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MARKSCHEME

NOVEMBER 2010

DESIGN TECHNOLOGY

Standard Level

Paper 3

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 to show that these marks have been transferred to the appropriate square bracket 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 front cover.
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 front cover 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 front cover**.

13. 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 the name of the process which causes the dough to double in volume as shown in step 6.*
aeration; *[1]*

(b) *Award [1] for identifying a reason for adding yeast to the pizza dough as shown in step 1 and [1] for a brief explanation.*
fermentation/the yeast produces carbon dioxide from the carbohydrate;
the carbon dioxide aerates the dough and increases its volume; *[2]*

(c) *Award [1] for each of three distinct correct points in an explanation of why the recipe for the pizza dough would have to be modified so that it would be suitable as part of a gluten-free diet.*
wheat flour contains gluten;
a considerable number of people suffer gluten intolerance/coeliac disease;
(symptoms include chronic diarrhoea and fatigue in adults and failure to thrive in children);
the wheat flour in the recipe needs to be replaced with a gluten-free alternative, *e.g.* potato flour or rice flour; *[3 max]*

A2. (a) *Award [1] for a definition of water activity to the effect of:*
water in food not bound to food molecules which can support the growth of microorganisms (bacteria, yeasts and fungi) and is measured on a scale of 0 to 1.0; *[1]*

(b) *Award [1] for each of two methods of food preservation which reduce the water activity of foods.*
dehydration;
use of sugar;
use of salt; *[2 max]*

A3. (a) *Award [1] for inserting the right numbers into the equation and [1] for a correct answer, including units.*

$$\frac{125}{(1.9)^2} \; ;$$

34.62 kg m^2 ;   *[2]*

(b) *Award [1] for identifying a reason why governments should raise public awareness of health issues relating to obesity and [1] for a brief explanation.*
increased risk of a range of serious health issues (*e.g.* high blood pressure, diabetes, heart disease, stroke cancer);
resulting in long-term illness;

social responsibilities of government;
informing of the potential for premature death;

they put pressure on the health services for long-term care;
this can cost the government a lot of money;

obesity causes low self-esteem;
this can lead to depression and added pressure on health services;

moral responsibility;
to educate/inform people of health risks/lifestyle choices;   *[2 max]*

A4. *Award [1] for each of two distinct correct points in a description of the role of emulsifiers in stabilizing food emulsions.*
emulsifiers are surface-active agents with a hydrophilic head and a hydrophobic tail (or see diagram);
they arrange themselves at the oil-water interface in an emulsion to prevent the oil droplets coalescing and so stabilize the emulsion;
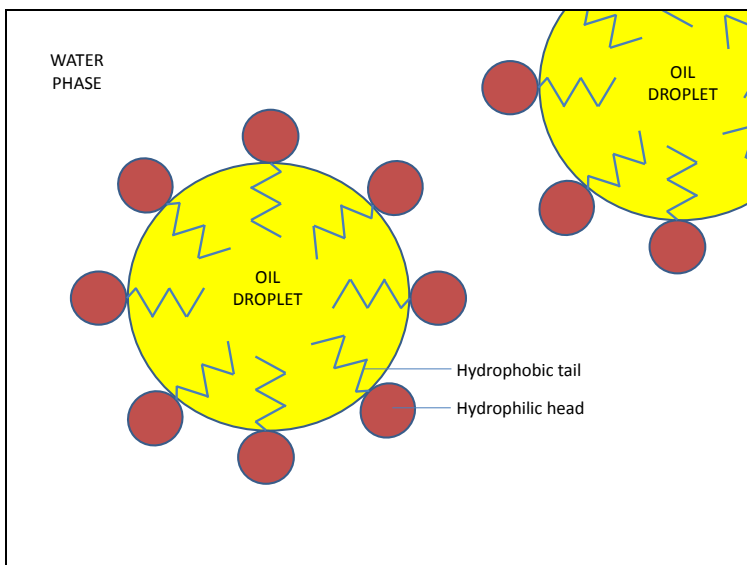
                                                                                                    [2 max]

A5. *Award [1] for identifying and [1] for each of two distinct correct points of explanation.*
Market pull:
finding a market is critical to new food product development;
market pull results from consumer demand;
consumers want more choice, more convenience, cheaper foods, longer shelf lives;

Technology push:
new technologies can enable food product innovation;
this can lead to new food products, *e.g.* snack foods, convenience foods;
or it can lead to the enhancement of existing food products, more convenient, longer
shelf lives;   *[6]*

A6. *Award [1] for each of three distinct issues relating to the effectiveness of legislation governing food labelling as a means of altering diet [3 max] for each issue.*
dietary habits are a combination of culture and habit;
food habits are very resistant to change;
individuals must choose to change and food labelling is unlikely to have much impact on consumer decision-making;

food labels provide a range of information;
this information may not be readily understood by consumers;
labelling relates to a specific product not to how that product is used as part of a balanced diet/in combination with other ingredients/food items;

many government initiatives, *e.g.* the traffic light system, focus on fat, fibre, sugar and salt intakes;
these relate to issues of high public concern, *e.g.* heart disease and diabetes;
public reaction against the "nanny state" so that people ignore the information on the label;

different supermarkets provide labelling in different ways;
some ways may be less easily understood by consumers;
this can lead to confusion;

some labelling is not related to legislation *e.g.* "farm assured";
but manufacturers/retailers use the label as a form of promotion/quality assurance and place the label in a prominent position;
consumers may only notice this type of label and not others hidden on the back of the package;

many consumers purchase their food regularly from large retailers *e.g.* supermarkets;
they place trust in the retailer to ensure food complies with legislation;
so do not feel the need to examine labels themselves;

consumers need to be aware of what to look for on a label;
many consumers are ignorant of this issue;
labels based on legislation are usually not very prominent on packaging;

many consumers are pressed for time when shopping;
and may be distracted by other things *e.g.* conversations with people, looking after their children;
so they do not have the time/opportunity to examine the labels on products;   *[9 max]*

Option B — Electronic product design

B1. (a) *Award [1] for stating the logic gate labelled X in Figure B1.*
         AND gate;   *[1]*

(b) *Award [1] for a correct response to E and [1] for a correct response to F.*

B	A	E	F
0	0	**1**	**0**
0	1	**1**	**1**
1	0	**0**	**0**
1	1	**0**	**0**

[2 max]

(c) *Award [1] for each distinct correct point in an explanation of the combination of switches needed to be pushed to open the lock mechanism.*
         A, C and D;
         NOT B,
         $F = 1$ when A and NOT $B = 1$;
         $G = 1$ when C and $D = 1$;
         $Q = 1$ when F and $G = 1$;   *[3 max]*

B2. (a) *Award [1] for a definition of programmable interface controller (PIC) to the effect of:*
         microchips that can be programmed to simulate an integrated circuit and then used in electronic projects;   *[1]*

(b) *Award [1] for identifying one way in which a PIC can extend the product life of a hearing aid and [1] for a brief explanation.*
         PICs are reprogrammable;
         a hearing aid PIC can be reprogrammed to match a person's hearing;   *[2]*

B3. (a) *Award [1] for identifying the ratio of R_f to R_a to achieve an amplification of ten times and [1] for a brief explanation.*
         R_f must be nine times R_a;
         gain $= 1 + R_f / R_a$;   *[2]*

(b) *Award [1] for stating why R_a and R_f should not be very low (e.g. less than 1 kΩ) and [1] for stating why they should not be very high (e.g. more than 10 kΩ).*
         if too low then excessive current and energy will be wasted;
         if too high then damp air and other components will affect the ratio;   *[2]*

B4. *Award [1] for identifying one advantage of a single mode fibre optic cable over a multi-mode fibre optic cable and [1] for a brief explanation.*
in a single mode fibre optic cable there is only one path for light so there is no dispersion;
there is no need for frequent regeneration;

in a multi mode fibre optic cable the light waves take different paths through the cable and arrive at different times;
so the pulses degrade;   *[2 max]*

B5. (a) *Award [1] for each of three distinct correct points in an explanation of why the component values given for the resistor and capacitor are suitable for producing a time of approximately 20 seconds.*
the time constant $T = 0.63\,C.R$ seconds;
$T = 0.63 \times 320000 \times 0.000100$ seconds;
$T = 20.16$ seconds;

(b) *Award [1] for each of three distinct correct points in an explanation of the effect of connecting a 200μF capacitor in parallel with the 100μF capacitor on the duration of the logic 0 output.*
$100\mu F + 200\mu F = 300\mu F$;
$T = 0.63 \times 320000 \times 0.000300$ seconds;

B6. *Award [1] for each distinct correct point in an explanation of the limitations of an open loop control system [3 max] and how positive and negative feedback [3 max] each are used in a closed loop system to overcome these limitations.*

Limitations of an open loop system:
there is no way of knowing if the output has responded to a change in the input;
the output may be affected by the loading on the system;
no sensor monitors the output and feeds back information about the current state of the output in comparison with the input requirement;

How positive feedback is used:
positive feedback occurs when an effect causes more of itself;
it can be used to make a device oscillate between its maximum and minimum states;
it is used when rapid, decisive switching or oscillation is needed;

How negative feedback is used:
negative feedback is used to correct output errors or to lower output to a pre-determined level;
it is used to stabilise a system;
e.g. the rotational speed of a lathe;   *[9 max]*

Option C — CAD/CAM

C1. (a) *Award [1] for stating one benefit for the manufacturer of using a CNC router for the manufacture of the Ben Wilson Chairfix design shown in Figure C3.*
less waste as parts tessellate together and would still be able to be cut;
accuracy when making pairs/multiples of a shape;
lower cost than conventional means; *[1 max]*

(b) *Award [1] for each distinct correct point in a description of how the straight cutting tool would be used to make the part in Figure C3 and [1] for a brief explanation.*
straight cutting tool programmed to remove material around each part very accurately;
at right angles to surface of the material; *[2]*

(c) *Award [1] for each of three distinct correct points in an explanation of how the CNC machine aids manufacture.*
accuracy/precision;
repeatable quality;
more effective manufacture;

global communication systems mean CNC machine data can be sent anywhere in the world;
this means the manufacturer can separate design and manufacture;
manufacturing of product can be completed wherever most cost effective in terms of material or labour costs;

flexible manufacturing;
CNC machine can be reprogrammed for different products;
reduced down-time between batches or one-off production; *[3 max]*

C2. (a) *Award [1] for a definition of feed speed to the effect of:*
the rate at which the cutting tool moves along the X, Y and Z paths; *[1]*

(b) *Award [1] for identifying one reason why feed speed is changed to suit material and tooling properties and [1] for a brief explanation.*
hardness of material;
harder materials, *e.g.* metals, cut at lower feed speeds than less hard materials, *e.g.* wood;

larger diameter tools waste more material than smaller diameter tools;
lower feed speeds; *[2 max]*

C3. (a)   *Award [1] for identifying the process which would be used to produce the back of the chair shown in Figure C4 from a 2–D sketch and [1] for a brief explanation.*
extrude (3–D effects);
need to specify the height of the extrusion;   *[2]*

(b)   *Award [1] for identifying the process which would be used to produce the wheel shown in Figure C5 and [1] for a brief explanation.*
revolve;
360 degrees around an axis;   *[2]*

C4.   *Award [1] for each of two input devices which can be used with CAD.*
2–D scanner;
3–D scanner;
digital camera;
graphics tablet;
keyboard;
mouse;   *[2 max]*

C5.   *Award [1] for each of three distinct correct points in a discussion of each of two ways in which CAD has affected consumer choice when considering a kitchen design [3 max] per way.*
CAD can produce high quality 2–D images of layouts and designs quickly;
clients are often non-specialists;
the images help the client visualize the design;

the design can be modified easily in discussion with the client;
alternative designs/colours for the different elements of the kitchen can be offered;
virtual modelling reduces wastage of resources/saves time;

consumers can take their time to consider their options;
they can visualise the CAD images on their own computer at home;
allowing a more informed choice/comparison with other ideas;

the CAD package can include automatic updating of costs;
as consumers consider different options;
they can easily compare price with value;

consumers can communicate with the designer/manufacturer electronically;
so they do not need a face-to-face meeting to discuss options;
this gives the consumer much more choice in the marketplace;   *[6]*

C6. *Award [1] for each of three distinct points in a discussion of three benefits of using rapid prototyping for the designers of electronic products [3 max] for each benefit.*
good for batch and one-off production;
working models can be easily produced;
use for market research/product testing;

reduced costs/lead times;
design developed with CAD;
manufactured cost effective with rapid prototyping;

reduced flexibility in relation to use of materials;
design for materials;
may limit design options;

reduced flexibility in relation to manufacturing strategy;
design for process;
may limit design options;   *[9 max]*

Option D — Textiles

D1. (a) *Award [1] for identifying a reason why care labelling for textile products should be mandatory.*
consumers, drycleaners and launderers need to select the correct care treatment;
the useful life of a textile product will be prolonged by using the correct care;
so that textile products will not be damaged by improper care;   *[1 max]*

(b) *Award [1] for identifying a reason why the care instructions should be accessible at the point of sale and [1] for a brief explanation.*
consumers need to be aware of how to care for products when they purchase them/consumers need to consider the cost of caring for products when they purchase them;
if specialist care is required the consumer may prefer not to purchase the product;   *[2]*

(c) *Award [1] for each distinct correct point in an explanation of why there is a need for international standards for care labels.*
fabrics are global products;
a garment produced in one country may be sold in another;
therefore they need to be understood in different language contexts;

market development;
garments intended for global markets;
need to take into account facilities for care of fabrics in different regions *e.g.* dry cleaning facilities;   *[3 max]*

D2. (a) *Award [1] for stating a property of silk.*
(very) absorbent / absorbs a large amount of water before it feels wet;
(very) strong material;
(very) high tensile strength;
light in weight;
inelastic;
melts on heating;   *[1 max]*

(b) *Award [1] for identifying a reason why silk production promoted international trade and [1] for a brief explanation.*
silk was carried from East to West along the Silk Road;
other products were carried along too and also from West to East;

the Silk Road was the information superhighway of its day;
it helped to disseminate ideas between the East and the West;   *[2 max]*

D3. (a) *Award **[1]** for identifying one way in which VELCRO$^{®}$ is an example of biomimetics and **[1]** for a brief explanation.*
the idea for the hook and loop system is taken from nature;
it is applied to the development of the VELCRO$^{®}$ product; **[2]**

(b) *Award **[1]** for identifying one advantage of using VELCRO$^{®}$ for the fastener of the child's trainer shown in Figure D4 and **[1]** for a brief explanation.*
quick and easy for children to put on and take off;
children may not be good at tying laces or doing buckles;

strong fastening;
remains fastened even under considerable pressure;

flexible fastening;
can accommodate odd shaped feet; **[2 max]**

D4. *Award **[1]** for each distinct correct point in a description of how a packaging material can affect the promotion of textile products.*
adds to the attractiveness of the product;
can make it a more desirable item and promote sales;

need to protect delicate fabrics en route to customer;
they need to arrive in the same state as they left the factory;

advertising:
the image/text on the packaging may entice customers *e.g.* sustainability; **[2 max]**

D5. *Award **[1]** for each of three distinct correct points in a discussion of two ways in which the use of CAM in the textile industry has helped to minimise waste **[3 max]** per way.*
nesting of product components;
can identify how to get the most components of the material virtually;
more efficient use of material;

quality control;
reduction in errors;
fewer faulty products;

24/7 working;
CAM machines do not suffer fatigue;
inconsistency of production due to social/health reasons **[6]**

D6. *Award [1] for each distinct correct point in an explanation of three factors that contribute to expansion of the textile industry due to automation [3 max] for each reason.*
global markets;
textile products are now manufactured and distributed world-wide;
automation facilitates mass production for enlarged market;

globalisation;
manufacturers from across the world are able to take on orders;
makes textile market very competitive;

economic considerations;
automation more cost-effective;
reduced cost per garment;
this increases demand for products/increases market;

mass customisation;
sophisticated automation processes allow consumers to customise products;
increases consumer choice/demand;   *[9 max]*

Option E: — Human factors design

E1. (a) *Award [1] for stating one characteristic of a product which becomes a global success.*
easily understood across cultures;
perceived need for product;
"must have" product / provides status to its owner;
suitable for different market sectors; *[1 max]*

(b) *Award [1] for identifying one way in which the simplicity of the iPod's user interface has contributed to its success and [1] for a brief explanation.*
it is very simple/attractive/intuitive to use;
so it is not a barrier to success; *[2]*

(c) *Award [1] for each of three distinct correct points in an explanation of why participatory design involving users helps designers to develop good user interfaces.*
it is difficult for the designer to understand all users' requirements;
a designer needs to look at the product through the eyes of a prospective user;
interacting with users which they undertake specific tasks enables the designer to understand why an interface may not be easy to learn; *[3]*

E2. (a) *Award [1] for a definition of population stereotype to the effect of:*
aspects of a design operate in the way that is consistent with deeply-ingrained cultural norms; *[1]*

(b) *Award [1] for a description of the relevance of population stereotypes in the design of controls for products.*
products which work as the user might expect from the population stereotype are easier to learn;
those which work in an unexpected way may be difficult to operate;
the user may intuitively use the controls as they expect them to operate;
controls may be broken/misused causing danger *e.g.* turning a gas tap off the wrong way; *[2 max]*

E3. (a) *Award [1] for identifying one reason why affordance is an important consideration in human factors design.*
affordance is a property of an object that indicates how it should be used;
e.g. on doors, handles are for pulling/push plates are for pushing; *[2]*

(b) *Award [1] for identifying one reason why the use of the push plate on the right-hand door in Figure E2 is a better design for a door that needs to be pushed than the handle and sign used on the left-hand door and [1] for a brief explanation.*
the push plate on the right-hand door indicates simply that the door should be pushed;
the handle on the left-hand door suggests that the door should be pulled and conflicts with the sign that says push and is confusing for users; *[2]*

E4. *Award [1] for listing two pieces of anthropometric data used in the design of a mobile phone.*
finger dimensions;
hand size;
thumb width;
angle/pressure which can be exerted by thumb and various fingers;
viewing angle;   *[2 max]*

E5. *Award [1] for identifying each of two ways in which human factors specialists determine adequate product safety and [1] for each of two distinct correct points of explanation [3 max] per way.*
behavioural testing;
performs a range of activities with the product;
e.g. unpacking, assembly, operation, maintenance;

conceptual testing;
evaluates safety instructions and warning messages;
people are not exposed to hazardous conditions;   *[6]*

E6. *Award [1] for each of three distinct correct points in an explanation of each of three advantages of paper prototyping [3 max] per advantage.*
cheap and easy to implement;
it can be quickly and easily modified and retested in the light of user feedback;
designs can be developed quickly;

it involves users/participatory design/user-centred design;
they represent the target market;
therefore the final design should match the needs of the target market better;

sophisticated designs often involve multi-disciplinary teams;
paper prototyping promotes communication between team members;
promotes a more holistic approach to the design process;

no computer programming is required;
therefore it is platform independent;
it does not require programming skills;   *[9 max]*