

# Markscheme

May 2017

Design technology

Higher level and standard level

Paper 2

This markscheme is **confidential** and for the exclusive use of examiners in this examination session.

It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Global Centre, Cardiff.

The following are the annotations available to use when marking responses.

| Annotation  | Explanation  | Shortcut | Annotation  | Explanation  | Shortcut |
|---|--|----------|---|--|----------|
|    | Correct point (automatically awards 1 mark for each tick, up to the maximum for the question part) | ALT 1    |    | Dynamic horizontal wavy line that can be expanded (for example, to highlight a section of irrelevant work) |          |
|    | Incorrect response (automatically awards zero)   | ALT 0    | <b>NAQ</b>  | Not answered question  | ALT 4    |
| <b>A+</b>   | Analysis   |          | <b>NBOD</b>   | No benefit of doubt  |          |
| <b>B+</b>   | Balanced argument  |          |    | Opinion  |          |
|    | Benefit of the doubt   |          | <b>OC</b>   | Off course   |          |
| <b>^</b>  | Caret – Omission   | ALT 2    | Text box  | On page comment  | ALT 9    |
|    | Cross – Incorrect point  |          |    | Unclear  |          |
| <b>D</b>  | Description  | ALT 5    |    | Repetition   |          |
| <b>EVAL</b>   | Evaluation   | ALT 7    | <b>SEEN</b>   | Seen (indicates that the point has been noted, but no credit has been given)                               | ALT 3    |
| <b>GEXP</b>   | [Good] Explanation (used when a point is explained (no EXP annotation))                            | ALT 6    |  | Too vague  |          |
|  | Dynamic, Horizontal (line that can be expanded)  | ALT 8    |  | Dynamic vertical wavy line that can be expanded (for example, to highlight a section of irrelevant work)   |          |
|   |  |          | <b>WTTE</b>   | Words to that effect (conveys the same meaning as marking point)   |          |

You **must** make sure you have looked at all pages. Please put the **SEEN** annotation on any blank page, to indicate that you have seen it.

## General Marking Instructions

1. Follow the markscheme provided, award only whole marks and mark only in **RED**.
2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.
3. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.**
4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use RM™ Assessor annotations to support your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.
5. Personal codes/notations are unacceptable.
6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, use the “ZERO” annotation to award zero marks. Where a candidate has not attempted the part question, use the “SEEN” annotation to show you have looked at the question. RM™ Assessor will apply “NR” once you click complete.
7. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers. Scoris™ will only award the highest mark or marks in line with the rubric.
8. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp “SEEN” on any additional pages that are blank or where the candidate has crossed out his/her work.
9. Mark positively. Give candidates credit for what they have achieved and for what they have got correct, rather than penalizing them for what they have got wrong. However, a mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the “CON” stamp.

## 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 ✓<br>are in opposite directions ✓ | Accept <i>force</i> for <b>acceleration</b> . | 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 tick (✓) 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  | lithium ion battery / unit needs to be replaced ✓<br>to enable maintenance / repair / servicing / testing ✓   | <i>Award [1] for stating a reason why the Tesla Powerwall needs to be easily accessible.</i>  | <b>1 max</b> |
|          |   | ii | uses solar energy ✓<br>which is a renewable / infinite resource / minimises energy derived from fossil fuels ✓<br><br>reduces the use of non-rechargeable batteries ✓<br>which lowers the impact on landfill / toxins in the environment ✓<br><br>adaptable / makes use of existing infrastructure ✓<br>as it connects to national grid ✓ | <i>Award [1] for identifying a reason why the Powerwall may be seen as an example of eco-design and [1] for a brief explanation.</i><br><br><i>Do not accept any answers in relation to cost or general terms such as environmentally/eco-friendly or green design.</i> | <b>2 max</b> |
|          | b | i  | renewable resources will not run out / can be replenished within a reasonable timeframe / are infinite ✓<br>non-renewable resources will run out / cannot be replenished as they do not re-form at a rate that makes its use sustainable / are finite ✓   | <i>Award [1] for identifying each difference between renewable and non-renewable energy up to [2].</i>  | <b>2</b>     |
|          |   | ii | the battery's life will decrease over time ✓<br>due to degradation occurring through discharge / repeated charging cycles ✓<br><br>the location of the battery in direct sunlight / exposed to high temperatures ✓<br>may lead to increased rates of thermal degradation ✓  | <i>Award [1] for identifying a reason why the efficiency of a lithium ion battery will not remain at 92% and [1] for a brief explanation.</i>   | <b>2 max</b> |
|          | c | i  | 2760Kw x 0.30cents = \$828 saved per year ✓<br>\$4000/828 = 4.83 years / 4 years 10 months / 57.97 months (accept 58 months / 4.8 years) ✓  | <i>Award [1] for the correct answer.</i><br><br><i>Award [1] for showing the working out.</i>   | <b>2</b>     |
|          |   | ii | technology has become more available / reliable / cheaper / feasible ✓<br>the market becomes more eco-conscious / demands a more environmental approach ✓<br>therefore, the market will adopt it / see it as worthwhile/ more economical ✓  | <i>Award [1] for each of three distinct points in an explanation of the influence of technology push and market pull in the development of the Powerwall.</i>   | <b>3 max</b> |

| Question |          | Answers   | Notes  | Total   |              |
|----------|----------|-----------|--|---|--------------|
|          | <b>d</b> | <b>i</b>  | act of insight ✓<br>chance ✓   | <i>Award [1] for listing the strategy of innovation for the safety pin.</i>   | <b>1 max</b> |
|          |          | <b>ii</b> | the term of the patent has expired ✓<br>patents only last for a designated period of time ✓<br><br>patents not valid globally ✓<br>others could take advantage of the patent ✓<br><br>patents have a limited lifespan ✓<br>which allows others to imitate the design ✓   | <i>Award [1] for identifying a reason why there is no longer a patent on the safety pin and [1] for a brief explanation.</i>                  | <b>2 max</b> |
|          | <b>e</b> | <b>i</b>  | the grain size of metals is determined by selective heating / cooling of the metal ✓<br>which can affect properties including density / tensile strength / malleability / flexibility / hardness / toughness / ductility ✓<br><br>the smaller the grain size, the stronger the material ✓<br>at higher temperatures, the metal produces larger grains / returns to a weaker / more ductile state ✓ | <i>Award [1] for identifying a reason why the grain size affects the properties of the safety pin and [1] for a brief explanation.</i>        | <b>2 max</b> |
|          |          | <b>ii</b> | hardening and tempering are processes used to control the grain size / properties of a metal ✓<br>hardening ensures the shape of the head and the sharpness of the point can withstand constant use / wear and tear ✓<br>tempering is a heat treatment that allows the pin to flex and return to its original shape ✓  | <i>Award [1] for each of three distinct points in an explanation of benefits of hardening and tempering in the production of safety pins.</i> | <b>3</b>     |

| Question |   |    | Answers   | Notes  | Total |
|----------|---|----|---|--|-------|
| 2        | a | i  | <p>toughened glass is selectively heat treated ✓<br/>so therefore designed to not crack or break easily ✓</p> <p>toughened glass is designed to shatter into small granular pieces / not into shards ✓<br/>which will not cause injury if glass breaks / making it safer ✓</p> <p>pool balls are heavy / hard ✓<br/>which requires toughened glass to withstand impact of the balls (bouncing) during play ✓</p>        | <p><i>Award [1] for identifying a reason why the pool table is made of toughened glass and [1] for a brief explanation.</i></p> <p><i>Accept the term 'tempered' in place of toughened.</i></p> <p><i>Do not award any marks for reference to the pool cue scratching the surface of the table, as the Vitrik acts as a surface layer.</i></p> | 2 max |
|          |   | ii | <p>aesthetics / transparency ✓<br/>the glass gives a unique / modern / attractive appearance ✓</p> <p>innovative / novel product ✓<br/>a unique marketing opportunity ✓</p> <p>easier to manufacture ✓<br/>glass is easy to cut / assemble ✓</p> <p>glass is readily available ✓<br/>making it easy to replace if damaged ✓</p> <p>may be lighter in weight than slate ✓<br/>making it easier to transport / move ✓</p> | <p><i>Award [1] for identifying a reason why the table is covered with glass rather than the traditional materials of slate covered by blue material and [1] for a brief explanation.</i></p>  | 2 max |
| 3        |   |    | <p>test comfort / feel / size / shape / grip / positions of buttons ✓<br/>to collect data / get feedback from potential range of users ✓<br/>which helps with modifying / developing the shape / improve the ergonomics ✓</p>   | <p><i>Award [1] for each of three distinct points in an explanation of why physical modelling is used to test the ergonomic characteristics of the Xbox 360 controller.</i></p>  | 3     |

| Question | Answers   | Notes  | Total |
|----------|---|--|-------|
| 4        | cradle to cradle builds in recyclability (do not accept recycle or reuse) ✓<br>to reduce waste to landfill ✓<br>providing a more environmentally friendly / sustainable approach ✓<br><br>cradle to cradle encourages waste elimination / is a circular strategy (made to be made again) ✓<br>cradle to grave considers the environmental effects of a product from pre-production to disposal / is a linear strategy ✓<br>cradle to cradle reduces the impact on resources / environment ✓ | Award [1] for each of three distinct points in an explanation of the advantage of cradle to cradle philosophy over a cradle to grave philosophy. | 3 max |

**Section B**

| Question |   | Answers  | Notes   | Total |
|----------|---|--|---|-------|
| 5        | a | <p>cost effective for the manufacturer ✓<br/>                     having a wider range of sizes would increase manufacturing costs / smaller range of sizes would decrease manufacturing costs ✓</p> <p>the three sizes cater to the population from the 5<sup>th</sup> – 95<sup>th</sup> percentile / a wide range of users ✓<br/>                     to provide the consumer with best fit / size ✓</p>   | <p><i>Award [1] for identifying a reason why the Ray Ban Aviator sunglasses are only sold in three sizes and [1] for a brief explanation.</i></p>   | 2 max |
|          | b | <p>adaptation is the transfer of an idea / concept from one context to another ✓<br/>                     the issue of sun glare / eye damage was identified (by the pilot) ✓<br/>                     and the idea was transferred from the field of photography to aviation ✓</p>  | <p><i>Award [1] for each of three distinct points in an explanation of why the Ray Ban Aviator sunglasses may be seen as an example of adaptation.</i></p>  | 3 max |
|          | c | <p><i>Form:</i><br/>                     lenses cover an area much larger than the eyes ✓<br/>                     lenses are slightly convex ✓<br/>                     frames encircle the distinctive teardrop shape ✓<br/>                     frames lightweight / minimalist appearance achieved by the form ✓<br/>                     glasses act as a fashion statement / stylish eyewear ✓<br/>                     glasses are easily recognizable ✓<br/>                     [3 max]</p> <p><i>Function:</i><br/>                     curved / tinted lens shields eyes from bright light / reduces glare ✓<br/>                     flexible temples hook comfortably behind the ears / enhance grip ✓<br/>                     hinged arms to fit in a case ✓<br/>                     adjustable nose pads for comfort ✓<br/>                     ergonomic bridge to fit on the user's nose ✓<br/>                     [3 max]</p> | <p><i>Award [1] for each of six distinct points in an explanation of the balance between form and function in the design of the Ray Ban Aviator sunglasses.</i></p> <p><i>[3 max for each].</i></p> | 6 max |

| Question        | Answers   | Notes  | Total               |
|-----------------|---|--|---------------------|
| <p><b>d</b></p> | <p>timeless appeal ✓<br/>                     the product has been around a long time ✓<br/>                     still popular / is a standard product of its time ✓</p> <p>dominant design ✓<br/>                     the sunglasses form and function became the accepted market standard ✓<br/>                     they meet the needs of different types of user ✓</p> <p>status / culture ✓<br/>                     highly regarded celebrities / public figures are seen using the product ✓<br/>                     giving it iconic status ✓</p> <p>defies obsolescence ✓<br/>                     continued demand is not dependent on marketing ✓<br/>                     new generation of users are attracted to the original product ✓</p> <p>ubiquity / omnipresence ✓<br/>                     has a constant presence in the marketplace ✓<br/>                     and are widely globally available ✓</p> <p>mass production ✓<br/>                     glasses are mass produced to meet demand ✓<br/>                     as the glasses have become very popular ✓</p> <p>widely imitated ✓<br/>                     has seen the introduction of numerous similar sunglasses ✓<br/>                     of cheaper / lower quality ✓</p> <p>image ✓<br/>                     the product creates an emotional / nostalgic response ✓<br/>                     and is instantly recognisable ✓</p> | <p><i>Award [1] for each of three distinct points in an explanation of why the Ray Ban Aviator sunglasses may be considered as a design classic.</i></p> <p><i>[3 max] for each separate and distinct explanation.</i></p> | <p><b>9 max</b></p> |

| Question |   | Answers   | Notes  | Total |
|----------|---|---|--|-------|
| 6        | a | Starck was not looking for a particular source of inspiration at the moment / did not set out to design a lemon squeezer ✓<br>but was inspired by a situation / context (eating squid / squeezing lemons)✓  | Award [1] for identifying a reason why the conceptual development of the Juicy Salif Citrus Squeezer may be considered as an act of insight and [1] for a brief explanation.                     | 2     |
|          | b | the design is unusual / interesting / quirky / unique ✓<br>as form is more important than function ✓<br>which may lead to greater adoption/diffusion into market ✓<br><br>observability refers to the extent that an innovation is visible to others ✓<br>through marketing / advertising / people's homes / talk shows / stores ✓<br>if a product is visible to more people it would have a better chance of becoming successful ✓   | Award [1] for each of three distinct points in an explanation of why Roger's characteristic of observability would be most important in the commercial success of the product.                   | 3 max |
|          | c | <i>Practical functions:</i><br>it does not include the features of other juicers ✓<br>there is no spout / container to catch the juice / strainer for the seeds / pith / pulp ✓<br>three long legs extend downwards leaving space for small container ✓<br>easy to clean ✓<br>focus is on aesthetics not function ✓<br><b>[3 max]</b><br><br><i>Psychological factors:</i><br>more expressive/ornamental than functional ✓<br>formed as one part, giving it an elegant shape / form ✓<br>is a good conversation starter ✓<br>the design triggers an emotional response ✓<br>the shape of the product indicates how it is used ✓<br><b>[3 max]</b> | Award [1] for each of six distinct points in a discussion of the design of the Juicy Salif Citrus Squeezer in relation to practical function and psychological factors.<br><br>[3 max for each]. | 6 max |

| Question        | Answers   | Notes  | Total               |
|-----------------|---|--|---------------------|
| <p><b>d</b></p> | <p>quality of the finish ✓<br/>                     with minimum finishing operations ✓<br/>                     good dimensional accuracy / consistent surface finish ✓</p> <p>form ✓<br/>                     casting is capable of producing intricate / complex shapes ✓<br/>                     and can be used to produce large parts ✓</p> <p>ease of manufacture ✓<br/>                     cast from a single piece ✓<br/>                     does not require any joining / assembly ✓</p> <p>cost effectiveness ✓<br/>                     casting is a suitable method for mass production ✓<br/>                     high production rate provides economy of scale ✓</p> <p>reduction of waste ✓<br/>                     through efficient use of materials ✓<br/>                     as excess metal / failed castings can be reused ✓</p> | <p><i>Award [1] for each of three distinct points in an explanation of why casting is used to produce the Juicy Salif Citrus Squeezer.</i></p> <p><i>[3 max] for each separate and distinct explanation.</i></p> | <p><b>9 max</b></p> |

| Question |   | Answers   | Notes  | Total        |
|----------|---|---|--|--------------|
| 7        | a | the components are easy to identify ✓<br>easy to access to components and parts ✓<br>the design helps facilitate recycling ✓<br>the stool is comprised of only a few parts / components ✓<br>the design allows components to be re-used ✓<br>screws are a non-permanent / temporary joining technique ✓   | <i>Award [1] for each way that the principle of Design for disassembly influences the design development is listed up to a maximum of [2].</i>               | <b>2 max</b> |
|          | b | the rod/bar is under tensile and compressive forces ✓<br>the rod/bar gives the stool stability ✓<br>preventing the base of the stool from separating / splaying ✓<br><br>the user sitting on the stool will apply force / weight to it ✓<br>the thickness / material / shape of the rod/bar will resist deformation under stress ✓<br>making it safer to sit on ✓ | <i>Award [1] for each of three distinct points in an explanation of why the concept of stress is relevant to the design development of the metallic bar.</i> | <b>3 max</b> |

| Question        | Answers   | Notes   | Total               |
|-----------------|---|---|---------------------|
| <p><b>c</b></p> | <p><i>Anthropometric factors:</i><br/>                     data on size and weight of people would need to be considered ✓<br/>                     although the stool only comes in one size ✓<br/>                     the stool would take into account the 50th percentile of size and weight of adults ✓<br/>                     size of posterior / leg length necessary to determine comfort ✓<br/>                     most people are able to use it ✓<br/>                     the highest and the lowest percentiles would have difficulty using it because it is not adjustable ✓<br/> <b>[3 max]</b></p> <p><i>Physiological factors:</i><br/>                     likely to be uncomfortable / cause fatigue if used for long periods of time ✓<br/>                     biomechanical forces are required to assemble the chair (tightening the screws) ✓<br/>                     the shape fits the human body while the user is seated ✓<br/>                     risk of injury, as the stool may not support the weight of heavy users ✓<br/> <b>[3 max]</b></p> | <p><i>Award [1] for each of six distinct points in a discussion of the design of the Butterfly Stool in relation to anthropometric and psychological factors.</i></p> <p><i>[3 max for each].</i></p> | <p><b>6 max</b></p> |

| Question        | Answers   | Notes  | Total               |
|-----------------|---|--|---------------------|
| <p><b>d</b></p> | <p>flexibility ✓<br/>                     ability to be formed into a complex / sculptural shape ✓<br/>                     using forming / lamination as a manufacturing process ✓</p> <p>high strength to weight ratio ✓<br/>                     plywood has alternating grain / good dimensional stability / mechanical properties ✓<br/>                     which provides high tensile / compressive strength ✓</p> <p>aesthetics / finishes ✓<br/>                     plywood can be laminated with a variety of different veneers ✓<br/>                     to provide a choice for consumers/ can be placed in different settings ✓</p> <p>resistance to damp environments ✓<br/>                     minimises warping / maintains its shape ✓<br/>                     making the stool more durable / long lasting ✓</p> | <p><i>Award [1] for each of three distinct points in an explanation of the characteristics of plywood that are important in the design of the butterfly stool.</i></p> <p><i>[3 max] for each separate and distinct explanation.</i></p> | <p><b>9 max</b></p> |