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MARKSCHEME

May 2012

DESIGN TECHNOLOGY

Standard Level

Paper 3

22 pages

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General Marking Instructions

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

Note:

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

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

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

2. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.**

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

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

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

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

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

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

9. For each Option: Add the totals for each question in the Option and write it in the Examiner column on the cover sheet.
   Total: Add the marks awarded and enter this in the box marked TOTAL in the Examiner column on the cover sheet.

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

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

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

13. Mark positively**.** Give candidates credit for what they have achieved and for what they have got correct, rather than penalizing them for what they have got wrong. A mark should not be awarded where there is contradiction within an answer. Make a comment to this effect in the left hand margin.

Subject Details: Design Technology 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. Do **not** award more than the maximum marks allowed for part of a question.

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

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

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

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

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

7.   If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing **OWTTE** (or words to that effect).

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

9.   Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. Indicate this with **ECF** (error carried forward).

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

11.   Do not penalize candidates for errors in 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 the pasteurisation process extends the shelf life of the milk.*
it kills off the bacteria in the milk;
(*do not accept "kills off bugs"*)   *[1]*

(b) *Award [1] for each of two correct distinct correct points in an outline of one way in which Ultra Heat treatment (UHT) affects the organoleptic properties of milk [2 max].*
changes the taste/tainted;
burning of sugars sweetens the taste;   *[2]*

(c) *Award [1] for each of three correct distinct points in an explanation of why powdered (dried) milk has such a long shelf life [3 max].*
dried milk has a low water activity;
bacteria/microorganisms cannot grow in low water activity conditions;
therefore the milk does not undergo microbiological spoilage/has a long shelf life;   *[3]*

A2. (a) *Award [1] for stating the role of protein in the body.*
building/repairing of body tissues;
production of enzymes and hormones;
production of antibodies that enable the body to fight infection;
supply of energy;   *[1 max]*

(b) *Award [1] for each of two effects of protein deficiency [2 max].*
stunted growth;
kwashiorkor;
marasmus;   *[2 max]*

A3. (a) *Award [1] for a reason for the increasing popularity of foods such as Pot Noodle and [1] for a brief explanation [2 max].*
cost;
they are relatively cheap;

convenience;
no preparation/limited cooking equipment required;

cooking skills;
easy to prepare/no knowledge/experience required;

shelf-life;
dried food, therefore long lasting/can be stored for extended periods;

availability of microwave ovens;
for quickly heating pre-prepared (fast) foods;

lifestyle;
fast pace of life requires fast food;   *[2 max]*

(b) *Award [1] for each of two correct distinct points in a description of how market testing would be used in the development of the Pot Noodle food product [2 max].*
to ensure that the food product meets the needs of its market;
appropriate flavour/texture characteristics (level of spiciness, *etc.*);   *[2]*

A4. *Award [1] for each of two factors which determine the need for primary processing of food commodities [2 max].*
enhanced storage properties/shelf life;
reduction of volume;
reduction of weight;
reduced energy consumption in distribution;
removal of contaminants;   *[2 max]*

A5. *Award [1] for each of three correct distinct points in a comparison of food allergy and food intolerance in relation to impact on diet [3 max] per issue.*

	Food allergy	**Food intolerance**
Nature of reaction	hypersensitivity to dietary substances;	an adverse food-induced reaction;
Effect on the body	provokes an immune response;	does not involve the immune system;
Timescale of reaction	acute/extreme reaction;	chronic reaction/builds over time;
Level of contact with food stuffs	cannot come into contact with any of the food stuff that is allergic to;	can choose to eat a limited amount of the food;
Specificity	individual food allergy;	range of foods with common elements;
Labelling requirements	mandatory;	not mandatory;

[6 max]

A6. *Award **[1]** for each of three correct distinct points in an explanation of why it is important for governments to raise public awareness of food-related health issues with reference to moral, social and economic responsibilities **[3 max]** for each factor.*

Moral responsibilities:
raising public awareness of the issues can encourage better eating habits;
this will result in a better quality of life;
and reduced incidence of disease;

Better eating habits:
lower incidence of food-related health issues;
better quality of life;

Economic responsibilities:
educating consumers regarding food-related health issues allows them to take responsibility for themselves when choosing diet;
reduces the pull on human resources/healthcare;
allows these resources to be allocated elsewhere;

Social responsibilities:
provide networks of care/advice;
food can cause chronic health problems in certain social groups;
but also have a wider impact on society as a whole;

School programme/health care visitors/health education:
uses a variety of media to get the message across;
targeting particular social groups *e.g*. young consumers;

Food can cause acute health problems *e.g*. food poisoning:
a large number of people can be involved at any point in time if a hotel, restaurant or public institution is involved;
this can overwhelm health services;   ***[9 max]***

Option B — Electronic product design

B1. (a) *Award [1] for stating the name of Component A.*
transistor;   *[1]*

(b) *Award [1] for identifying the purpose of component P1 in relation to the exterior solar lamp and [1] for a brief explanation [2 max].*
variable resistor;
it allows the user to determine the light level at which the lamp switches on;   *[2]*

(c) *Award [1] for each of three correct distinct points in an explanation of the operation of a comparator [3 max].*
saturation can be positive or negative;
if the non inverting input is of a higher voltage, the output of the op-amp should saturate positive (+V);
if the non inverting input is of a lower voltage, the output of the op-amp should saturate negative (–V);

when the light level drops R (LDR) increases and voltage at input 2 of the comparator falls;
when the voltage (at pin 3) drops below the pre-set voltage the inverting action of the amplifier causes the output voltage to rise;
the very high gain ensures that it rises to saturate at the positive supply voltage;   *[3 max]*

B2. (a) *Award [1] for stating one advantage of converting a telephone system from analogue signal to digital signal.*
speed of signal;
increased quantity of information;
bandwidth;
quality of signal;
reliability of signal;
compatibility with different input and output devices;
increased security/encryption possibilities   *[1 max]*

(b) *Award [1] for each correct distinct point in an outline of one reason why some telephone systems are still analogue [2 max].*
cost;
installing a digital signal requires significant capital expenditure;

availability of the technology;
some countries/locations may not have access to the digital technology/equipment;

user needs;
may not be the demand for digital system;

timescale;
conversion from analogue to digital may be spread over many years;   *[2 max]*

B3. (a) *Award [1] for each of two correct distinct points in a description of how the system shown in Figure B3 operates [2 max].*
when a car moves over the wire, it alters the magnetic field;
the sensors in the system computer detect a change in the input current;

the car alters the frequency of oscillation;
the computer detects the change in frequency; *[2 max]*

(b) *Award [1] for identifying one limitation of the use of the underground electrical wire for other road users and [1] for a brief explanation [2 max].*
bicycles would not affect the magnetic loop;
the traffic light output would not change/they will be stuck for a while; *[2]*

B4. *Award [1] for identifying one benefit for the user in purchasing electronic products which are based on generic standards and [1] for a brief explanation [2 max].*
reduced cost;
savings passed on from manufacturers using generic systems in their products;

function;
enables inter-operability between devices;

convenience;
user doesn't have to search for/decide which peripheral components are needed;

improved reliability;
R&D is focussed on the same design for parts/parts are standardised;

maintenance;
easier to get replacement parts/repair/recondition; *[2 max]*

B5. *Award [1] for each of two distinct issues and [2 max] for each point relating to each issue when considering implementing an information transfer system using copper wires [3 max] per issue.*
copper wires have limited bandwidth;
can only support a limited number of users;
are therefore not cost effective;

copper is a limited resource;
copper wire is relatively expensive;
recycled copper is not appropriate for this application;

electrical noise is electromagnetic;
making copper wire vulnerable to interference;
limiting its capability to transfer information;

copper cables suffer significant Ohmic loss;
signal amplifiers are required;
so signals can be transmitted over long distances;

copper is a soft metal;
it needs protecting from external damage;
regular maintenance is required;   *[6 max]*

B6. *Award [1] for each of three correct distinct points in a discussion of three reasons why Programmable Interface Controllers can be considered sustainable technology [3 max] per reason.*
extend the life of the product;
through downloading software upgrades/reprogrammable;
enabling enhanced functionality;

reduced amounts of raw materials;
low volumes of silicon are used in their production;
which is non toxic/readily available;

low energy usage;
reduces battery consumption during life;
fewer batteries are used;

allows miniaturization;
reduced number of components;
less material required for encasing the product/reduces waste for landfill;   *[9 max]*

Option C — CAD/CAM

C1. (a) *Award [1] for stating one disadvantage of a subtractive process.*
it produces waste material;   *[1]*

(b) *Award [1] per correct distinct point in an outline of how the CNC machine settings would need to be changed to cut thin card rather than plastic [2 max].*
feed speed could be increased;
with same power setting;

power of laser could be reduced;
at same feed speed;   *[2 max]*

(c) *Award [1] for each correct distinct point in an explanation of one advantage of using a laser cutter rather than a CNC router to make the sign in Figure C1 from a thermoplastic in relation to quality of finish of the lettering [3 max].*
only one cut is needed with a laser cutter/laser more accurate;
while a CNC router would use multiple paths;
so the laser cutter produces a smoother surface finish;   *[3]*

C2. (a) *Award [1] for stating the characteristic of the liquid resin used in stereo lithography that makes it appropriate for 3D printing.*
photosensitivity;   *[1]*

(b) *Award [1] for each correct distinct point in an outline of one limitation of rapid prototyping for volume production [2 max].*
cost per unit is high;
manufacturing time is comparatively slower than volume production techniques;

surface finishing is poor;
due to the resolution of the layers;

slow process;
part is built up in layers;

suitability of material in different contexts;
RP materials do not have the same properties if formed using other techniques;   *[2 max]*

C3. (a) *Award [1] for each correct distinct point in a description of the relationship between the X, Y and Z axis of the CNC router and the manufacture of the part in Figure C3 [2 max].*
X and Y axis control the direction of cut;
Z axis controls the cutting depth;

X and Y axis work in the horizontal plane;
Z axis in the vertical plane; *[2 max]*

(b) *Award [1] for each correct distinct point in an outline of one way in which the machine tool step variable will determine the quality of the chair seat shown in Figure C3 when using a ball nose cutter [2 max].*
the machine step variable controls the quality of the cut and the surface finish;
if reduced the surface finish will be of higher quality;

the machine tool step variable/stepover should be reduced;
in order to reduce the ridge size/stepover distance to create an accurate profile/shape; *[2]*

C4. *Award [1] for each correct distinct point in an outline of one benefit of using CAD/CAM to create lost wax castings [2 max].*
cost effective;
much quicker process with CAD/CAM than traditional design and manufacture of the mould;

complexity of the design;
CAD/CAM can be used to create a detailed/precision mould;

skills required;
hand crafting skills are eliminated allowing access to a wider range of people; *[2 max]*

C5. *Award [1] for each correct distinct point in a suitable explanation of two differences between haptic technology and virtual reality [3 max] per difference.*
feedback;
user has more control over the environment with haptic technology;
the virtual reality environment is pre-determined;

feedback;
in haptic technology mechanical actuators apply force to the user so s/he can feel the action;
in virtual reality the action is all visual;

the environment can stimulate changes/decisions by the user;
so with haptic technology response time is improved;
a virtual reality environment requires the user to be more passive;

haptic technology provides feedback on the users' movements/physiology which is not possible with virtual reality;
this provides the designer with detailed information about how the user physically interacts with the environment;
which would be very difficult to replicate without the use of haptic technology; *[6 max]*

C6. *Award [1] for each correct distinct point in a discussion of each of three issues in relation to the design of the flat pack furniture shown in Figure C7 for its manufacture using CNC machinery [3 max] per discussion of each issue.*
efficient use of material is required to minimise costs;
nesting of components helps to reduce wastage;
a common thickness of material is often used;

size and range of tooling available;
to design beyond their capabilities;
without the expense to design and make specialist tooling;

maximum machine bed size;
to make efficient use of sheet material;
and not design parts larger than the capabilities of the machine;

the designer must consider the range of fixings available;
by using standard components;
costs can be reduced;

edges of material will require finishing after machining;
to enhance the aesthetics of the product;
and add protection against possible damage;

the veneer will be very thin;
the designer must ensure that the product can be manufactured with the CNC equipment without damaging the veneer;
the designer must consider how to fix the material in place when using the CNC machine; *[9 max]*

Option D — Textiles

D1. (a) *Award [1] for stating one reason why retailers might choose the Supertag rather than the Unisen Duraltag.*
visibility/you can see it more easily;
deters consumer theft;
ease of handling by retail staff;   *[1 max]*

(b) *Award [1] for each correct distinct point in an outline of one reason why the tagging systems are only suitable for soft goods [2 max].*
the pin makes a hole;
which may cause damage to some fabrics;

the weight of the tag;
can distort fabrics with low dimensional stability;   *[2 max]*

(c) *Award [1] for each correct distinct point in an explanation of why the tagging systems are more popular with department stores than small shops [3 max].*
staffing levels;
small shops tend to have a better ratio of staff to customers;
so supervision of customers is easier and negates the need for the tags;

layout;
department stores tend to have a large amount of garments on display;
customers can mingle freely between displays/racks;
small shop layout is more compact and easier to oversee;

customer service;
small shops may provide a more personal service;
they do not want to give the impression they expect customers to steal;

cost;
small shops may not be able to absorb the cost of the system;
due to a small turnover of products/the price products are sold;   *[3 max]*

D2. (a) *Award [1] for stating one characteristic of silk that makes it suitable for undergarments for mountaineers.*
insulating;
breathable/hypoallergenic;
absorbent;
lightweight;
easy to care for;
comfort;
exothermic;
smooth surface/texture;
tactile quality;   *[1 max]*

(b) *Award [1] for identifying the most suitable manufacturing technique and [1] for clarification of the relevance of the technique [2 max].*
knitting;
dimensional stability/the fabric can stretch in all directions for added comfort;   *[2]*

D3. (a) *Award [1] for a correct point and [1] for clarification relating to one advantage of using CAD to design the fabric [2 max].*
feedback from the client;
designs can be altered easily and customised;

simulate the fabric in the clients environment (using virtual reality);
ensure it meets the client's needs before production;

quicker/cheaper to design;
shorter lead time;   *[2 max]*

(b) *Award [1] for a correct point and [1] for clarification relating to one issue that the designer must consider when designing the fabric for production using CAM [2 max].*
compatibility with software/hardware/complexity of design;
otherwise the design will not be able to be manufactured by CAM/may provide a poor quality product;

suitability of design/chosen material;
must suit machining processes;

capability of the CAM machine in relation to the size of machine;
the design must be able to work at the intended scale;   *[2 max]*

D4. *Award [1] for a correct point and [1] for clarification of the point for an advantage of using lace to create underwear [2 max].*
aesthetics;
consumer appeal/sensual;

breathability;
open fabric with lots of holes/allows air to circulate;

fine threads/creates a fine fabric;
not bulky under clothes;   *[2 max]*

D5. *Award [1] for each correct distinct point in a discussion of two disadvantages of the method of producing stain resistant carpets [3 max] per disadvantage.*
type of chemicals used in the treatment;
can be hazardous to manufacturer/user/pets;
chemical waste is produced;

maintenance;
limited product life;
the user has to pay for it to be reapplied at intervals;

cost;
an additional stage;
applying chemicals will add to cost;   *[6 max]*

D6. *Award [1] for each correct distinct point in a discussion of three issues relating to branding of sports clothing as a global market strategy. [3 max] per issue.*
image;
the brand logo communicates the company ethos;
the image and the brand is seen as culturally acceptable globally;

product differentiation;
sports clothing market is highly competitive;
the brand helps the product to stand out in the market place;

branding makes marketing more effective;
reinforces the brand identity;
product placement/celebrity endorsement;

copyright/intellectual property;
once the brand has been established/a market pull has been achieved;
companies need to invest in brand protection;

people develop emotional attachments to brands;
which makes the launching of new products under the same brand name more cost effective;
can underpin corporate growth strategy/long term growth;

price/value/tend to be expensive;
for some consumers the appeal of the brand is exclusivity;
this makes the product aspirational;

social sustainability;
must have items/peer pressure/teenage pressure on parents;
can lead to social problems such as theft/credit card debt;   *[9 max]*

Option E — Human factors design

E1. (a)   *Award [1] for stating the adult percentile which would be used to decide the height of the wall unit*
       5th (percentile);   *[1]*

   (b)   *Award [1] for each of two pieces of anthropometric data required to determine the depth of the base unit to allow users to gain access to the wall mounted socket [2 max].*
       reach/arm length;
       abdominal allowance;   *[2]*

   (c)   *Award [1] for each correct distinct point in a suitable discussion of how the user would make best use of the kitchen units for storage in terms of efficiency and safety [3 max].*
       heavy items stored in the base units;
       light items in the wall units;
       items most frequently used stored in cupboards with easiest access/near to appliances to be used *e.g.* saucepans in the cupboard nearest to the hob;   *[3]*

E2. (a)   *Award [1] for stating one reason for using polymorph modelling material in the design development stage of body armour for skateboarders.*
       economical to use;
       re-usable;
       pliable/can be shaped to body parts;   *[1 max]*

   (b)   *Award [1] for each correct distinct point in an outline of one reason why the use of polymorph modelling material can contribute to a green design strategy [2 max].*
       biodegradable;
       no waste disposal issues;

       reusable/recyclable;
       reduction in landfill/use of raw materials/energy;   *[2 max]*

E3. (a) *Award [1] for each correct distinct point in a description of how the designer has combined ease-of-use with aesthetics for the storage unit [2 max].*
retractable/pull-out shelves;
with easy access to items;

uniform appearance when the shelves are closed;
no collision danger when not in use/visual appeal;

easy to grip front of shelves;
but the handles lie flush with the front of the unit when closed;   *[2 max]*

(b) *Award [1] for each correct distinct point in an outline of one limitation of the storage unit in relation to bodily tolerance [2 max].*
the user has to twist his/her body to reach the printer when seated at the desk;
which can cause fatigue/injury;   *[2]*

E4. *Award [1] for each of two objectives of annual product safety testing for electrical equipment [2 max].*
compliance with health and safety regulations;
to identify possible causes of misuse;
social responsibility of employer to employee;
identify risk assessment issues;
identify faults/damage to products;
give users confidence;   *[2 max]*

E5. *Award [1] for each correct distinct point made as part of a suitable discussion of two user considerations for the adoption of the Maltron keyboard as a mass market product [3 max] per consideration.*
aesthetics;
the keyboard is an unusual shape;
which may not fit in with a workstation layout;

intuitive behaviour;
the user will probably be adept at using a conventional keyboard;
so will have to unlearn behaviour to use this one;

training;
the user will need to spend time learning how to use the keyboard;
and might not feel that the potential benefit of changing to this type of product is worth the effort;   *[6 max]*

E6. *Award* **[1]** *for each correct distinct point in a discussion of three issues relating to displacing population stereotypes in the design of controls for products.* **[3 max]** *per issue.*

people become used to how controls work for a product;
they often do not think about how to use the controls;
but they use them intuitively;

people come into contact with familiar products;
but sometimes in unfamiliar contexts *e.g.* a telephone in a hotel room;
if the controls work differently to the product they are most familiar with they may misuse the product/become frustrated with it;

safety;
if a user assumes a product works in a particular manner;
they may misuse the controls which could cause a safety problem;
e.g. leaving a gas tap on;
(accept a suitable example)   **[9 max]**