M11/4/DESTE/HP2/ENG/TZ0/XX/M

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MARKSCHEME

May 2011

DESIGN TECHNOLOGY

Higher Level

Paper 2

15 pages

If you do not have a copy of the current Design Technology Guide, please request one from IB Cardiff.

General Marking Instructions

Assistant Examiners (AEs) will be contacted by their team leader (TL) by e-mail (or telephone) – if by e-mail, please reply to confirm that you have downloaded the markscheme from IBIS. The purpose of this initial contact is to allow AEs to raise any queries they have regarding the markscheme and its interpretation. AEs should contact their team leader by e-mail at any time if they have any problems/queries during the marking process.

Note:

The DHL courier service must be used to send assessment material to your team leader/senior moderator and to IB Cardiff. (However, this service is not available in every country.) The cost is met directly by the IB. It is vitally important that the correct DHL account number is used.

If you have any queries on **administration** please contact:

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1. Follow the markscheme provided, award only whole marks and mark only in **RED**.

2. 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.**

3. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases write a brief annotation to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking. It should be remembered that the script may be returned to the candidate.

4. Unexplained symbols or personal codes/notations are unacceptable.

5. Record marks in the right-hand margin. For Section A this should be against each mark allocation shown in square brackets *e.g.* ***[2]***. The total mark for a question must equal the number of ticks for the question.

6. Do **not** circle sub-totals. **Circle the total mark** for the question in the right-hand margin **at the end of the question.**

7. Where an answer to a part question is worth no marks, put a zero in the right-hand margin next to the square bracket.

8. Where work is submitted on additional sheets the marks awarded should be shown as ticks and a note made on both the additional sheet and in the right-hand margin of the corresponding question part in the body of the script to transfer these marks to that question part in the script.

9. Section A: Add together the total for each question and write it in the Examiner column on the cover sheet.
Section B: Insert the total for each question in the Examiner column on the cover sheet.
Total: Add up the marks awarded and enter this in the box marked TOTAL in the Examiner column on the cover sheet.

10. After entering the marks on the cover sheet check your addition to ensure that you have not made an error. Check also that you have transferred the marks correctly to the cover sheet. **All scripts are checked and a note of all clerical errors will be given in feedback to examiners.**

11. If an answer extends over more than one page and no marks have been awarded on a section draw a diagonal line through that section to indicate that it has been marked.

12. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers and use the marks of those answers that have the highest mark, **even if the candidate has indicated the question(s) to be marked on the cover sheet**.

13. A mark should not be awarded where there is contradiction within an answer. Make a comment to this effect in the left-hand margin.

Subject Details: Design Technology HL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A (total 40 marks) **ONE** question in Section B [20 marks]. Maximum total = 60 marks.

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.

2. Each marking point has a separate line and the end is signified by means of a semicolon (;).

3. An alternative answer or wording is indicated in the markscheme by a slash (/) – either wording can be accepted.

4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.

5. Words that are underlined are essential for the mark.

6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

7. 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 markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing ***OWTTE*** (or words to that effect).

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

9. 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. Indicate this with **ECF** (error carried forward).

10. Only consider units at the end of a calculation. Unless directed otherwise in the mark scheme, unit errors should only be penalized once in the paper. Indicate this by writing **–1(U)** at the first point it occurs and **U** on the cover page.

11. Do not penalise candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

SECTION A

1. (a) (i) *Award **[1]** for stating the major fuel used in electricity production in the US.*
coal; ***[1]***

(ii) *Award **[1]** for stating one factor which will determine the actual range of the Segway® Personal Transporter once fully charged **[1 max]**.*
load/weight of person riding;
style of riding;
terrain;
incline/whether uphill, downhill or on the level; ***[1 max]***

(iii) *Award **[1]** for identifying one way in which the design of an off road model of the Segway® Personal Transporter would differ from the basic model shown in Figure 1 and **[1]** for a brief explanation **[2 max]**.*
the tyres/build quality would be more sturdy;
to enable the Segway® to travel easily over uneven ground;

better suspension;
to enable a more comfortable ride over uneven ground; ***[2 max]***

(b) (i) *Award **[1]** for each point in a brief explanation of why the Segway® Personal Transporter does not produce carbon dioxide emissions during use but is quoted as creating 0.704 kg of CO_2 per recharge, i.e. per 20 km **[2 max]**.*
electricity production includes burning of coal and other fossil fuels;
thus electricity usage by the Segway® involves carbon dioxide production; ***[2]***

(ii) This question has been removed and no marks should be awarded.

(c) (i) *Award **[1]** for stating one dimension of the Segway® Personal Transporter which is adjustable for different users.*
height of handlebar; ***[1]***

(ii) *Award **[1]** for each of three correct distinct points in an explanation of the percentile range that the Segway® Personal Transporter would be designed for **[3 max]**.*
5^{th} to 95^{th} for height for adult users;
most people will fall into this range;
designing for a wider range would be uneconomical; ***[3]***

(d) (i) *Award **[1]** for stating the type of evaluation shown in Figure 4.*
performance/impact test; ***[1]***

(ii) *Award **[1]** for each distinct correct point in an explanation of why user trials are not used to evaluate the protective head gear **[3 max]**.*
safety;
user trials would cause harm to humans;
and the data would be qualitative not quantitative; ***[3]***

(e) (i) *Award **[1]** for identifying one reason for using test headforms of different weights and **[1]** for a brief explanation **[2 max]**.*
to represent different head sizes/weights;
in order to be more representative of the user population/percentile range; ***[2]***

(ii) *Award **[1]** for identifying one reason why different anvil shapes are used to test the head gear and **[1]** for a brief explanation **[2 max]**.*
different anvil shapes are used to represent different shaped hazards;
e.g. kerbstones; ***[2]***

2. (a) *Award **[1]** for each point in an explanation of one way in which Dyson's Ball-barrow is an example of constructive discontent **[2 max]**.*
Dyson identified problems associated with the traditional wheelbarrow;
he then worked to develop a design which would overcome the problems; ***[2]***

(b) *Award **[1]** for identifying one way in which Dyson might have worked with users to develop a clear understanding of problems experienced with the traditional wheelbarrow and **[1]** for a brief explanation **[2 max]**.*
user trial;
observed how the wheel barrow was used;

user research;
obtained users'responses/interview/questionnaire/survey; ***[2 max]***

3. (a) *Award **[1]** for each of two distinct correct points in a description of the process of filament winding **[2 max]**.*
fibre is impregnated with resin and passed between two rotating discs;
the chair would then be cured in an oven to toughen the fibres; ***[2]***

(b) *Award **[1]** for stating one advantage of producing the chair using filament winding and **[1]** for a brief explanation **[2 max]**.*
hollow fibres/less material/cheaper;
high strength to weight ratio/light and strong;
suitable for a wide range of shapes/forms;
no fixtures/fittings; ***[2 max]***

4. (a) *Award **[1]** for stating the process which would be used for the production of PET water bottles from the preforms **[1 max]**.*
blow moulding; ***[1]***

(b) *Award **[1]** for each of three distinct points in a discussion of one advantage of purchasing standard preforms and caps for the production of PET water bottles for the manufacturer **[3 max]**.*
reduces the need for two lots of equipment/tooling;
preforms and caps are made by injection moulding;
makes the process cheaper and more cost-effective;

water bottles often have distinctive shapes as part of their branding;
the preforms can be made into specific shapes according to the customer's requirements at the bottling site;
reduces storage space required; ***[3 max]***

5. (a) *Award **[1]** for identifying the corporate strategy adopted by the Powertraveller company and **[1]** for a brief explanation **[2 max]**.*
pioneering strategy;
the Powertraveller company were the first to introduce a product of this type; ***[2]***

(b) *Award **[1]** for each point in an outline of one way in which the Minigorilla can be seen as an example of a product which can be sold globally **[2 max]**.*
the Minigorilla is designed to be used globally;
it comes complete with interchangeable plugs to operate on different power supply systems; ***[2 max]***

6. (a) *Award **[1]** for each of two distinct correct points in a description of a superalloy **[2 max]**.*
metallic alloys often based in iron, cobalt or nickel;
that can be used in excess of 0.7 of their melting point/can resist high temperatures; ***[2]***

(b) *Award **[1]** for change one reason why nickel-based superalloys are appropriate materials for application in aircraft engines **[2 max]**.*
most metals decrease in strength as temperature increases;
nickel based alloys maintain good strength even at high temperatures;

aircraft engines get very hot;
superalloys have very high melting points; ***[2 max]***

SECTION B

7. (a) (i) *Award **[1]** for each of two distinct correct points in a description of the process of high-pressure die casting **[2 max]**.*
molten metal is forced under pressure into a (lubricated) mould;
and the pressure is maintained until the casting has solidified;
the scrap (gate, runners, sprues and flash) is separated from the casting; ***[2 max]***

(ii) *Award **[1]** for outlining an advantage of producing the metal frame using high-pressure die casting and **[1]** for a brief explanation **[2 max]**.*
high accuracy/dimensional consistency;
good standard of repeatability;

good surface finish/little finishing required;
smooth surfaces can be achieved;

high rate of production;
there can be multiple castings in a die;

good where fine detail is required;
enables the production of thin-walled sections;

can produce parts with low tolerances;
die fills before any solidification takes place; ***[2 max]***

(b) (i) *Award **[1]** for each of two distinct correct points in a description of the term factor of safety **[2 max]**.*
design load;
divided by the normal maximum expected value;

a structure/product is designed to withstand loads higher than normally expected;
to increase safety/cope with the unexpected; ***[2 max]***

(ii) *Award **[1]** for each of three distinct correct points in an explanation of why the Tandem Sling Chair would be designed to have a high factor of safety **[3 max]**.*
difficult to predict how the chair might be used and abused in a public area;
although it might be expected that one person would sit on one chair but when busy people might sit on each other's knees/people put luggage on chairs;
it is important that the structure does not fail as this might cause injury/people might sue airport; ***[3]***

(c) (i) *Award **[1]** for each point in an outline of one way in which consumer feedback could be collected to inform the development of the design **[2 max]**.*
user trial/field trial;
let people use it and see how they react to the design; ***[2]***

(ii) *Award **[1]** for each of three distinct correct points in an explanation of how the designers have met three potentially conflicting aspects of the specification for the Tandem Sling Chair: security; aesthetics; ease of maintenance **[3 max]** per aspect **[9 max]**.*
security:
easy for security people to inspect chair system;
difficult to conceal any bombs or other terrorist devices in the chair and would be easily spotted;
they would fall through the hole at the back;

aesthetics:
minimalist design/contemporary style;
black upholstery and metallic frame looks sophisticated;
look good individually and as a chair system in the airport;

neutral colours;
will not clash with other colours;
in the airport environment;

ease of maintenance:
upholstery is made of tough material;
will not crack easily;
durable;

aluminium does not rust/corrode;
surface remains easy to maintain;
looks good for a long period of time;

material is impervious to liquids so spilt drinks would not soak into the material;
the slight angle and the space at the back of the chair means any liquid would run off the seat down the back;
can be wiped over to keep clean; ***[9 max]***

8. (a) (i) *Award **[1]** for each point in an outline of one limitation of the use of solar and wind energy as alternatives for fossil fuels **[2 max]**.*
high set-up costs;
both solar/wind energy require expensive systems for energy generation and exploitation;

unreliable supply/lack of continuity of supply;
in many parts of the world Sun/wind does not shine/blow 24/7;

low energy density/produces low levels of energy;
the amount of energy produced may be too low for many applications; ***[2 max]***

(ii) *Award **[1]** for each of three distinct correct points in an explanation of how solar power is harnessed by the photovoltaic panel **[3 max]**.*
light falls on panel which contains photosensitive material (silicon);
electrons are excited by the light energy;
flow of electrons through circuits powers electrical products;

panel contains photosensitive material;
which absorbs energy from light;
and converts it into electrical energy; ***[3 max]***

(b) (i) *Award **[1]** for each point in an outline of one reason why thermal conductivity is an important consideration in the design of the building envelope **[2 max]**.*
thermal conductivity is a measure of how well a material conducts heat;
heat/gain loss is an important consideration in the design of a building; ***[2]***

(ii) *Award **[1]** for each of two distinct correct points in a description of how a designer can modify the heat lost or gained through the building envelope **[2 max]**.*
by selecting materials with different U values;
the designer can determine the heat loss or gain through the building envelope; ***[2]***

(c) (i) *Award **[1]** for each point in an outline of one reason why an active solar water heating system might be installed alongside the photovoltaic system shown in Figure 14 and **[1]** for a brief explanation **[2 max]**.*
electrical water heating consumes a large amount of energy;
the solar power system may need to be very large to supply sufficient energy;

active solar water systems are very efficient;
this would reduce the requirements on the photovoltaic system; ***[2 max]***

(ii) *Award **[1]** for each distinct correct point in an explanation of each of three ways in which buildings can be designed to reduce energy consumption **[3 max]** per way **[9 max]**.*
elongation of the east-west axis of the building;
this maximizes the area of the building exposed to the Sun during the day;
this can maximize heat and light gain in a building and so reduce energy consumption;

position the interior spaces requiring the most heat and light towards the Sun;
some areas do not require heating, *e.g.* storage areas;
putting these on the sides of the building away from the Sun reduces energy consumption;

use of thermal mass;
this can heat up during the day when the Sun shines;
it can release its heat in the night to reduce the need for space heating;

appropriate ventilation;
achieves appropriate air change requisite for comfort;
can reduce need for air conditioning;

window placement;
can ensure appropriate heat gain/loss from the building;
use of natural lighting instead of artificial lighting during the day reduces energy consumption;

landscaping;
can be used to shade the building in summer;
deciduous trees lose their leaves and can allow the Sun to shine on the building in the winter and increase solar heat gain reducing energy consumption for space heating;

roof overhangs;
shade south facing windows in high summer;
reduce solar heat gain and therefore need for cooling/air conditioning;

use materials with low thermal conductivity;
which will help to insulate the building;
and prevent heat loss; ***[9 max]***

9. (a) (i) *Award **[1]** for identifying the class of lever and **[1]** for a brief explanation **[2 max]**.*
first class lever;
effort – fulcrum – load; ***[2]***

(ii) *Award **[1]** for each step in a calculation of the force to be applied to the end of each wing of the corkscrew shown in Figure 15 to lift the cork out of the bottle **[3 max]**.*

two arms so divide by 2 for each arm, *i.e.* $\frac{360}{2} = 180 \text{ N}$;

$\text{force}_1 \times \text{distance}_1 = \text{force}_2 \times \text{distance}_2$, $180 \times 15 = \text{force}_2 \times 90$;

$\text{force}_2 = 30 \text{ N}$; ***[3 max]***

(b) (i) *Award **[1]** for each of two distinct correct points in a description of how design costs would contribute to the final cost of the Alessi Anna G corkscrew **[2 max]**.*

design costs are part of the fixed costs;
they have to be recovered before there is any return on the investment; ***[2]***

(ii) *Award **[1]** for each of two distinct correct points in a description of how the concept of break-even relates to the production of the Alessi Anna G corkscrew*
***[2 max]**.*

manufacturer decides how many corkscrews will be produced to cover the fixed costs;
a proportion of the fixed cost is included in the price of each corkscrew, no profit until fixed costs are covered; ***[2]***

(c) (i) *Award **[1]** for identifying each of two distinct correct points in how Alessandro Mendini has managed to balance form with function in the design of the Alessi Anna G corkscrew **[2 max]**.*

the wings of the corkscrew are like the arms of a girl;
the tab to wind the worm into the cork is like the head;

the form of the corkscrew is based on the shape of a girl/female;
the corkscrew functions like a conventional corkscrew/double winged lever design; ***[2 max]***

(ii) *Award **[1]** for each of three distinct correct points in a discussion of how consumers might use product image, performance and durability at different stages in the product lifecycle to evaluate the Alessi Anna G corkscrew **[3 max]** per stage **[9 max]**.*

product image:
particularly important before purchase of the corkscrew when shopping around;
the Alessi Anna G corkscrew is an extremely attractive aesthetically pleasing item and in much demand;
the consumer is likely to balance product price against product image to evaluate value for money;

performance:
this is particularly important at the point of purchase and immediately afterwards;
the product must perform well to be identified as good value for money and for the consumer to be satisfied;
if the consumer is disappointed early on then he/she is likely to return the corkscrew to the retailer and demand his/her money back;

durability:
the durability will determine how long the corkscrew will last;
if the durability is low then the consumer will be disappointed;
high durability will mean that the corkscrew is good for long-term use; ***[9 max]***