

© International Baccalaureate Organization 2024

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 2024

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, 2024

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/>.

Design technology
Higher level and standard level
Paper 2

8 May 2024

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

Candidate session number

1 hour 30 minutes

--	--	--	--	--	--	--	--	--	--

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.



Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1. Outdoor gardening products have historically been powered by fossil fuels, but the market is quickly changing, and consumers are now adopting battery-powered products.

The Husqvarna 448i lawnmower, see **Figure 1**, is a robust, battery-powered machine with a 480 mm aluminium cutting deck. When in use, the spinning blades and grass cuttings are safely contained under the cutting deck.

Figure 1: Husqvarna 448i lawnmower



The Husqvarna 448i is designed for users in need of a reliable and quiet lawnmower. It also has low running costs and easy maintenance.

The handle on the lawnmower has a fixed height when in use, see **Figure 2**.

Figure 2: Husqvarna 448i lawnmower handle



(This question continues on the following page)



(Question 1 continued)

- (a) (i) State the percentile that would be used to determine the height of the handle of the Husqvarna 448i lawnmower. [1]

.....
.....

- (ii) Outline why practical function is influential in the design of the Husqvarna 448i lawnmower. [2]

.....
.....
.....
.....

- (b) (i) The aluminium cutting deck provides a robust base for the Husqvarna 448i lawnmower. Outline **one** property of aluminium that makes it suitable for the cutting deck. [2]

.....
.....
.....
.....

- (ii) Describe the type of computer-aided design (CAD) modelling used to test the forces acting on the aluminium cutting deck. [2]

.....
.....
.....
.....

(This question continues on page 5)



Please **do not** write on this page.

Answers written on this page
will not be marked.



(Question 1 continued)

- (c) (i) Outline how modular innovation is used as the design innovation strategy for the Husqvarna 448i lawnmower. [2]

.....

.....

.....

.....

- (ii) Rogers' characteristics of innovation describe consumer adoption of products. Explain the **relative advantage** of the Husqvarna 448i lawnmower over fossil fuel powered lawnmowers. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

(This question continues on the following page)



(Question 1 continued)

Husqvarna have a standard battery, see **Figure 3** and **Figure 4**, that can also be used in other Husqvarna outdoor gardening products.

Figure 3: Standard Husqvarna battery



Figure 4: Husqvarna batteries in use



(This question continues on the following page)



(Question 1 continued)

- (d) (i) The batteries for the Husqvarna 448i lawnmower can get hot during use. State the type of plastic that would be used for the battery cases. [1]

.....
.....

- (ii) The plastic wheels for the Husqvarna 448i lawnmower are injection moulded. Outline how plastic is injection moulded. [2]

.....
.....
.....
.....

- (e) (i) The Husqvarna 448i lawnmower uses a lithium-ion battery. List **two** advantages of using lithium-ion batteries. [2]

.....
.....
.....
.....

- (ii) Explain how the Husqvarna 448i lawnmower minimizes pollution in utilization compared to lawnmowers that use fossil fuels. [3]

.....
.....
.....
.....
.....
.....
.....
.....
.....



2. Marshall have been making audio equipment since 1960. The Marshall Speaker (2017) was inspired by the original Marshall Guitar Amplifier (1960), see **Figure 5**. The volume dial on the Marshall Speaker can be adjusted from 0 to 10 to achieve the desired volume, see **Figure 6**.

Figure 5: Marshall speakers



The Marshall Speaker (2017)



Marshall Guitar Amplifier (1960)

Figure 6: Marshall Speaker volume dial



(This question continues on the following page)



(Question 2 continued)

- (a) Describe the type of scale used to adjust the volume on the Marshall Speaker, see **Figure 6**.

[2]

.....

.....

.....

.....

- (b) Outline the classic design strategy used for the Marshall Speaker.

[2]

.....

.....

.....

.....



- 3. The Puzzler is a selection of sensory tools otherwise known as fidgets, designed to help relieve stress and improve focus for children in busy classroom environments. Their design is made up of two-pieces that fit together like a puzzle. Each one is decorated differently, including animal prints and nature-inspired textures, see **Figure 7**.

Figure 7: Puzzler design inspiration from nature



The Puzzler is a conceptual design that has not been taken to market. However, physical models of the Puzzler pieces have been made using rapid prototyping, see **Figure 8**.

Figure 8: Puzzler physical models in use



(This question continues on the following page)



(Question 3 continued)

Explain why analogy was used in the development of the Puzzler.

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

4. Fuse deposition modelling (FDM) is a type of rapid prototyping. Explain why designers would use FDM for prototyping.

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



Section B

Answer **one** question. Answers must be written within the answer boxes provided.

5. California-based Ecoline Brewery* uses by-products from the beer-making process to create biodegradable can rings that safely decompose, see **Figure 9**. The team initially experimented with seaweed but soon realised it became too rigid outside of water – which meant it might cut or choke an animal. Instead, they compression moulded a wheat and barley composite with the waste left over from the brewing process, see **Figure 10**.

Figure 9: Ecoline Brewery can rings



Figure 10: Ecoline Brewery can rings holding cans together



If the Ecoline Brewery can ring ends up in the ocean, in a matter of hours it starts breaking down, which addresses the issue of animals getting stuck in them.

* Note: Ecoline Brewery is a fictitious company, created for this case study.

(This question continues on the following page)



(Question 5 continued)

- (a) Outline the waste mitigation strategy used by the can rings. [2]

.....

.....

.....

.....

- (b) Explain how the can rings would be compression moulded. [3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

(This question continues on the following page)



(Question 5 continued)

(d) Explain how the barley and wheat composite addresses tensile strength, elasticity **and** plasticity.

[9]

A large rectangular area containing 25 horizontal dotted lines for writing the answer to question (d).



- 6. The Mia Hoodie Chair can support children with autism; it aids children’s focus, learning and emotional intelligence. Its fabric seat hugs children, promoting calmness.

When overwhelmed, children can pull up the hoodie to create a comforting, enclosed space, see **Figure 11**.

Figure 11: A child in the Mia Hoodie Chair



The Mia Hoodie Chair is made of solid timber, aluminium joints, and 3D mesh fabric. The one-piece arm and back rest is made from laminated timber, see **Figure 12 and 13**.

Figure 12 and 13: Mia Hoodie Chair with yellow arrows showing laminated backrest



(This question continues on the following page)



(Question 6 continued)

(a) Outline the driver for invention for the Mia Hoodie Chair.

[2]

.....

.....

.....

.....

(b) Explain the process of lamination.

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

(This question continues on the following page)



(Question 6 continued)

(c) Explain how the Mia Hoodie Chair satisfies the psychological factors of texture **and** light. [6]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(This question continues on the following page)



(Question 6 continued)

- (d) Explain how sketches, mock ups **and** surface modelling would have been used in the development of the Mia Hoodie Chair.

[9]

A large rectangular box containing horizontal dotted lines for writing.

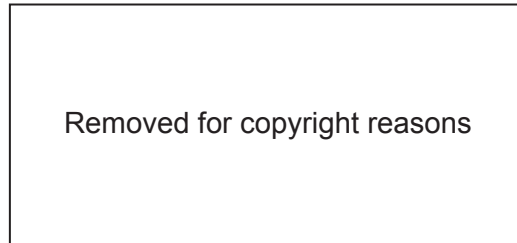


24EP19

Turn over

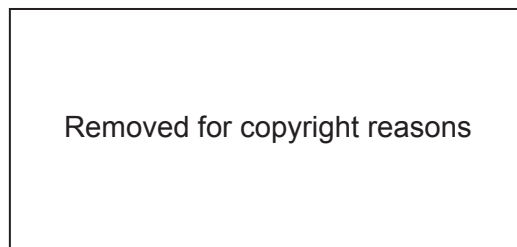
7. The Klhip ergonomically correct nail clipper gives increased control and leverage for trimming fingernails. Users find the nail clipper uses less force to cut and achieves a cleaner cut, see **Figure 14**.

Figure 14: Klhip nail clipper in use



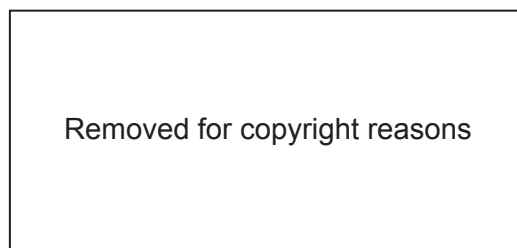
The Klhip nail clipper is precision engineered from surgical grade stainless steel, see **Figure 15**.

Figure 15: Stainless steel Klhip nail clipper



Klhip have used a combination of patents, copyright **and** trademarks to protect its intellectual property (IP), see **Figure 16**.

Figure 16: Klhip logo



(This question continues on the following page)



(Question 7 continued)

(a) Outline why stainless steel was used for the Klhip nail clipper.

[2]

.....

.....

.....

.....

(b) The stainless steel parts of the Klhip nail clipper are manufactured by casting. Explain the process of casting.

[3]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(This question continues on the following page)



(Question 7 continued)

- (c) Explain how static **and** dynamic ergonomic data would have been used in the development of the Kihip nail clipper.

[6]

A large rectangular box containing 20 horizontal dotted lines for writing an answer to the question above.

(This question continues on the following page)



(Question 7 continued)

(d) Explain how Klhip would use patents, copyright **and** trademarks to protect its intellectual property (IP).

[9]

A large rectangular box containing horizontal dotted lines for writing the answer to question (d).



Disclaimer:

Content used in IB assessments is taken from authentic, third-party sources. The views expressed within them belong to their individual authors and/or publishers and do not necessarily reflect the views of the IB.

References:

Figure 1 Images with permission from Husqvarna.

Figure 2 Images with permission from Husqvarna.

Figure 3 Images with permission from Husqvarna.

Figure 4 Images with permission from Husqvarna.

Figure 5 [Left image] With permission from Zound Industries International AB. © All Rights Reserved.

[Right image] Unbeirrt. https://commons.wikimedia.org/wiki/File:JTM_45_MK_II_Reissue_1997.jpg. Licensed under BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0/>. Image adapted.

Figure 6 With permission from Zound Industries International AB. © All Rights Reserved.

Figure 7 [Top left image] Coral – Photo by Bruno Figueiredo on Unsplash.

[Top middle image] Wood bark – Photo by Explore with Joshua on Unsplash.

[Top right image] Tiger stripes – Photo by Max van den Oetelaar on Unsplash.

[Remaining 6 images] Images with permission from Devanshi Mehra Brower.

Figure 8 Images with permission from Devanshi Mehra Brower.

Figure 9 Images with permission from E6PR.

Figure 10 Images with permission from E6PR.

Figure 11 Images with permission from Tink Things.

Figure 12 Images with permission from Tink Things.

Figure 13 Images with permission from Tink Things.

All other texts, graphics and illustrations © International Baccalaureate Organization 2024



24EP24