



MARKSCHEME

May 2014

DESIGN TECHNOLOGY

Standard Level

Paper 3

20 pages

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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 **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

1. (a) *Award [1] for stating one health benefit of the 5 A DAY shopping list and menu planner for families with young children.*
codifies nutritional best practice;
makes it easier for consumers to develop better eating habits;
convenience;
easy access to advice 24/7;
appealing to different age groups;
creates interest in menu planning/nutritional value of food;
gets children involved in the design and preparation of healthy meals;
skills development;
helps families develop better menus based on seasonal produce;
promotes a healthy/balanced diet; **[1 max]**
- (b) *Award [1] for each of two nutritional benefits of eating more fruit and vegetables [2 max].*
higher fibre intake;
higher intake of water-soluble vitamins/vitamin C/B vitamins;
lower energy density/reduced energy intake;
slow-release carbohydrate;
provides minerals/sodium/potassium for diet; **[2 max]**
- (c) *Award [1] for each of three distinct correct points in an explanation of why some governments provide public health advice and tools, such as the 5 A DAY shopping list and menu planner [3 max].*
many people do not understand the health implications of diet;
governmental public health advice can promote healthier lifestyles;
this can reduce the incidence of avoidable illness associated with poor lifestyles;

governments have a moral/ethical responsibility for their citizens;
providing public health advice is one way to evidence these responsibilities;
this can reduce the economic burden of health care;
- Note to markers: candidates may offer linked examples from more than one cluster. Award [1] for each correct point regardless of the cluster as long as it ensures an appropriate depth of response.* **[3 max]**

2. (a) *Award [1] for a definition of biological value.*
a measure of the amount of nitrogen content of food is retained by the body;
a measure of the essential amino acid content of a protein; **[1 max]**
- (b) *Award [1] for each of two distinct correct points in a description of how low biological value foods are complemented in different parts of the world to ensure that amino acid requirements are met [2 max].*
some vegetable proteins do not contain all the essential amino acids;
using different vegetable sources can ensure that the essential amino acid requirements of the body are met;
- grains, eg wheat, are low in one amino acid and beans are low in another;
eating grain and beans together ensure essential amino acid needs are met, eg rice and beans in South America/beans on toast; **[2 max]**
3. (a) *Award [1] for each of two distinct correct points in a description of how an apple browns within a few minutes of being cut open [2 max].*
enzymic browning/apples contain an enzyme called polyphenol oxidase;
when an apple cut its cells are damaged and oxygen in the air allows enzymic reaction/polyphenols to react with the enzyme and other chemicals; **[2]**
- (b) *Award [1] for each of two distinct correct points in a description of how the browning of the toasted bread in Figure A3 occurs [2 max].*
Maillard reaction/non-enzymic browning/chemical reaction between an amino acid and a reducing sugar;
occurs as a result of heating; **[2]**
4. *Award [1] for a function of primary food packaging and [1] for a brief explanation [2 max].*
to protect the food;
from (physical/microbiological/chemical) spoilage; **[2 max]**

5. *Award [1] for each distinct point in an explanation of each of two ways in which the packaging of food products contributes to the development of brands [3 max] per type, [6 max] total.*

the shape of the packaging/the colour of the packaging, eg the Coca-Cola® red packaging;

promotes brand recognition;

promotes consumer loyalty/promotes sales;

the packaging can display the manufacturer's logo;

the logo/brand may be associated with quality;

promotes consumer confidence;

[6]

6. *Award [1] for each distinct correct point in each of three ways in which the food industry in developed countries operates as a tightly-controlled just-in-time system [3 max] per way, [9 max] total.*

food is delivered to store in line with customer requirements;

so there is no storage of stock;

reduced wastage;

strong information and communication technologies underpin the system;

so that supply is matched to demand;

ensures that the right amount of product is in the right place at the right time;

strong supply chain;

the food retailer must have a good understanding of lead times for supplies;

to get the product to the retail outlet/store at the right time;

lean;

no inventory/no wastage;

cost benefits for customer;

requires strong market research capability;

to understand customer needs (which can vary across different parts of a country);

loyalty cards can provide detailed data on customer needs;

[9 max]

Option B — Electronic product design

7. (a) Award **[1]** for one piece of input data that is needed for the climate control unit to control the air temperature in a car.
 required air temperature / actual air temperature; **[1]**

(b) Award **[1]** for one other variable that will impact on the effectiveness of the closed loop control system and **[1]** for a brief explanation **[2 max]**.
 the number of people in the car;
 the more people the less effective will be the system in maintaining a steady temperature;

 people’s temperature preferences;
 the greater the difference between the preferred temperature and the ambient temperature the harder the climate control unit will have to work;

 if the windows are open;
 the system will be trying to control the temperature beyond the car; **[2 max]**

(c) Award **[1]** for each of three distinct correct points in an explanation of why the closed loop climate control system for a car uses negative feedback **[3 max]**.
 negative feedback will stabilize the system;
 so when the input changes in a manner which affects the performance of the system;
 the type of feedback will create an appropriate response (output); **[3]**

8. (a) Award **[1]** for stating the type of operational amplifier circuit shown in Figure B3.
 inverting; **[1]**

(b) Award **[1]** for identifying the correct formula for an inverting amplifier and for substituting the right values and **[1]** for identifying that the output voltage is twice the input voltage **or** cannot be more than 12 volts as it is clipped **[2 max]**.

$$V_{out} = -\left(\frac{R_2}{R_1}\right) V_{in};$$

$$V_{out} = -\frac{100}{50} \times V_{in};$$

$$V_{out} \geq -12 \text{ volts};$$

Note to markers: the diagram does not state what the input voltage is, candidates may assume 12 volts, but if it is clear they have assumed a different value for V_{in} , then follow through the logic and award marks as appropriate.

9. (a) Award [1] for an advantage for a consumer using a generic digital music system and [1] for a brief explanation [2 max].
compatibility between devices/systems;
familiarity/usability of systems/consumers will not have to learn how to master another system;

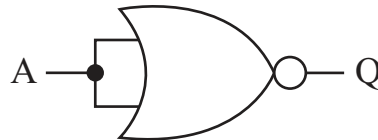
the generic digital music system will allow access to support services;
eg an app store and movie rentals;

[2 max]

- (b) Award [1] for an advantage for a manufacturer of developing its own digital music system and [1] for a brief explanation [2 max].
protected content using digital rights management (DRM);
ties content to specific devices/promote brand loyalty/promotion/control;

[2]

10. Award [1] for showing a NOR gate and [1] for connecting it as shown [2 max].



[2 max]

11. Award [1] for each of three distinct correct points in a discussion of each of two reasons why electronic products are designed to operate at dual voltages, for example, US 120 V UK 240 V [3 max] per reason, [6 max] total.

convenience/global standards;
product can be used in any country context/increase size of market;
consumer only needs to take one product when s/he travels;

safety;

if a 240 V product were to be used on a 120 V supply it will underperform/not perform at all;

if a 120 V product were to be used on a 240 V supply it will malfunction/fuse/be unsafe;

[6]

12. Award [1] for each of three distinct correct points in an explanation of each of three advantages of using programmable interface controllers (PICs) when developing a hearing aid [9 max].

customization;

individual settings as all users are different;

the amplification required by different users at different wavelengths is different as shown by their audiograms;

miniaturization/digital processing power evolves exponentially;

hearing aids can get smaller meaning the hearing aid can be closer to the ear drum;

so requires less battery power thus enhancing battery life;

environmental considerations;

filtration of extraneous noise;

differentiation of speech and other environmental noises in real time;

reprogrammability;

programmable software for individual needs;

better programming means better sound processing in multiple sound environments – from a quiet library to a noisy restaurant;

[9 max]

Note to markers: candidates may offer linked examples from more than one cluster. Award [1] for each correct point regardless of the cluster as long as it ensures an appropriate depth of response.

Option C — CAD/CAM

13. (a) *Award [1] for stating one reason for using different feed speeds during the production of the scale model in Figure C2.*
different feed speeds are required for different tool sizes/surface finishes/depth of cut;
speed needs to be matched to the material/matched to the force the machine can withstand; **[1 max]**
- (b) *Award [1] for identifying one advantage of using a five-axis CNC machine to produce the scale model in Figure C2 and [1] for a brief explanation [2 max].*
platform and cutting tool movements reach all model sides/all sides of the machine with undercuts;
there is no need for repositioning/additional fixtures; **[2]**
- (c) *Award [1] for each of three distinct correct points in an explanation of one benefit of creating the CAD simulation in Figure C1 for the production of the scale model in Figure C2 [3 max].*
allows a realistic visualization of the product (for the client/non-technical audiences);
so problems can be detected before actual production commences;
manipulate surface finishes/colours/dimensions; **[3]**
14. (a) *Award [1] for a definition of motion capture technology.*
the recording of human and animal movement by video, magnetic or electro-mechanical devices; **[1]**
- (b) *Award [1] for identifying how motion capture technology assists in the design development of car interiors and [1] for a brief explanation [2 max].*
by recording the interaction of different sized users;
data is used to create digital humans in order to optimize the ergonomics of the interior;
- by moving from motion capture to the digital world;
this is more cost effective/easier than using “real” humans for design development;
- speeds up design development process;
more iterations per unit time; **[2 max]**

15. (a) Award **[1]** for identifying one advantage of using orientation A (Figure C4) with solid object printing and **[1]** for a brief explanation **[2 max]**.

orientation B requires support material;
orientation A does not;

speed;
orientation A means nozzles only deposit build material on the platform;

less post processing;
model will not require the removal of any support material; **[2 max]**

- (b) Award **[1]** for identifying why either orientation A (Figure C4) or orientation B (Figure C5) is suitable for use with select laser sintering (SLS) and **[1]** for a brief explanation **[2 max]**.

no support material is required for SLS;
the prototypes would be supported on all sides by powder; **[2]**

16. Award **[1]** for each of two distinct points in a description of one health and safety issue related to using a laser cutter in industrial manufacturing **[2 max]**.

risk of personal injury;
issue regarding appropriate risk control measures/personal protective equipment;

toxic fumes;
need proper ventilation; **[2 max]**

17. Award **[1]** for each of three distinct points in an explanation of each of two impacts of introducing computer numerically controlled (CNC) machines on the fixed and variable costs of a multinational company **[3 max]** per impact, **[6 max]** total.

Fixed costs:

the company will have to make a capital investment in CNC machines;
so fixed costs will rise;
the company will have to consider its return on investment/breakeven;

Variable costs:

labour costs should reduce;
following an initial period of redundancy and retraining;
fewer but probably better paid/more technical jobs;

material costs should reduce;
increased accuracy;
fewer errors; **[6 max]**

Note to markers: candidates may offer training as either a fixed (as a part of the purchase of the CNC machines) or variable costs (where additional costs may be incurred after the CNC machines have been installed) depending on the context, in this case either approach is acceptable and responses may be derived from more than one cluster.

18. Award **[1]** for each of three distinct points in a discussion of three issues when using natural timber to produce furniture with CNC equipment. **[3 max]** per issue, **[9 max]** total.

type of construction;

CNC machines cannot make intricate joints;

the product needs to be designed to take account of this;

structure of natural timber/natural irregularities;

natural wood does not have a uniform grain structure and includes knots;

cutting tools are affected/damaged/need regular maintenance;

stability;

changes in humidity and temperature may lead to shrinkage;

differences in dimensions must be accounted for when using CNC;

damage to natural timber in CNC machining eg burning;

can require further surface treatment;

leading to added cost;

[9 max]

*Note to markers: candidates may offer linked examples from more than one cluster. Award **[1]** for each correct point regardless of the cluster as long as it ensures an appropriate depth of response.*

Option D — Textiles

19. (a) *Award [1] for stating one characteristic relating to ease of maintenance that makes polyester suitable for the Nike Flyknit shoe.*
resistant to most chemicals;
quick drying;
wrinkle resistant;
mildew resistant;
easily washed; **[1 max]**
- (b) *Award [1] for a characteristic of knitted fabrics that contributes to the tight fit of the finished Nike Flyknit shoe and [1] for a brief explanation [2 max].*
low dimensional stability;
the knitted upper can take on the shape of the athlete's foot; **[2]**
- (c) *Award [1] for each of three distinct correct points in an explanation of the advantage to Nike of launching the Flyknit shoe at the London 2012 Olympics [3 max].*
athletes are positive role models;
people, especially young people, want to emulate them;
this would promote sales of the shoe and other Nike products;

the 2012 Olympics was a high profile event;
it would be watched by billions of people globally;
lots of people would want to have the same shoes as worn by the winning athletes/creates market pull; **[3 max]**
20. (a) *Award [1] for stating one way that mass customization of textile products has enhanced consumer choice.*
individualized design within a defined range of options;
consumer can order particular colour combinations; **[1 max]**
- (b) *Award [1] for one way in which CAD contributes to the mass customization of textile products and [1] for a brief explanation [2 max].*
enables individualization of design;
addition of logos/photos to textile products, eg t-shirts;

linked to CAM individualized designs can be manufactured;
makes manufacturing more flexible so can produce small volumes/one offs; **[2 max]**

21. (a) *Award [1] for a reason why Velcro is an example of biomimetics and [1] for a brief explanation [2 max].*
biomimetics is the application of methods and systems found in nature to the study and design of engineering systems and modern technology;
the burrs were the inspiration for Velcro; [2]
- (b) *Award [1] for a reason why nylon is suitable for the production of Velcro and [1] for a brief explanation [2 max].*
nylon can be produced in threads of various thickness;
thicker threads for the hooks/thinner threads for the loops;

nylon is durable;
it will have a long product life;

it does not rot/go mouldy;
often used on waterproof clothing;

cost-effective;
suitable for volume production/cheap material and manufacturing costs; [2 max]
22. *Award [1] for way in which computer-aided manufacture (CAM) had contributed to the sustainability of the textile industry and [1] for a brief explanation [2 max].*
reduction in waste;
better tessellation of components;

lower tolerance;
more accurate operation results in fewer errors;

reduction of costs;
wages are not a significant cost factor; [2 max]
23. *Award [1] for each of three distinct points in an explanation of each of two considerations in relation to the biocompatibility of textile vascular prostheses. [3 max] per consideration, [6 max] total.*
textile vascular prostheses are in contact with blood;
blood contains antibodies to reject foreign materials;
if the textile is not biocompatible it will be rejected;

cleaning/sterilization/packaging involves heat treatment/and interaction with other materials;
the quality of materials can deteriorate during production;
biocompatibility must be tested in their final state; [6]

24. Award [1] for each distinct correct point in each of three ways in which branding of textile products contributes to a global marketing strategy [3 max] per way, [9 max] total.

brand loyalty;

consumers often develop allegiance with a particular brand;

they will buy that brand in preference to another brand;

brand recognition/awareness;

branding a product makes it easier to promote with potential consumers;

this makes it easier to launch new products;

co-creations of brands;

consumer websites/Facebook/Twitter allow consumers to have their say and to contribute to the development of a brand;

global brands have to develop mechanisms to support consumer involvement;

a brand may not fit the culture of a particular country context;

a brand may need to be adapted to meet particular requirements – glocalized;

this poses challenges for global brands since digital technologies are not limited by country borders;

[9 max]

Option E — Human factors design

25. (a) *Award [1] for stating one reason why the control buttons on the handset are not all the same size.*
so they fit within the profile of the handset;
larger sizes are used for the buttons that are used most/easier to press;
differentiate between (major and minor) functions;
visually easier to navigate;
users more easily develop a memory of how to use the product;
aid partially sighted users (to distinguish certain functions); **[1 max]**
- (b) *Award [1] for stating one reason for the shape (profile) of the handset in Figure E1 and [1] for a brief explanation [2 max].*
fits comfortably in the hand / allows for a good grip;
leaves the thumb/fingers of the other hand free to press the buttons;

the narrowing in the centre of the handset;
makes it suitable for most sizes/children and adults/balances the weight of the handset; **[2 max]**
- (c) *Award [1] for each of three distinct points in an explanation of one reason for using a colour scheme for the buttons on the handset shown in Figure E1 [3 max].*
colour schemes are used to differentiate between different functions/groups of functions;
to facilitate ease of use;
the black buttons relate to common functions on the TV (eg channel selection) /
the blue buttons relate to additional features / the red, green, blue and yellow buttons relate to special functions / easy to learn / low memory burden – colour code / no need for glasses to read small print /no need for labels;

convention/stereotyping;
coding system enables ease of recognition of control functions;
global product/easy to use in different contexts; **[3 max]**
26. (a) *Award [1] for stating the type of measurement scale used for the shirt sizes in the first row of Table E1.*
ordinal; **[1]**
- (b) *Award [1] for stating one reason why some manufacturers choose to produce shirts in sizes small, medium and large and [1] for a brief explanation [2 max].*
cost effectiveness;
range of sizes is smaller so potentially less manufacturing costs/wastage;

consumers may buy the shirt to wear informally/loosely/without a tie;
so neck size no longer as important/as long as it is big enough; **[2 max]**
- Do not award marks for consumer related reasons.*

27. (a) *Award [1] for each of two distinct correct points in a description of the function of the sensory input when receiving a text message on a mobile phone and [1] for a brief explanation [2 max].*
visual/audible/vibratory alert;
nerve impulse sent to central processes/brain from sensory organ/eyes/ears/skin; [2]
- (b) *Award [1] for identifying a reason why the motor processing stage may lead to errors in writing a response to the received message and [1] for a brief explanation [2 max].*
disability;
there may be a breakdown in the information flow from the brain to the muscles of the hand/the muscles may not be able to carry out the action;

dyslexia;
there may be a problem in the way the brain interprets written text;

speed;
the brain may process the information quickly but the muscles cannot respond as quickly and the wrong keys are pressed;

dexterity;
the physical interaction with the keys may not be accurate/controlled enough/predictive text – not noticed when incorrect; [2 max]
28. *Award [1] for stating one reason why appearance prototypes are expensive to produce and [1] for a brief explanation [2 max].*
appearance prototypes need to look like the intended final product;
so much attention has to be paid to the quality of the surface finish/detailing of the appearance which requires time/skill;

prototype materials may be more expensive than production materials;
because the material may be specialist/not purchased in bulk; [2 max]

29. Award [1] for each of three distinct correct points in a suggestion of each of two reasons why dimensions in anthropometric data tables are stated as estimates [3 max] per reason, [6 max] total.

sample size of users;

may not be representative of all the user population/people of different ethnicity;

so measurements taken may not be totally accurate;

date when the measurements were taken;

dimensions of the user population may have changed since that date;

due to diet/nutrition;

difficult to measure people/reliability of the measuring;

a tolerance is included to allow for a small amount of error;

measuring instruments may not have been very accurate;

dimensions are stated in whole numbers;

actual measurements taken may have included decimal figures;

numbers are rounded up for ease of use;

[6 max]

30. Award [1] for each of three distinct points in a discussion of human factor considerations in the design of a car seat belt for a volume-produced car in relation to anthropometrics, psychological and physiological factors [3 max] per factor, [9 max] total.

Anthropometrics:

data required for relevant aspects of body size (eg. dimensions of the abdomen/chest/height;

dimensions to relate to all the user population;

range of adjustability within 5th-95th percentile;

Psychological:

users must feel safe/reassured by the “click” with the seatbelt on;

the driver must also be satisfied about the safety of passengers;

and complying with legislation;

Physiological:

comfort/feel of the material is important to users;

the range of adjustability of the belt must provide comfort for all users;

the tension of the belt must provide safety but also ease-of-use by a wide range of users;

[9]

Note to markers: If candidates have used the incorrect heading but the content is appropriate, mark positively and do not penalize the candidate for the incorrect use of a heading.