



# **MARKSCHEME**

**May 2013**

**DESIGN TECHNOLOGY**

**Standard Level**

**Paper 3**

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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**

- A1.** (a) Award [1] for stating **one** reason why craft-produced breads are generally more expensive than mass-produced breads.  
craft production is a labour-intensive process / smaller batches more work/time input per loaf;  
more expensive raw materials / specialist ingredients; [1 max]
- (b) Award [1] for identifying how gluten in flour contributes to the final texture of dough and [1] for a brief explanation [2 max].  
gluten is the protein in flour which hydrates to form an elastic matrix;  
this contributes to the elastic nature of the bread dough; [2]
- (c) Award [1] for each of three distinct points in an explanation of how the addition of yeast to bread dough contributes to the physical properties of bread [3 max].  
lowers the density of the dough/bread;  
yeast ferments sugar to carbon dioxide which aerates/produces small gas bubbles in the dough;  
the dough/gas expands during heating;  
cooking denatures the gluten so becomes inelastic/retains deformed shape/aerated/leavened bread; [3 max]
- A2.** (a) Award [1] for stating **one** function of primary food packaging.  
extends shelf life;  
adequately contains product so it does not leak;  
protects the product from damage;  
displays the product so the customer can see what s/he is buying;  
carries nutritional and other information about the food;  
prevents food deteriorating/being contaminated; [1 max]
- (b) Award [1] for identifying **one** benefit of using biodegradable material for food packaging and [1] for a brief explanation [2 max].  
can be composted along with the remains of any food it contains;  
less non-biodegradable waste goes to landfill;  
(allegedly) helps reduce global warming; [2 max]

- A3.** (a) Award [1] for *one* reason why it is important that governments raise public awareness of food-related health issues and [1] for a brief explanation [2 max].  
eating the wrong balance of foods can result in a wide range of chronic/acute food-related issues, for example, obesity, diabetes, food poisoning;  
governments can reduce the incidence of these by providing educational materials to raise public awareness of health-related issues/reduce cost of healthcare provision;  
governments have a moral responsibility for public health;  
government policies educate public/advocate healthy eating; [2 max]
- (b) Award [1] for each of two distinct points in an identification of why “The eatwell plate” system would not be appropriate for children below the age of two years [2 max].  
babies and very young children have different nutritional requirements to older children/adults;  
babies and very young children need energy-dense foods/their digestive systems cannot cope with the wide range of foods on the eatwell plate some of which are difficult to digest; [2]
- A4.** Award [1] for identifying *one* reason why values of body mass index (BMI) might be misleading [2 max].  
BMIs relate to perfect people / fit and healthy people come in a wide variety of shapes and sizes;  
the bodyweight of sportspersons, (for example, bodybuilders), may be increased through being well-muscled;  
thus their BMI might be high but not indicative of increased risk of heart disease and other conditions associated with being overweight/obese; [2 max]
- A5.** Award [1] for each of three distinct points in an explanation of each of how travel and the media have promoted the development of an international cuisine [3 max] for travel and [3 max] for the media.  
*Travel:*  
through travelling and eating out more in restaurants people are exposed to different dishes;  
on their return home they want to recreate their holiday experiences;  
supermarkets/other food outlets now carry a wide range of authentic ingredients so they are able to do this;  
*The media:*  
cooking books/programmes/commercials/articles in newspapers/magazines present dishes from other cultures;  
they show people how dishes from different cultures should be prepared/served;  
people are able to experiment for themselves; [6]

**A6.** Award [1] for each of three distinct points in an explanation of each of **three** implications of urbanization for the food industry in developed countries. [3 max] for each factor.

high population density / lots of people live in a small area;  
urban dwellers often totally reliant on the food industry for the provision of their dietary needs;  
they no longer have access to land for growing of food;

food is a highly-perishable commodity;  
food processing (freezing, canning, *etc*) extends shelf-life of foods;  
this can facilitate distribution from rural areas where food produced to urban areas where food consumed;

food manufacturers operate just-in-time (JIT) systems to deliver food to the point of sale;  
CIM/logistics enable this;  
they ensure the right amounts of food products are available as and when required by consumers;

more food shops;  
provide access to food in urban areas;  
encourage/promote the development of new food products;

better law enforcement;  
easier access for law enforcement officials;  
forces higher standards;

[9 max]

**Option B — Electronic product design**

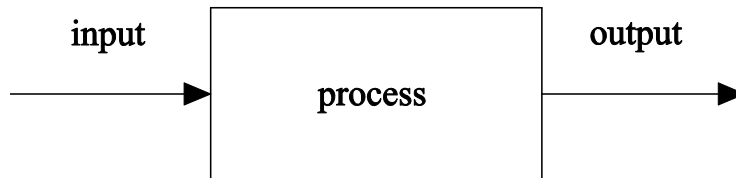
**B1.** (a) Award [1] for stating the type of circuit.  
comparator; [1]

(b) Award [1] for substituting appropriately into the formula  $T = CR$  and [1] for a calculation showing units [2 max].  
 $T = CR$ ;  
 $T = 470 \times 50000 = 23500000$  microseconds ;  
 $T = 0.000470 \times 50000 = 23.5$  seconds; [2 max]

(c) Award [1] for each of three distinct points in an explanation of how the circuit operates when the switch is opened [3 max].  
when the switch opens, the voltage on the capacitor rises;  
the timer starts;  
when the voltage on the capacitor meets/exceeds that of the R1 R2 divider the comparator switches low, so turning on/activating the relay;

when switch opens, current from the resistor flows into the capacitor;  
capacitor charges / its voltage rises from 0V;  
after some time it goes above/exceeds the voltage at the +/-non-inverting input and the output from the op amp switches over/becomes zero/low;  
turns on/activates relay; [3 max]

**B2.** (a) Award [1] for correctly drawing a diagram representing an open loop system.



[1]

(b) Award [1] for identifying a limitation of an open loop system and [1] for a brief explanation of the effect on the function of a toaster.  
open loop systems do not provide feedback;  
a toaster will not automatically shut off when the set time is reached; [2]

**B3.** (a) Award [1] for *X* and [1] for *Y* [2 max].

<i>A</i>	<i>B</i>	<i>X</i>	<i>Y</i>
0	0	1	0
0	1	1	0
1	0	1	0
1	1	0	1

[2]

(b) Award [1] for **one** reason why, in practice, digital logic functions would be implemented using NAND gates and [1] for a brief explanation [2 max].

NAND gates are universal gates;  
they can implement any (Boolean) logic gate function without the need to use any other gate type;

NAND gates are economical and easier to fabricate;  
they are used in digital logic families;

[2 max]

**B4.** Award [1] each for identifying **two** components of a digital hearing aid.

- microphone;
- battery;
- filters/split signal into various frequencies/frequency bands;
- analogue to digital convertor;
- processor for amplification;
- speakers;

[2 max]

**B5.** Award [1] each for stating **three** different implications for the consumer for both TDM and FDM. [3 max] each.

- FDM bandwidth supplied to the user in fixed allotments/amounts;
- supports a limited number of users at a set bandwidth;
- the higher the amount of bandwidth supplied by the ISP, the faster the connection will be for individual users;

- TDM users have an individual signal digitally coded in short duration pulses/bursts;
- pulses for each user are sent in order along the link in “packets”;
- the receiver must be synchronized with the user so information bytes can be correctly reassembled to produce signals;

[6]



**B6.** Award [1] for each distinct issue and [2] for a detailed explanation of each issue in a discussion of *three* issues a designer may need to consider in the design of a laptop computer for different global markets. [3 max] each.

company-specific standards may differ in different regions;

patents may not be internationally recognized;

software and applications may not be available/acceptable in different markets;

local environmental regulations may affect material specifications required of a laptop computer;

including the use of toxic/hazardous materials/power sources;

“take back” legislation in some countries controls how electronic products are disposed;

differences in electrical voltage supply and plug/socket design in various global regions;

require alternate designs for power or battery charging units;

120V/60Hz / 240V/50Hz;

maintenance/after sales provision;

availability of spares/accessories;

advice/expertise;

aesthetics;

colour availability/shape/styles;

value systems, such as those attributed to colours, may differ from country to country;

different keyboard designs to support different languages;

different markets may be different sizes;

cost implications;

[9 max]

**Option C — CAD/CAM**

- C1.** (a) *Award [1] for stating the type of CNC machine used to manufacture the part in Figure C1.*  
CNC Lathe; **[1]**
- (b) *Award [1] for each of the distinct points in a description of how a CNC machine would need to be reprogrammed if the part in Figure C1 would be made from metal instead of plastic [2 max].*  
reduced/slower feed rate;  
shallower depth of cut per pass;  
different cutting tools; **[2 max]**
- (c) *Award [1] for each of three distinct points in an explanation of why the product in Figure C1 would require more than one tool for manufacture [3 max].*  
each tool does a different job/produces different finishes;  
one tool will be used for cutting the shape;  
another tool will be used for cutting the thread; **[3]**
- C2.** (a) *Award [1] for stating a wet rapid prototyping technique.*  
stereolithography;  
FDM;  
3D / solid object printing; **[1 max]**
- (b) *Award [1] for stating an advantage of using a wet rapid prototyping technique and [1] for a brief development of the advantage identified [2 max].*  
can result in a fully-functioning item/prototype;  
intricate internal construction is possible / wide range of materials possible;  
which increases the scope for the designer;
- high level of accuracy;  
and quality of surface finish;
- no waste of parent material;  
rest of fluid can be reused; **[2 max]**

**C3.** (a) *Award [1] for each distinct point in a description of the purpose of the CAD mould flow simulation.*

the colours show cooling of material as injected into the mould;  
the blue area indicates the point of injection/ensures material will not harden before it gets to all parts of the mould;

[2]

(b) *Award [1] for each distinct point in an outline of **one** way in which CAD simulations can aid cost analysis in the manufacture of the plastic product.*

number of parts needed can be calculated;  
aiding the planning of assembly;

material properties can be simulated using FEA;  
so a cheaper material could be used as an alternative;

cost;  
can calculate how much material is required to fill the mould;

wall thickness can be tested;  
reduction in wall thickness will reduce cost of product;

the amount of material required to fill the mould can be calculated;  
enabling the design to be altered to enhance cost-effectiveness;

the amount of time needed for the material to cool in the mould can be calculated;  
enabling the manufacturer to calculate the number of items per hour;

better quality control;  
identify potential stress areas/problems;

can test time taken for material to fill the mould;  
can calculate efficiency/rate of production;

[2 max]

**C4.** *Award [1] for each distinct correct point in a description of a four-axis CNC machining process [2 max].*

the milling tool moves in 3 axes (X, Y and Z);  
the piece of work can rotate about one axis;

a lathe;  
plus milling tool;

[2 max]

**C5.** Award [1] for each distinct point in a discussion of **two** benefits of using rapid prototyping in the design development of the perfume bottle prototype. [3 max] for each benefit.

physical/performance testing;  
for a range of attributes/needs/purposes;  
for example, size/ergonomics/weight/performance/capacity;

design can be quickly altered;  
more iterations per unit time/reduces design development time;  
reduced time to bring a product to market;

additive process;  
reduced waste;  
reduced material usage in prototype production;

visualization/market testing / discussions with clients/consumers;  
user feedback can be gained;  
to inform ongoing design development;

expert appraisal;  
manufacturers/engineers can provide feedback;  
to advise on cost-effectiveness/feasibility/production;

cost-effective method of prototyping;  
cheap process/resources;  
easy to use/carry out;

[6 max]

**C6.** Award [1] for each distinct point in a discussion of *three* benefits for consumers of purchasing classroom furniture produced by CAD/CAM. [3 max] per benefit.

virtual images help consumers decide if furniture is suitable;  
furniture can be virtually inserted into a 3D CAD model of the room;  
the consumer decides if this gives adequate space for pupils/range of activities;

flexibility of CAD;  
bespoke furniture can be designed to fit the space;  
and manufactured using CAM;

the furniture can be flat-pack;  
reducing the cost of distribution/assembly/storage;  
the consumer can assemble/disassemble the furniture easily onsite to move it;

furniture can be modular;  
the design can be adjusted for different needs/additional pieces can be added at a later date;  
to address ever-changing usage of the class environment;

maintenance/ease of repair;  
parts can be purchased and replaced easily on site;  
due to the use of fasteners/exploded views;

cost-effectiveness;  
can reduce price;  
so perceived as better value for money by consumers;

designs can be modified through discussion between the designer and the consumer;  
this can result in customization of the design;  
so supports mass-customization;

[9 max]

**Option D — Textiles**

- D1.** (a) Award [1] for stating **one** characteristic of polyester that makes it suitable for the graft apart from biocompatibility.  
it stretches;  
good chemical resistance;  
it is durable;  
lightweight;  
low moisture absorption; **[1 max]**
- (b) Award [1] for stating **one** benefit of using a woven fabric for the graft and [1] for a brief explanation [2 max].  
dimensional stability;  
will fit more closely to the artery;  
  
can be closely woven;  
less likely to leak;  
  
flexibility/ease of use/handling;  
can be shaped as required; **[2 max]**
- (c) Award [1] for each distinct point in an explanation of **one** reason why biocompatibility is important in the development of textile vascular grafts [3 max].  
compatible with body tissues / does not induce immune response / does not provoke inflammation;  
no rejection;  
no need to have repeat surgery/take (immuno-suppressive) drugs;  
enhances success of surgical procedures; **[3 max]**

- D2.** (a) *Award [1] for stating **one** benefit of producing yarn from mixed fibres.*  
longer threads created;  
stronger threads created;  
simple process;  
can design in the properties that you want;  
create a yarn with a specific texture/colour; **[1 max]**
- (b) *Award [1] each of two distinct correct points in a description of **one** advantage of spinning wool fibres into yarn [2 max].*  
strength;  
longer/thicker yarn;
- very little waste;  
all fibres are used in the spinning process;
- can spin for different durations/speeds;  
to get yarn with different properties (plys);
- produces a yarn of even thickness;  
and consistent properties;
- easy to spin;  
applicable to different scales of production; **[2 max]**
- D3.** (a) *Award [1] for each distinct point in an outline of **one** benefit of the introduction of circular knitting machines for manufacturers.*  
no/few seams;  
therefore less processing/finishing;  
reduces costs/more cost-effective;
- flexibility;  
different scales of production;
- greater scope for the design of knitted items;  
broadens the market; **[2 max]**
- (b) *Award [1] for stating **one** benefit of circular knitting machines for consumers and [1] for a brief explanation [2 max].*  
no/few seams;  
more comfortable/aesthetically pleasing product;
- patterns can be knitted in;  
so more choice;
- a single process;  
more confidence in quality; **[2 max]**

**D4.** Award [1] for each point and [1] for a justification of **one** benefit of using CAM for embroidering clothes [2 max].

mass customization;  
can add own details/logo to clothes;

repeatability;  
more consistent than by hand embroidering;

faster than doing by hand;  
more cost effective;

[2 max]

**D5.** Award [1] for each of three distinct points in a discussion of each of **two** issues relating to the branding of textile products for adolescents [6 max].

peer pressure to buy particular brand of clothes;  
adolescents might not be able to afford branded textile products;  
so have low self-esteem/get depressed;

models are used to promote branded textile products;  
stereotype/perfect people become role models for adolescents;  
(stereotype) may be unachievable for many adolescents;

temptation to buy the latest item from brand;  
buying more than is needed;  
spending more money or wasting resources;

image associations with a brand;  
adolescents will portray this image;  
it might not be positive, for example, violence/antisocial tendencies;

reduced security / promotes crime;  
counterfeiting of branded products;  
increased risk of mugging/theft;

persuade parents to buy brands;  
pressure on parents / pester power;  
buying things they can't afford/can lead to debt;

branded products are generally more expensive than non-branded products;  
parents/adolescents can't necessarily afford them;  
low self-esteem or buying beyond their means;

belong to a group of people;  
feel important;  
better self-esteem/status;

unbranded products may be seen as inferior/lesser quality;  
impacts on sales;

[6 max]



**D6.** Award [1] for each of three distinct points of explanation of each of **three** advantages of using nylon for an automobile (car) airbag. [3 max] per advantage.

very good strength to weight ratio;  
will resist the force of the rapid inflation/explosion of air into the bag;  
without tearing;

can be packed into a small space;  
it can be used in very thin sections;  
still function effectively;

interaction with the human body;  
will not damage body/skin;  
despite the dynamic interaction of the material with the person;

nylon is a man-made material;  
it is easy to manufacture nylon with different properties;  
the properties required for the airbag are very specific;

readily available material;  
relatively cheap to make/obtain;  
it is cost-effective/easy to manufacture;

non-toxic material;  
easier to dispose of;  
does not cause waste disposal issues after use;

[9 max]

**Option E — Human factors design**

- E1.** (a) Award [1] for stating the type of data scale represented by the general comfort rating scale in Figure E1.  
ordinal; [1]
- (b) Award [1] for stating **one** reason for using this type of data scale shown in Figure E1 and [1] for a brief explanation [2 max].  
it is based on a sequence of numbers;  
the positions on the scale represent some kind of order/progression / there are no fixed units for comfort; [2]
- (c) Award [1] for each of three distinct points of explanation of which point on the comfort rating scale would be appropriate for the design of public seating in a railway station as part of a policy of Design for Discomfort [3 max].  
3;  
the seating should be designed to be comfortable enough for rail users waiting for a train for a limited period of time;  
the designer does not want the seating to be too comfortable so that people use the railway station as a general meeting area/for refuge; [3]
- E2.** (a) Award [1] for stating how designers allow for variations in human dimensions within a particular size.  
adjustability/elastication/stretchy fabric/Velcro/extra buttons/laces/buckles, etc; [1]
- (b) Award [1] for stating the correct percentile range used for shoe sizes for the mass market and [1] for a brief explanation [2 max].  
5<sup>th</sup> – 95<sup>th</sup>;  
economically viable range;  
people with feet sizes outside this range are uneconomical for volume production; [2 max]

- E3.** (a) Award [1] for stating **one** advantage of the door handle in relation to human factors and [1] for a brief explanation [2 max].  
length of handle enhances mechanical advantage;  
reduces force needed to open door;
- easy to use by a wide range of users;  
as it just requires the user to pull the handle down to open the door/no twisting required; [2 max]
- (b) Award [1] for stating **one** advantage of the door knob in relation to human factors and [1] for a brief explanation [2 max].  
smooth surface;  
no sharp edges;
- shape fits into hand;  
helps user to grasp the knob;
- round shape;  
limits the possibility of snagging on clothes;
- easy to use;  
as long as no twisting action is required (if the door is held in place by a ball catch device); [2 max]
- E4.** Award [1] for stating **one** disadvantage of using appearance prototypes at the design development stage and [1] for a brief explanation [2 max].  
they are very expensive to produce;  
need to have good surface finish/be life-size;
- time-consuming to produce;  
extending the design development time;
- they are non-functional/ they model appearance not functionality;  
which limits the feedback for further design development; [2 max]

**E5.** Award [1] for each of three distinct points in a discussion of each of *two* human factors considerations in the design of *The Butterfly Stool* shown in Figure E4 [6 max].

no back support;

the user will need to adopt an upright posture;

to prevent discomfort/potential back pain;

no arm rests;

the user will need to sit on the stool carefully;

and use a lot of leg muscle/power to stand up after sitting;

curved ends of the seat;

stops the user slipping sideways off the stool;

and gives more support than a conventional flat surface;

could be a problem if too narrow for some users;

hard surface;

likely to be uncomfortable/number 3 on the comfort rating scale;

when sitting for a lengthy period of time;

gap in the middle of the seat;

could pinch the skin;

or snag on clothing;

[6 max]

**E6.** Award [1] for each of three distinct points in a discussion of each of **three** pieces of legislation which impact on human factors aspects of the design of an open-plan office [9 max].

temperature;

legislation states the minimum and maximum temperature range for offices;

employees can legally refuse to work in an office outside the range;

lighting levels;

must be appropriate to task being undertaken;

legislation states the minimum and maximum light levels in an office environment;

light spread evenly/no glare;

noise;

legislation states the maximum noise level in an office environment;

employees can legally refuse to work in an office with noise limits in excess of the maximum;

size of computer work stations;

legislation states the minimum dimensions for worktops to be used for computers;

and the distance between users;

seating;

legislation states that computer users must have chairs which are adjustable;

for height and posture;

eye strain;

legislation is in place to ensure users do not suffer eye strain from computer screen glare;

employers may offer to pay for an annual eye test for employees who constantly use computers;

back strain;

legislation states the maximum loads workers are allowed to carry;

on level floors/up and down stairs;

trip hazards;

legislation states that cables must be secured to surfaces;

carpets not worn/frayed at the edges, etc;

fire regulations;

clear access to fire exits required;

for maximum number of occupants/all areas;

mandatory health and safety considerations;

must not be compromised in the design of the open-plan office;

fire exits/extinguishers / smoke detectors, etc;

[9 max]

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