



MARKSCHEME

NOVEMBER 2011

DESIGN TECHNOLOGY

Higher Level

Paper 3

24 pages

*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 IB Cardiff.*

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

Subject Details: Design Technology HL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **ONE** of the Options [**1 × 40 marks**].

Maximum total = [**40 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 shown 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 **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. When marking, indicate this by adding **ECF** (error carried forward) on the script.
10. Do not penalize candidates for errors in units or significant figures, unless it is specifically referred to in the markscheme.

Option A — Food science and technology

A1. (a) Award [1] for stating one benefit of canning peaches.
longer lasting; [1]

(b) Award [1] for each point in a list of two ways in which a consumer would decide that the fresh peach is suitable for purchase [2 max].
smells fresh;
no physical damage;
good colour;
firm/not too hard or too soft;
no microbial growth; [2 max]

(c) Award [1] for a comparison of fresh and canned peaches in relation to one organoleptic property [3 max].

Property	Fresh peaches	Tinned peaches	
Texture;	Fibrous;	Soft/lacking texture;	
Taste;	Sharp/fresh;	Sweet/syrupy;	
Colour;	Varied/red/orange /yellow/white;	Uniform yellow/orange;	
Smell;	Fresh/fruity smell;	Sugary smell;	[3 max]

A2. (a) Award [1] for stating the temperature above which bacteria are killed.
63°C; [1]

(b) Award [1] for identifying one reason why frozen chicken should be thawed before cooking and [1] for a brief explanation [2 max].
frozen chicken may be contaminated with food poisoning bacteria, e.g. salmonella;
the centre temperature of a frozen chicken may not get high enough to kill the bacteria during cooking; [2]

A3. (a) Award [1] for identifying one lifestyle factor which has led to the increased consumption of ready meals and [1] for a brief explanation [2 max].

loss of cooking skills;
many (young) people in developed countries do not have cooking skills;

working women;
women traditionally cook food and if working are less able to do so;

single occupancy households;
not worth cooking for one person;

convenience/time;
busy people want to have tasty meals with minimum fuss;

reduction of set family meal times;
erosion of family values in the western world;

pace of life;
fast food fits into a fast lifestyle;

[2 max]

(b) Award [1] for each of two distinct correct points in a description of the role of market testing in the development of food products such as the chicken tikka masala ready meal [2 max].

to ensure that the food product meets the needs of its target market;
appropriate flavour and texture characteristics (level of spiciness, etc.);

to gain feedback from the target market;
in order to decide whether to make any changes to the design of the product;

[2 max]

A4. Award [1] for each of three distinct correct points in an explanation of each of two distinct reasons why farmers' markets have become popular in urban areas in many countries [3 max] per issue [6 max].

provenance / knowing where food has come from is increasingly important to consumers;

food scares have contributed to people being wary of supermarket and mass produced foods;

buying food at farmers' markets promotes consumer confidence;

sustainability;

farmers' markets enable farmers to command a larger share of the food dollar and make their farms more sustainable;

farmers will get less for their products if they sell food to supermarkets and food wholesalers than if they sell directly to consumers;

economic reasons;

food will be cheaper and fresher at farmers' markets than in supermarkets;

this is good for consumers;

[6 max]

- A5.** (a) *Award [1] for outlining one way in which climate can contribute to food insecurity [2 max].*
extreme weather conditions (drought, flooding, climate change);
affects the supply/availability of food; [2]
- (b) *Award [1] for outlining one reason why local strategies are important in combating food insecurity [2 max].*
ownership/empowerment by communities;
strategies will be more sustainable; [2]
- (c) *Award [1] for each point in an outline of one advantage of international strategies in combating food insecurity [2 max].*
scale;
larger impact;

sustainability;
international agreements/political support for the strategies;

response times;
airlifting in supplies (UN, Christian Aid etc);

publicity;
creates public awareness of food insecurity issues/creates wider support; [2 max]

A6. (a) *Award [1] for each of three distinct correct points in an explanation of why producers would be reluctant to label genetically-modified crops [3 max].*

many people will not purchase GM products knowingly;
thus the value of the product is reduced;
economic viability of crop destroyed;

image;
in some countries GM crops have a poor image;
because of media representation/scaremongering;

[3 max]

(b) *Award [1] for each of three distinct correct points in a discussion of an issue concerning GM crops as an inappropriate technology for a developing country [3 max].*

GM seeds are more expensive than normal seeds;
if a farmer uses GM seed he cannot harvest the seed to sow the following year under the conditions of the license;
he ties himself into a cycle of having to continuously pay for seed for the following year;

GM technology itself does not create jobs using local skills and labour;
farming jobs may remain the same or may even be reduced;
GM crops are often developed to make farming less labour-intensive;

GM technology is not understood by the people who use it;
GM technology is complex technology;
where education levels are low it is unlikely to be understood by the people who use it;

GM crops may be detrimental to quality of life;
there are concerns about the appropriateness of GM crops and their impact on humans in the longer term;
until longer term research has been conducted it is probably unethical to use them in developing countries;

could be detrimental to the environment;
there are concerns about gene transfer to other species and the implications of these;
many GM crops are about resistance to pesticides and if gene transfer were to occur then the “weeds” to which transfer takes place would be resistant to pesticides which could prove problematic;

[3 max]

A7. *Award [1] for each of three distinct points in an explanation of each of three ways in which controls are used in food manufacturing to ensure the quality of a food product [3 max] for each factor, [9 max].*

specifying the quality of raw material inputs;
monitoring the quality of ingredients;
provides a consistent starting point for food processing;

monitoring of equipment/machinery;
times/temperatures of processing;
contribute to consistent product quality;

monitoring of product quality;
visual quality checks / taste panels;
ensure product meets specification;

standardisation/brand identity;
high volume product;
want to ensure consistent quality of product;

legislation;
different food legislation in different countries;
needs to meet the strictest legislation to be sold in every country;

due diligence;
pick up any faults with the product;
avoid a food scare;

staff training;
ensure good hygiene;
prevent contamination of food;

maintenance/cleaning;
equipment needs regular maintenance/cleaning;
to prevent contamination of food;

[9 max]

Option B — Electronic product design

- B1.** (a) Award [1] for stating the operational amplifier's function.
comparator; [1]
- (b) Award [1] for the correct value for R2 and [1] for the correct value for R3.
R2 = 10 kΩ;
R3 = 20 kΩ; [2]
- (c) Award [1] per correct row of voltages.

Voltage of battery to be tested	Voltage at X	Voltage at Y
less than 6V	0V;	0V;
between 6 and 9V	0V;	12V;
more than 9V	12V;	12V;

[3 max]

- B2.** (a) Award [1] for stating one output device that could be used in a home security system.
(strobe) light;
bell;
buzzer;
siren;
auto-dial security service; [1 max]
- (b) Award [1] for stating an advantage of using video cameras as input devices for a home security system and [1] for an explanation.
video cameras can be placed in various key locations;
allowing real time observation to take place in one central location;

recordings can be stored digitally;
and reviewed when necessary;

remote access;
can monitor video feeds when away from the home; [2 max]

- B3.** (a) *Award [1] for stating the type of signal and [1] for an explanation of how the signal operates.*
a digital signal would be either on or off;
an analogue signal can be continuously varied;
this will give different values for different volume levels; [2]
- (b) *Award [1] for each point in an outline of one implication of using an open loop control system to amplify the audio signal.*
no feedback sensors to the input signal;
the volume level will not be automatically adjusted; [2 max]
- B4.** *Award [1] for each point in a discussion of the hearing abilities of the people whose audiograms are shown in Figures B3 and B4 [6 max].*
Figure B3 shows severe hearing loss;
pitch/loudness show high frequency losses;
only loud sounds/speech over 65dB at low frequencies and 80dB at higher frequency would be heard;
- Figure B4 shows normal hearing;
a normal range of sounds can be heard over 0dB;
as frequency or pitch increases hearing loss fluctuates only slightly; [6 max]
- B5.** (a) *Award [1] for each point in an outline of one way in which miniaturization of electronic components contributes to a green design corporate strategy [2 max].*
smaller components use less materials;
which helps to conserve resources; [2 max]
- (b) *Award [1] for each point in an outline of the concept of dematerialization [2 max].*
reduction in weight/reduction in the use of materials;
helps to conserve resources and reduces material for landfill; [2 max]
- (c) *Award [1] for listing an advantage to the consumer of purchasing a product that has been designed for ease of disassembly and [1] for an explanation of the advantage.*
extends product life;
as components can be repaired/upgraded/reassembled;
- consumer purchasing policy;
fits in with some consumers values/policy for purchasing products;
- makes it easier to disassemble and components can be separated;
to be recycled/disposed of responsibly/reused; [2 max]

- B6.** (a) *Award [1] for each correct distinct point in an explanation of how converging technologies can enhance communication.*
use of converging technologies requires a multidisciplinary approach;
the use of converging technologies offers opportunities to communicate in different ways;
using only one product instead of more than one product; [3]
- (b) *Award [1] for each correct distinct point in an explanation of how hearing impairment can be enhanced by means of converging technologies [3 max].*
converging biotechnology and nanotechnology;
to assist the hearing impaired through implants;
or regenerative biological replacements; [3]
- B7.** *Award [1] each for identifying implications of the adoption of generic standards in digital electronic products for the designer, manufacturer and consumer [3 max] for each.*
- designer:
need to know what the standards are and conform to them;
this imposes constraints on the designer;
however, designs which satisfy the generic standards will be appropriate for sale in the global marketplace;
- exploit existing generic data systems;
or develop new systems;
to increase the interoperability of different devices;
- manufacturer:
standardization of the electronic products/components;
improves cost-effectiveness of production;
reduction in product development times;
- reduction in the use of materials;
gain product loyalty;
reduction in R&D costs;
- consumer:
more consumer choice;
more competitive prices;
better value for money;
- enhanced functionality and interoperability of products;
no need to purchase separate components;
reducing cost by purchasing multifunctional products; [9 max]

Option C — CAD / CAM

- C1.** (a) *Award [1] for stating the type of CNC machine used to produce the prototype sign.* **[1]**
CNC Vinyl cutter/CNC Plotter Cutter;
- (b) *Award [1] for each of two distinct correct points in a description of how the CNC machine produces the sign [2 max].* **[2]**
instructions from CAD moves material through the machine on the y axis;
the cutter moves on x axis to cut the sign;
- (c) *Award [1] for identifying an appropriate issue faced by the manufacturer when choosing an appropriate machine to make the sign and [1] for each of two distinct correct points of discussion of the issue [3 max].*
type of sign/complexity of design;
number of colours required;
quality of finish required;
- size of the sign;
whether the manufacturer wants to invest in a large machine so different sizes can be produced;
or whether to choose a machine for one particular size; **[3 max]**
- C2.** (a) *Award [1] for stating one way in which CAM has reduced the use of natural resources.*
additive techniques for rapid prototyping/only the material which will be part of the final product is added;
nesting of parts on material;
less error/wasted parts; **[1 max]**
- (b) *Award [1] for identifying one reason why using a CNC machine is safe for a worker and [1] for a brief explanation [2 max].*
guard on machine;
worker is isolated;
- waste material is contained;
protects the eyes/respiration system of worker;
- automatic cut-off;
material/design defects not a problem; **[2 max]**

- C3.** (a) *Award [1] for an advantage of stereolithography for the production of a prototype for the designer and [1] for a brief explanation [2 max].*
prototype with a smooth surface;
fine detail;
- excellent visual prototype for photo-shoots;
market testing and giving feedback to client; **[2 max]**
- (b) *Award [1] for an advantage of stereolithography for the production of a prototype for the manufacturer and [1] for a brief explanation [2 max].*
low volume production of complex shapes;
cheap compared to other modeling techniques;
- accuracy;
means easy assembly of parts for modular product/identical products; **[2 max]**
- C4.** *Award [1] for each of three distinct correct points in a suitable discussion of two benefits for the manufacturer of using the CNC router to manufacture the flat pack furniture [3 max] for each benefit [6 max].*
to increase efficiency;
increasing speed of production;
removing human error / good quality control;
- perform complicated procedures;
by using a wide range of tooling;
such as to drill/slot/profile edges;
- suitable for large scale production;
cost-effective;
reduced labour costs; **[6 max]**

- C5. (a)** *Award [1] for identifying one way in which robots can be used in the assembly of cars and [1] for a brief explanation [2 max].*
AGV's;
to transport parts/tools around a factory;
- joining body parts;
welding/riveting/gluing;
- painting body;
consistency of finish / health and safety;
- for quality control;
identifies defects/tightens nuts to the correct torque; **[2 max]**
- (b)** *Award [1] for identifying a reason and [1] for a brief explanation of why robots work in teams when assembling cars [2 max].*
increase speed of production;
by completing a number of operations on the one part at the same time;
- where one is required to hold part in position;
while another one joins parts;
- due to limitations in movement of the robot arm;
unable to work on the top and bottom of a part; **[2 max]**
- (c)** *Award [1] for each of two ways in which robots help to conserve resources.*
less wasted material;
higher accuracy/more consistency;
reduced number of defective products; **[2 max]**
- C6. (a)** *Award [1] for each point in an explanation of one reason for creating a wax model when making the ring in Figure C4.*
modelling wax can be machined by CNC machine (router/mill/lathe);
the modelling wax outcome can be used to produce a master mould;
the ring can then be cast; **[3]**
- (b)** *Award [1] for each point in a comparison of the process of CAD/CAM and craft production to make the ring in relation to value for money for the consumer.*
if the ring is an individual/one-off design then craft production by a highly skilled craftsman might give the best value for money;
but if the ring is produced for selling to a large number of people/different people CAD/CAM is likely to be better value for money;
as the high set-up costs of the machinery would be offset by the volume of sales; **[3]**

C7. *Award [1] for each of three distinct points in a discussion of each of three advantages of using CAD when designing electronic product housing [9 max].*

complexity of the design;

intricate/very detailed product;

CAD allows designer to work on these details *i.e.* zoom in to design;

CAD modeling software;

2D modeling/3D modeling;

aesthetic models;

production drawings with dimensions/sectional views;

manufacturing;

can run a simulation of CAM;

capability of manufacture of the design by CAM;

checking assembly of parts;

FEA;

virtual test for strength/stiffness;

feedback for aspects of re-design;

[9 max]

Option D — Textiles

- D1.** (a) *Award [1] for one type of natural yarn suitable for making felt.*
wool/animal hair; [1]
- (b) *Award [1] for identifying the property of felt which makes it a suitable material for making a hat and [1] for a brief explanation.*
low thermal conductivity;
conserves heat well/insulates from cold air;
- low stiffness;
takes the shape of the head;
- low in density;
not too heavy to wear; [2 max]
- (c) *Award [1] for each distinct point in an explanation of one reason why felt is a suitable material for the volume production of hats.*
cost effective;
easy to cut/shape;
edges do not fray/no finish required;
- abundant material;
readily available throughout the world;
suitable for mechanization/automation;
- can be easily dyed;
to produce a wide range of colours;
increases market potential; [3 max]
- D2.** (a) *Award [1] for a correct economic reason why a multinational textile company might establish a manufacturing outlet in a developing country.*
cheap labour/low overheads; [1]
- (b) *Award [1] for a distinct point and [1] for brief explanation of one way in which a multinational company can satisfy social sustainability by establishing a manufacturing outlet in a developing country.*
employing local people;
which increases local wealth/supports economic development/alleviates poverty;
- skills development;
creates a skilled workforce to support entrepreneurship/other opportunities; [2 max]

- D3.** (a) *Award [1] for a point and [1] for a distinct clarification of the point stating the most suitable method of joining the strap to the body of the rucksack.*
sewing/stitched;
easy to attach/strong/easy to repair; [2]
- (b) *Award [1] for a mechanical property of nylon and [1] for a brief explanation of why it is suitable for the rucksack.*
good tensile strength;
product will be long lasting;

high toughness;
the fabric won't tear easily; [2 max]
- D4.** *Award [1] for each distinct implication of using laser image transfer technology to produce the black and white design and colour design t-shirts and [1] for each clarification [3 max] for each.*
cost;
larger image/more colours;
uses more ink;

time;
colour will take longer to print compared to the black and white;
less T-shirts per minute for volume production; [6]
- D5.** (a) *Award [1] for a characteristic and [1] for a brief explanation of the characteristic of cotton that make it suitable for recycling.*
made from fibres that can be separated;
and re-spun or formed; [2]
- (b) *Award [1] for one reason why the manufacture of cotton clothing can be wasteful and [1] for justification.*
manufacturing defects;
cause clothing to be rejected;

clothing produced by wasting process/technique of cutting;
creates remnants/off-cuts;

pattern matching/tessellation/orientation of fabric;
may not make optimal use of the cloth; [2 max]

- (c) *Award [1] for one way in which designing cotton products for ease of maintenance may extend their life cycle and [1] for brief explanation.*

good resistance to detergent/abrasives;
therefore can be washed many times before the fabric deteriorates;

different types of finishes are available for cotton fabric;
in order to protect the fabric from deterioration due to moisture/bacteria/light; **[2 max]**

- D6.** (a) *Award [1] for an issue and [1] for each of two points in an explanation relating to an environmental issue relating to fashion in the clothing industry.*

environmental issues are concerned with materials/energy/disposal;
relating to the individual consumer/retailer;

Consumer:

individual consumers may be left with obsolete garments due to change in fashion;
which become waste items;

Retailer:

change the stock due to style/trends/season;
may be left with volumes of clothing which cannot be sold so become waste; **[3 max]**

- (b) *Award [1] for a reason and [1] for each of two points of explanation relating to why it is difficult to automate the process of sewing textile products.*

needs manual input;
as fabric is eased and stretched to form complex shapes when sewing;
which makes automation not cost effective; **[3]**

D7. Award [1] for each issue identified and [1] for each point in an explanation related to branded clothing in the sports industry for the designer, manufacturer and consumer [3 max] per issue [9 max].

Designer:

brand identity is a constraint on the design brief;
designers need to use their creativity to produce innovative designs;
integrating colour/logos *etc.* which consumers will recognise as part of the brand;

Manufacturer:

brand identity is not an issue for cost effectiveness;
but adds value to the product;
premium prices can be charged/increasing profits;

Consumer:

consumer is influenced by the image of the brand;
brand image is promoted to the consumer by advertising/marketing/celebrities;
consumer feels part of a group/cultural identity;
increase confidence/personal image;

quality control is important;
if the quality is poor/defects occur;
the brand image will be tarnished/affected;

[9 max]

Option E — Human factors design

- E1.** (a) Award [1] for stating the correct percentage of the population.
90%; [1]
- (b) Award [2] for outlining **one** reason that the shape of the distribution curve would change depending on the user population it represents.
this is a model representing a specific user group;
the shape of the curve would change depending on the make-up of the user group; [2]
- (c) Award [1] for each point in an explanation of the relevance of the shaded areas of the graph to the work of the designers.
the shaded areas represent 10% of the user population;
1st–5th and 95th–99th are extremes in the population;
therefore, can be uneconomical for volume production;

they represent niche markets;
products produced can be regarded as specialist;
they can command premium prices; [3 max]
- E2.** (a) Award [1] for a correct definition of motion capture.
the recording of human/animal movement by any means; [1]
- (b) Award [1] for identifying one limitation of motion capture for animation and [1] for a brief explanation.
limited to motions which are anatomically possible;
and so cannot be used for supernatural/exotic animations; [2 max]
- E3.** (a) Award [1] for outlining **one** reason why the Ergo-sof pen may be suitable for people with limited hand movement and [1] for a brief explanation.
shape of the pen;
means that less pressure is applied to the hand/finger muscles/shape means that the pen or the arms of the pen grips the hand to prevent slippage; [2]
- (b) Award [1] for each point in an outline of one advantage relating to human factors of designing the Ergo-sof pen in Figure E2 with a soft rubber finish.
grip;
the rubber is non-slip and so adheres to the skin; [2 max]

E4. Award [1] for each distinct point in a suitable comparison of two human factor considerations [3 max] for each consideration [6 max].

home office can be configured to suit anthropometric data of the individual user;
a commercial office would need to be suitable for a range of people;
with different body measurements;

legislation;

does not apply to the home office but does apply to a commercial office;
such as the amount of light / headroom etc.;

commercial office is used by people for different tasks;
some people are static (work at a computer) others are dynamic (move around);
different peoples perception of comfort levels in relation to psychological factors (heat, light etc.);

health and safety;

the arrangement of furniture/fixtures needs to take into account the requirements of the different tasks/safety issues;

in the home office, people will work around their own mess;

[6 max]

E5. (a) Award [1] for each distinct point in a suitable outline of one benefit of increased access to product information by impaired consumers.

consumer choice;
access to a wider range of products;

independence;

can use the internet to gain information and purchase products;

accessibility;

do not have to travel to a conventional retail outlet;

consumer satisfaction;

more time to consider the appropriateness of products/compare with other products/gain advice;

[2 max]

(b) Award [1] for each point in an outline of one benefit to manufacturers of the global marketplace in relation to products for disabled groups.

there are many types of disabilities so a relatively small market nationally;
but in the global marketplace disability groups can benefit from economies of scale;

[2 max]

(c) Award [1] for each point in an outline of one reason why legislation relating to disability may not be in place in developing countries.

not considered a priority;
lack of funding to improve facilities etc.;

image/status of disability groups;

marginalized groups, not considered valuable members of society;

[2 max]

E6. (a) *Award [1] for each distinct point in a suitable explanation for one way in which smart technology could be used to provide assistance to wheelchair users for gaining entry to an office building in which they work.*

user could have a swipe card;
which would be used to gain entry electronically;
requiring less effort than manually opening the door;

user could have an electronic key fob;
which can be used sitting normally in the wheelchair;
to activate the door without having to stretch;

[3 max]

(b) *Award [1] for each point in an explanation of one disadvantage of the ramp system to able-bodied users of the building.*

slip hazard;
ramps may become slippery when wet/icy;
unless a non-slip material/surface is used;

[3 max]

E7. *Award [1] for each distinct point in a suitable discussion of how human factor data relating to clearance, reach and comfort can be used in the design of an aircraft cabin [3 max] for each consideration [9 max].*

Reach:

overhead lockers need to be accessible to the majority of users;
so the 5th percentile would be used to decide the height;
meaning that 95% of the user population would be able to reach the lockers;

Comfort:

the size of the seats needs to be suitable for people in the 5th-95th percentile range for seat width;
and the shape of the seats needs to aid comfort/give back support;
adjustability, most aircraft seats allow limited adjustability (rake);

Clearance:

the arrangement of seats need to ensure that there is sufficient clearance for legs when users are seated in the aircraft;
aircraft use different leg space for different seat class (economy, business class);
in economy class, the leg space is designed for people in the 75th percentile;

clearance for height of users;
so they do not hit their heads on the overhead luggage compartments when getting in and out of their seats;
passengers could sue the airline if they bang their heads on the lockers;

sufficient clearance in the aisles for cabin crew and trolleys;
the trolley needs to move down the aisle without disturbing passengers;
there is a direct relationship between the width of the trolley and the width of the aisle;

[9 max]