



MARKSCHEME

November 2013

DESIGN TECHNOLOGY

Standard Level

Paper 3

18 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 the IB Assessment Centre.*

Subject Details: Design Technology SL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **ONE** of the Options [**1 × 30 marks**].
Maximum total = [**30 marks**]

1. A markscheme often has more marking points than the total allows. This is intentional.
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 *WTTE* (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

1. (a) *Award [1] for stating one reason for freezing food apart from reducing waste.*
 buy in bulk/save money;
 have unconsumed food available for another occasion;
 convenience;
 extend shelf life; **[1 max]**
- (b) *Award [1] for reason why it is recommended that when frozen food is defrosted it should be used on the same day and [1] for a brief explanation [2 max].*
 freezing does not kill microorganisms;
 once defrosted any microorganisms which were on the food will continue to grow;

 it will taste better/fresher;
 minimize further deterioration in the quality/taste/texture/colour of the food; **[2 max]**
- (c) *Award [1] for each of three distinct points in an explanation of one benefit of the new labelling advice apart from stopping enormous amounts of food being wasted each year [3 max].*
 to comply with standards/best practice;
 food retailers should provide suitable guidance to consumers on how to use their products;
 if no guidance is provided consumers may not use products safely/wisely;

 image/reputation;
 food retailers demonstrate corporate social responsibility;
 attractive to environmentally conscious consumers/market pull;

 reduced need to produce as much food;
 reduced carbon and water footprint for food production and distribution;
 better use of (non-renewable) resources; **[3 max]**
2. (a) *Award [1] for stating one category of person for whom BMI can be misleading definition of body mass index (BMI) to the effect of:*
 very short/tall people;
 very muscular people (for example, sportspersons);
 pregnant/lactating women; **[1 max]**
- (b) *Award [1] for listing two reasons why acceptable ranges of BMI for health may vary in different parts of the world and [1] for a brief explanation [2 max].*
 societal norms;
 racial characteristics;
 genetic determination;
 climatic considerations;
 nutritional status; **[2 max]**

3. (a) *Award [1] for each of two distinct points in a description of the role of B vitamins for athletes [2 max].*
B vitamins are important for energy production;
they help release energy from carbohydrate/sugar; **[2]**
- (b) *Award [1] for each of two distinct points in a description of the importance of sodium and potassium for athletes [2 max].*
sodium and potassium are lost from the body in sweat during exercise;
they need to be replaced for the athlete to remain healthy;
- sodium - It helps regulate fluid balance and promotes proper muscle function;
potassium - It is important in the transmission of nerve impulses, the building muscle tissue and for the beating of the heart; **[2 max]**
4. *Award [1] for each of two distinct points in a description of the importance of the product design brief in driving the design of new food products [2 max].*
identifies the goals/constraints/target market;
for example, is the product is pioneering or imitative/does it have to be delivered at a particular price; **[2]**
5. *Award [1] for each distinct point in an explanation of each of two types of food spoilage [3 max] per type, [6 max].*
physical spoilage;
protective outer layer of food is damaged, for example, by rough handling or pest damage;
increases the chance of microbiological or chemical spoilage;
- chemical spoilage;
leads to changes in the colour/taste of foods;
for example, rancidity of oils/fats;
- microbiological spoilage;
can be caused by bacteria, moulds or yeasts;
use the food as a substrate for growth; **[6 max]**

6. *Award [1] for each distinct point in each of three ways in which on-farm processing can enhance the sustainability of the rural economy [3 max] per way, [9 max] total.*

processed foods command a higher price/cost more than unprocessed materials;
therefore farmers get a larger share of the food dollar;
this contributes to economic sustainability;

on-farm processing creates jobs in the rural economy;
therefore people do not have to migrate from rural areas to find jobs;
this contributes to social sustainability;

consumer confidence;
provenance is increasingly important for consumers;
knowing where and by whom the food was produced makes it more attractive to consumers;

on-farm processing reduces food miles/the distance that food travels from the production to consumption;

less energy is invested in the production/distribution of the processed food;
this contributes to environmental sustainability;

[9 max]

Option B — Electronic product design

7. (a) Award **[1]** for stating the type of digital logic gate on the chip shown in Figure B1.
NAND;

[1]

(b) Award **[1]** for completing the truth table for the logic circuit shown in Figure B2
[1] for output Q and **[1]** for output X.

A	B	Q	X
0	0	1	0
0	1	1	0
1	0	1	0
1	1	0	1

[2]

(c) Award **[1]** for each distinct correct point in an explanation of one reason why a manufacturer might decide to use the quad logic chip shown in Figure B1 in circuit design **[3 max]**.

NAND (and NOR) gates are universal logic gates/all digital logic functions can be implemented without using other gates;
the manufacturer would not have to hold different stock items;
the manufacturer might get a better price for buying components in bulk;

[3]

8. (a) Award **[1]** for stating one way in which programmable interface controllers extend the product life cycle.
PICs extend the life of a product by downloading software upgrades/reprogrammability;

[1]

(b) Award **[1]** for identifying way that programmable interface controllers have contributed to an increase in the portability of electronic products and **[1]** for an explanation **[2 max]**.

PICs are small but powerful devices;
which have replaced larger/amount of components so overall product size can be reduced;

[2]

9. (a) Award [1] for resistance and [1] for identifying the range of resistance within which the resistance of R_2 lies including units [2 max].
brown = 1, green = 5, orange = 3 0s so 15000 Ω gold = + 5 % ;
142500 – 15750 Ω /14.25 – 15.75k Ω ; [2]
- (b) Award [1] for showing the working and [1] for the correct answer [2 max].
 $V_{out}/V_{in} = R_2/(R_1 + R_2)$;
 $R_1 = 7.5 \text{ k}\Omega$ therefore ratio is 7.5:15/1:2; [2]
10. Award [1] for showing the correct formula and [1] for calculating the correct answer [2 max].
$$\text{Gain} = -\frac{R_1}{R_2};$$
$$= -\frac{220}{22} = -10;$$
 [2]
11. Award [1] for each of three distinct points in an explanation of each of two criteria for an appropriate solution for the supply of electricity to communities in remote areas of developing countries [3 max] per way, [6 max].
the technology must be understood by local communities;
it must be consistent with local skills and resources;
so that it empowers them not subjugates them;

cost-effectiveness;
extending the National Grid is unlikely to be cost-effective;
there needs to be a localized solution for the supply of electricity;

the solution needs to be based on renewable resources,
for example, hydroelectric, solar and wind;
non-renewable resources are finite;

the solution should not be based on fossil fuels unless they are particularly abundant in the area;
fossil fuels are non-renewable;
they also generate carbon emissions; [6 max]

12. Award [1] for each distinct correct point in an explanation of each of three different considerations for installing a copper wire network in comparison to a fibre optic network [3 max] per type, [9 max] total.

cost-effectiveness;

lower capital cost than a fibre optic system;

if the system does not require high capacity then a copper wire system may be a most cost-effective solution;

ease of installation;

they are not as fragile as fibre optic cables;

a copper wire system requires less technical expertise than a fibre optic system;

maintenance;

more straightforward maintenance required;

less specialist skill/equipment required;

[9]

Option C — CAD/CAM

13. (a) *Award [1] for stating one advantage to the designer of using FDM rapid prototype manufacturing technology.*
research and development time reduced;
feedback on evolving design;
can rapidly produce detailed/accurate models;
little waste;
cost-effective process once equipment purchased; **[1 max]**
- (b) *Award [1] for each of two distinct correct points in a description of the function of the extrusion head in the FDM process shown in Figure C1 [2 max].*
the extrusion head moves back and forth; **[2]**
building up the model with layers of molten plastic which then cools rapidly;
- (c) *Award [1] for each of three distinct correct points in an explanation of one reason why support material is required when using FDM rapid prototyping techniques [3 max].*
supports are required to provide a good/level surface for the plastic;
as the layers are built up;
and to ensure an appropriate level of detail/surface finish; **[3]**
14. (a) *Award [1] for stating one disadvantage of subtractive manufacturing techniques for the environment.*
produces waste which often cannot be used for another purpose; **[1]**
- (b) *Award [1] for identifying one advantage of a laser cutter over a plotter cutter and [1] for a brief explanation [2 max].*
more flexible/larger range of materials;
can achieve a wider range of applications;

greater accuracy;
especially for high detail designs; **[2 max]**

15. (a) *Award [1] for identifying an advantage of a CIM system for consumers and [1] for a brief explanation [2 max].*
cost-effective process;
may provide cheaper products;
- individuality;
allows for an element of consumer choice/preference;
- quality control/assurance of product;
manufacturing is totally computerized so eliminates human error; **[2 max]**
- (b) *Award [1] for identifying a disadvantage of adopting a CIM system for a small manufacturing company and [1] for a brief explanation [2 max].*
scale of production;
a CIM system is only cost-effective for high volume production;
- high capital costs;
a CIM system consists of sophisticated equipment; **[2 max]**
16. *Award [1] for identifying one advantage of finite element analysis (FEA) to designers when choosing a suitable material for a load-bearing structure and [1] for a brief explanation [2 max].*
FEA shows how a material will behave in the load-bearing structure;
the design of the structure can be modified to overcome inadequacies;
- to identify any stress concentrations;
so the designer can modify the design to reduce/eliminate stress concentrations to ensure the safety of the structure; **[2 max]**
17. *Award [1] for each of three distinct correct points in a discussion of two advantages of using virtual reality software in designing new buildings. [3 max] for each advantage, [6 max] total.*
the consumer can visualize the apartment more easily in 3D than 2D;
to get a better impression of what it will look like;
make a more informed decision about whether to go ahead with the purchase;
- consumer can interact with the designer;
can suggest modifications;
ensure the final product is more closely aligned to his/her needs;
- cost saving;
consumer does not have to travel to a 3D model;
can views items easily in different colours etc; **[6]**

18. Award [1] for each of three distinct correct points in each of three ways in which CAD/CAM has impacted on the market for furniture from a consumer perspective [3 max] per way, [9 max] total.

there is a wider choice for consumers;
consumers may choose furniture based on price range;
or styles/surface finish/colour;

many designs are modular;
consumers can mix and match;
to suit lifestyle/space available/match with existing furniture;;

fixtures and fittings are standardized;
so a limited range of tools are required;
instructions for assembly are included in the pack;

furniture is flat-packed;
can be stored easily by the retailer;
transported by the consumer/promotes impulse buying;

planned obsolescence;
consumers do not expect furniture to last a long time;
so they expect to change the furniture readily;

CAD/CAM requires high scales of production;
cost effective production;
cheaper products for the consumer;

shorter lead times for furniture production;
supports JIT production and reduces storage cost and capital investment in inventory;
reduced costs for customer;

reduced costs for customer;
makes latest styles of furniture quickly/cheaply available to customers;
facilitates ease of distribution;

[9 max]

Option D — Textiles

19. (a) *Award [1] for one reason why the Chinese had a monopoly of silk production for about 3000 years.*
silk production was a closely-guarded secret; *[1]*
- (b) *Award [1] for identifying one way in which the “Silk Road” can be considered the information superhighway of its day and [1] for a brief explanation [2 max].*
the “Silk Road” was a means of transporting goods;
it also promoted the exchange of cultures and knowledge between the east and the west that it passed through; *[2]*
- (c) *Award [1] for each of three distinct correct points in a reason for the continued popularity of silk for clothing [3 max].*
natural/lightweight fabric;
good heat retention and cooling properties;
absorbs sweat/perspiration so skin feels dry and comfortable;
- tradition/culture;
in some parts of the world silk has been used for thousands of years;
there is still a well established manufacturing capability;
- status/image;
silk is viewed as a luxurious fabric;
expensive/used for high quality clothing by rich people;
- texture/drape/silk hangs/falls;
fine silk thread;
creates a tightly woven fabric; *[3 max]*
20. (a) *Award [1] for one property of woven fabric*
good tensile strength;
good dimensional stability;
high toughness; *[1 max]*
- (b) *Award [1] for stating the correct name for A and [1] for stating the correct name for B [2 max].*
A – warp;
B – weft; *[2]*

21. (a) *Award [1] for identifying one reason why the hat is made by hand and [1] for a brief explanation [2 max].*
hand crafted look;
desirable;
- cottage industry;
non mechanized environments;
- produced from locally sourced materials;
diversification; **[2 max]**
- (b) *Award [1] for way that the design of the hat could be modified to reduce its cost of manufacture and [1] for a brief explanation [2 max].*
use alternative/raw material;
maintain the design characteristics;
- standardize pattern/design;
enable larger scale production;
- remove tassels;
they are very time-consuming to make; **[2 max]**
22. *Award [1] for stating one situation when adhesives would be preferable to sewing for joining two pieces of fabric and [1] for a brief explanation [2 max].*
fabric would rip if holes were made in it when sewn;
adhesive don't create holes;
- if seam needs to be watertight;
adhesives create a watertight seam;
- access to join is difficult;
machine cannot reach; **[2 max]**
23. *Award [1] for each of three distinct correct points in an explanation of each of two ways in which Lycra[®] has contributed to the enhanced performance of racing cyclists [3 max] per way, [6 max] total.*
elastic;
forms to shape of body;
gives the rider a more aerodynamic shape;
- can be combined with other materials, such as cotton;
benefit from properties of both materials;
provides greater comfort; **[6]**

24. Award **[1]** for each of three distinct correct points in an explanation of each of three ways that the use of computerized manufacture in the textile industry has improved the quality of products **[3 max]** per way, **[9 max]** total.

accuracy;

the precision which can be achieved with CNC machinery;

reduces errors in manufacture;

consistency;

volume production of textile products;

removes human errors;

high volume low cost production;

offering consumers a range of products;

good value for money;

flexibility of the production process/programmability;

in relation to colours/weave patterns;

linking machines into a flexible manufacturing system;

mass customization;

computer technology enables product to be customized;

to meet the individual needs of individual consumers/clients;

[9 max]

Option E — Human factors design

25. (a) Award [1] for stating the type of data scale used for the data shown in Figure E1.
ratio scale; [1]
- (b) Award [1] for identifying why the 5th percentile is used in relation to each of the measurements associated with reach and [1] for a brief explanation [2 max].
to cater for 95% of the user population;
only the very smallest people/less than 5th percentile will not be able to reach; [2]
- (c) Award [1] for each of three distinct correct points in an explanation of why the data for toe projection is given in terms of the 50th and 95th percentiles [3 max].
toe projection limits how close the person can get to an object;
for these dimensions it is the larger percentiles that need special attention;
the 95th percentile is therefore critical dimension; [3]
26. (a) Award [1] for stating one risk assessment strategy would be used to identify patterns of behaviour that precede accidents.
scenario analysis; [1]
- (b) Award [1] for each of two distinct correct points in a description of the purpose of behavioural testing to determine adequate product safety.
get people to use the product;
observe the different ways they use/abuse it/design in safety to ensure safety in use; [2]
27. (a) Award [1] for identifying one reason why able bodied people may have difficulty opening ring pull cans with their fingers and [1] for a brief explanation [2 max].
fingers too big/fat/very short (bitten down) fingernails;
difficult to lift up the ring pull/ space for fingers too small;

may not have enough strength to use one finger;
due to infirmity/injury/low dexterity/age;

amount of force required to open the can;
varies from can to can;

inequalities in can manufacture;
some ring-pulls require more strength to open them than others; [2 max]
- (b) Award [1] for each of two distinct points in a suitable outline one potential disadvantage of using the Magipull ring pull can opener for able-bodied people [2 max]:
may apply too much force;
so the contents of the can would spill out/the ring may break off; [2]

28. Award [1] for each of two distinct correct points in a description of how poor organisation of a product's user interface imposes a memory burden on users [2 max].
users have to learn how to use the interface;
and remember how the various functions work (since they won't work intuitively);

may be too complicated for the user to remember how to operate the product;
user may only be able to access a small proportion of the product's functionality;

good/intuitive user interface organization;
ensures the product is easy to use;

[2 max]

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

Sure grip cutlery has chunky handles;
the Baroque cutlery has a twisted design and are thinner handles;
the Sure grip handles are easier to hold than the Baroque handles;

Sure grip handles are made from a non-slip material;
Baroque cutlery handles are made from stainless steel which is shiny/slippery;
Sure grip handles are easier to grip, especially for people with arthritis;

Sure grip cutlery is designed to fit into the hand;
so the full strength of the arm muscles can be used;
but the Baroque cutlery is held by the fingers and requires more dexterity to use;

[6 max]

30. Award [1] for each of three distinct correct points in each of three advantages of paper prototyping in the design of the controls for electronic products [3 max] per advantage, [9 max] total.

cheap/low cost/fast;

as easy to do;

does not require expensive skills/training/time;

just needs a piece of paper and a pen/pencil;

designer can get instant feedback from potential users;

the design can be modified accordingly;

participatory design strategy;

users can input to the design of the product;

ensures customer satisfaction with the final product;

flexibility;

easy to modify;

in relation to feedback from users;

ease-of-communication;

especially for a design team;

platform independent/not reliant on computer technology/no need for computer programming;

[9 max]