</i></p>	6

Question		Answers	Notes	Total
7.	d	<p>Design for materials: designing in relation to materials during processing; (mild) steel/iron would have been used to produce the body/components of the car; using fabricating/pressing/shaping/bending/welding/joining/casting;</p> <p>Design for process: designing to enable the product to be manufactured using the most effective/optimal process; with high quality/consistency; meeting mass production capacity/demands;</p> <p>Design for assembly: designing taking into account assembly at various levels (such as component to component, components into sub-assemblies and sub-assemblies into complete products); using standard components/fasteners/methods of assembly; to optimise cost/time/production efficiency;</p>	<p><i>Award [1] for each of three distinct points in an explanation of how the design of the Model T Ford ensured the optimum use of existing manufacturing capability in relation to design for materials up to [3 max].</i></p> <p><i>Award [1] for each of three distinct points in an explanation of how the design of the Model T Ford ensured the optimum use of existing manufacturing capability in relation to design for process up to [3 max].</i></p> <p><i>Award [1] for each of three distinct points in an explanation of how the design of the Model T Ford ensured the optimum use of existing manufacturing capability in relation to design for assembly up to [3 max].</i></p> <p><i>Do not award marks across different clusters.</i></p> <p><i>Mark as [3] + [3] + [3].</i></p>	9