Markscheme

May 2015

Design technology

Standard level

Paper 3

18 pages

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

2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.

3. 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.**

4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use RM™ Assessor annotations to support your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.

5. Personal codes/notations are unacceptable.

6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, use the "ZERO" annotation to award zero marks. Where a candidate has not attempted the part question, use the "SEEN" annotation to show you have looked at the question. RM™ Assessor will apply "NR" once you click complete.

7. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers. RM™ Assessor will only award the highest mark or marks in line with the rubric.

8. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp "SEEN" on any additional pages that are blank or where the candidate has crossed out his/her work.

9. There is no need to stamp an annotation when a candidate has not chosen an option. RM™ Assessor will apply "NR" once you click complete.

10. 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. However, a mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the "CON" stamp.

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 <u>underlined</u> are essential for the mark.

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

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

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

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

10.   Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

Option A — Food science and technology

1. (a) *Award [1] for stating one reason for the selection of a head of wheat for both the gluten-free symbols shown in Figures A1 and A2.*

    cereals, *eg* wheat, are a major dietary source of gluten and thus a major problem in relation to gluten intolerance;
    the seed head of the plant is an easily recognizable shape and thus a good visual symbol; **[1 max]**

   (b) *Award [1] for identifying how gluten intolerance impacts on diet and [1] for a brief explanation [2 max].*

    people who suffer gluten intolerance should avoid foods that contain cereals;
    this can be difficult as a lot of processed foods contain wheat flour;

    because wheat flour is used widely in processed foods and recipes;
    it can be difficult to achieve a varied, interesting and balanced diet;

    products containing wheat / gluten in diet need to be replaced;
    by gluten free foods; **[2]**

   (c) *Award [1] for each of three distinct correct points in an explanation of why many food retailers have produced ranges of gluten-free foods [3 max].*

    gluten intolerance is increasingly common;
    food retailers are responding to a distinct market segment;
    the size of the market segment makes gluten-free ranges financially viable; **[3]**

2. (a) *Award [1] for a definition of lifestyle to the effect of:*

    the way a person or group lives, including patterns of social relations, consumption, entertainment and dress; **[1]**

   (b) *Award [1] for identifying a lifestyle factor which impacts on health and [1] for a brief explanation [2 max].*

    working women with less time to cook food for their families;
    increasingly rely on fast/convenience/processed foods which are often high in fat and sugar and low in fibre;

    working men living on their own and not interested in cooking;
    increasingly rely on fast/convenience/processed foods which are often high in fat and sugar and low in fibre;

    young people, *eg* students (males and females);
    increasingly rely on fast/convenience/processed foods which are often high in fat and sugar and low in fibre;

    shift work/changing shift patterns;
    families do not eat together and may be increasingly reliant on fast/convenience/processed foods which are often high in fat and sugar and low in fibre

sportspersons/people with active lifestyles;
may choose to eat more healthily avoiding junk food and reducing intake of
saturated fats and increasing intake of vitamins and proteins;					**[2]**

3.	(a)	*Award **[1]** for each of two distinct correct points in a description of one way in which the packaging of Coca-Cola® has contributed to the development of the Coca-Cola® brand **[2 max]**.*

the red colour/the shape of the bottle/can/the font used/logo;
highly recognizable/distinctive;
are all strongly associated/synonymous with the brand;

The structural design of the packaging is good;
easy to hold/easy to open/recyclable;

aesthetically sound – timeless design;
has provided a consistent image for the product;					**[2 max]**

(b)	*Award **[1]** for one purpose of food labelling and **[1]** for a brief explanation **[2 max]**.*

to provide nutritional information;
nutritional information is designed to help consumers make informed food choices (*eg* to achieve a balanced diet);

to indicate storage information;
correct storage will maximize the shelf life of the product;

to provide serving ideas;
consumers may not be sure how the product should be used

to indicate the ingredients used;
especially those that may cause allergies;					**[2 max]**

4.	*Award **[1]** for each of two distinct correct points in a description of the role of primary processing in the production of food products **[2 max]**.*

storage properties;
to extend the shelf life of the product and prevent food spoilage;

concentrating the product removes water and reduces volume/weight;
to facilitate distribution/reduce energy costs of distribution;
water can be added back during secondary processing;					**[2 max]**

5. *Award [1] for each distinct point in an explanation of two principal causes of chemical spoilage of food [3 max per cause, 6 max].*

enzymic spoilage (or autolysis);
living organisms use enzymes to catalyse chemical reactions in its cells;
after harvesting these enzymes can cause the decomposition of the tissue so the food decays;

rancidity;
relates to the fat/oil content of a food;
chemical breakdown of the fat or oil leads to off-flavours in the food; **[6]**

6. *Award [1] for each distinct correct point in an explanation of the impact of low intakes of protein, carbohydrate and water-soluble vitamins on the body [3 max for each nutrient, 9 max total].*

Low protein:
stunted growth/muscle wasting;
decreased resistance to infection;
in extreme conditions this can lead to kwashiorkor/marasmus;

Low carbohydrate:
low energy production;
difficulty in undertaking physical activity;
tiredness/lethargy/weight loss;

reduced fibre intake;
constipation and bowel issues;
increased risk of digestive cancers and cardiovascular disease;

Low water-soluble vitamins:
B vitamins;
low energy production;
difficulty in undertaking physical activity;
deficiency leads to tiredness/lethargy;
vitamin B1/Thiamine;
deficiency leads to beriberi;
vitamin B2/Riboflavin;
deficiency leads to cataracts/sore tongue/dermatitis;
vitamin B3/Niacin;
deficiency leads to cramps and nausea;
vitamin B6/pyridoxine;
deficiency leads to anaemia and kidney stones;
vitamin B12/cobalamin;
deficiency leads to anaemia;

vitamin C;
important for collagen synthesis;
which is important in tissue integrity;
long-term vitamin C deficiency leads to scurvy; **[9 max]**

Option B — Electronic product design

7.   (a)   *Award [1] for stating the function of the component labelled Y in Figure B1.*

thermistor to sense change in temperature;   **[1]**

(b)   *Award [1] for identifying the function of the arrangement of components X, Y, R_1 and R_2 and [1] for a brief explanation [2 max].*

they act as a bridge circuit/potential divider/voltage divider;
they determine the voltages of the inputs to the terminals of the operational amplifier and whether its output is high or low to drive the transistor and the alarm;   **[2]**

(c)   *Award [1] for each of three distinct correct points in an explanation of how the circuit works so that the buzzer sounds if the freezer malfunctions [3 max].*

if the freezer malfunctions the temperature in the freezer will rise and the resistance of thermistor Y will decrease;
if the voltage at the inverting input (-) is lower than that that of the non-inverting (+) input;
the output of the op-amp will be high (or vice versa);
this will turn the transistor on and the buzzer will sound;   **[3]**

8.   (a)   set user temperature;   **[1]**

(b)   *Award [1] for each of two distinct correct points in a description of how feedback is used in a closed loop control system [2 max].*

the user sets the variable under control, *eg* temperature;
a sensor monitors the output and senses the actual size of the variable and compares it with the required size;
the output is changed to reduce the difference between the variable set and the actual variable;   **[2 max]**

9. (a) *Award [1] for each of two distinct correct points in a description of an optical fibre [2 max].*

a cable made of coated glass or plastic;
covered with a strengthening layer to prevent damage and then a thermoplastic;   **[2]**

(b) *Award [1] for each of two distinct correct points in a description of the role of synchronization in time division multiplexing [2 max].*

TDM splits a signal into distinct time slots;
synchronization ensures the correct recombination of the time slots so the signal can be read correctly;   **[2]**

10. *Award [1] for each of two distinct correct points in a description of Ohm's law [2 max].*

Ohm's law is the mathematical relationship linking electric current, resistance and voltage;
$V=IR$;   **[2]**

11. *Award [1] for each distinct point in an explanation of two benefits for the consumer of a manufacturer adopting a generic standard for a particular function of an electronic product [3 max per explanation, 6 max].*

cost;
to develop the functionality requires R&D;
the cost of the R&D is a fixed cost which would be passed on to the consumer;

interoperability;
the product is likely to be able to integrate with other products using the generic standard;
this makes the product more competitive and gives it an advantage in the marketplace;   **[6]**

12. *Award [1] for each distinct correct point in a discussion of three strategies that can be used to minimize the environmental impact of electronic products on disposal [3 max for each strategy, 9 max total].*

use of temporary fittings/take back legislation;
facilitate ease-of-disassembly and promote reuse and recycling;
reduce waste to landfill;

shredding;
used for small products;
does not promote reuse of components or recycling of materials;

avoiding the use of toxic substances in components/sub-assemblies;
lead, cadmium and other metals are poisonous to living organisms;
if disposed to landfill can poison soil and pollute water courses;

use of shape memory alloys for screws;
change shape on heating to critical temperature;
screws lose threads and fall out;   **[9 max]**

Option C — CAD/CAM

13. (a) *Award [1] for stating the correct name of cutting tool A.*

round nose;   **[1]**

(b) *Award [1] for a reason why the feed rate changes according to the material being processed and [1] for a brief explanation [2 max].*

harder materials / metals require a lower feed rate than softer materials;
if you have it too high the tool will not cut properly / will become damaged;   **[2]**

(c) *Award [1] for each of three distinct correct points in a comparison of the effects of using large or small diameter tools for CNC machining [3 max].*

large diameter tools will carry out the process more quickly than small diameter
tools as they cut out a larger area;
but they cannot cut intricate shapes precisely;
especially where curved surfaces are required;   **[3]**

14. (a) *Award [1] for a definition of numerical control to the effect of:*

automated machines that require data to be (inputted manually by a trained
operator);   **[1]**

(b) *Award [1] for identifying a reason why numerical control machines are preferred by some manufacturers to CNC machines and [1] for a brief explanation [2 max].*

numerical control machines are suitable for producing designs which are
repetitive in nature, *eg* carpets;
they lack the flexibility of CNC machines but are cheaper;   **[2]**

15. (a) *Award [1] for each of two distinct correct points in a description of the relationship of the dark and light colours in the FEA image shown in Figure C1 [2 max].*

the darker colours represent parts of the car unaffected by the crash/not damaged;
the lighter the colour the greater the effect of the impact on the car;

the darker colours show parts of the car unaffected by the impact;
the lighter colours show where the greatest stress concentrations have occurred;   **[2 max]**

(b) *Award [1] for a reason why the designer would carry out a series of tests to obtain reliable data from FEA CAD images similar to that in Figure 2 and [1] for a brief explanation [2 max].*

test the vehicle at different speeds;
based on typical speed limits for different roads;

test at different impact angles;
drivers will take different forms of evasive action in a crash;

test for impact with different objects;
to see how their properties may affect the amount of damage / stress loading;

to design better vehicles;
which are safer in a range of different scenarios;   **[2 max]**

16. *Award [1] for a reason why stereo lithography (SLA) is classified as a 3D printing process and [1] for a brief explanation [2 max].*

a laser is used to print the pattern of the model by sintering a thin layer of heat-fusible powder;
which gradually builds up the form of the model;   **[2]**

17. *Award [1] for each distinct point in an explanation of two ways in which the use of rapid prototyping influences the design development cycle for a new product [3 max per way, 6 max].*

speed;
rapid prototyping means that sophisticated models can be produced very quickly;
so decisions can be taken about the final design more quickly than with the use of traditional modelling techniques;

cost;
although rapid prototyping can be expensive to produce;
it often eliminates the need for other types of modelling;
which reduces the overall cost of the cycle;

user trial/expert appraisal;
rapid prototype models allow potential users/experts to evaluate/test the design concept;
resulting in feedback which can be used to improve the final design;   **[6 max]**

18. *Award [1] for each distinct correct point in a discussion of three reasons why car manufacturers often use animation to promote new vehicles on their websites [3 max per reason, 9 max total].*

animation allows the consumer to view all angles of the vehicle as it rotates;
so it gives a good overall impression of what the car looks like in reality;
and its features;

the consumer can control the speed of the animation;
so they can study a particular angle/feature;
and zoom in/out to see some features more closely;

the animation can be linked to other aspects of the website;
so the consumer can gain more detailed information from links/pull-down menus *etc*;
in order to fully evaluate the vehicle's suitability for them;

animation is more interesting for consumers than static images;
it can be used by sales people interacting with consumers in a car showroom to demonstrate features of the car;
a skilled salesperson will concentrate on the features which the consumer is particularly interested in;

raise the "sophistication" of the website;
client has a better "opinion" of the company;
increase customer satisfaction and potential sales;   **[9 max]**

Do not award marks for television advertisement and/or design developments.

Option D — Textiles

19. (a) *Award [1] for stating one property of Spandex which makes it suitable for use in the Cedar jacket.*

elasticity;   **[1]**

(b) *Award [1] for one material characteristic of polyester that makes it suitable for the fleece jacket and [1] for a brief explanation [2 max].*

good thermal conductivity;
a fleece jacket is usually worn outdoors in cold weather;

washability;
the jacket is likely to get dirty from use with outdoor activities and so needs to be easy to maintain;   **[2 max]**

(c) *Award [1] for each of three distinct correct points in an explanation of one disadvantage of nylon for the lining of the jacket [3 max].*

nylon is not breathable;
jacket will be worn outdoors and likely to be used when undertaking vigorous exercise;
moisture / sweat will be trapped making the jacket uncomfortable / creating an unpleasant odour;   **[3]**

20. (a) *Award [1] for stating one characteristic of felt that has made it a popular fabric for military hats (berets).*

does not crease when folded away;
comfortable;
does not weigh much;
easy to maintain;
pliable;
elastic;   **[1 max]**

(b) *Award [1] for stating why many felt military hats (berets) are made in one size only and [1] for a brief explanation [2 max].*

the material stretches;
to enable the hat to accommodative some variation in head size/shape;   **[2]**

21. (a) *Award [1] for one reason why weaving is an appropriate technique to manufacture the prosthesis shown in Figure 2 and [1] for a brief explanation [2 max].*

woven products have good dimensional stability;
so the product will not deform;   **[2]**

(b) *Award [1] for one reason why the design of textile vascular prostheses requires a large and diverse design team and [1] for a brief explanation [2 max].*

the technology involved is complex;
specialists from the medical profession and the textile industry are required;   **[2]**

22. *Award [1] for one reason why feedback is important when producing an intricate lace pattern in a CAD/CAM system and [1] for a brief explanation [2 max].*

quality control;
threads in lace are very delicate and may break;

if the design is too intricate for the CAM facility;
feedback is required from the CAD part to prevent major errors in CAM manufacture
from setting up; **[2 max]**

23. *Award [1] for each distinct point in a comparison of mass customization with craft production in relation to value-for-money for a consumer wishing to purchase a one-off item of clothing [3 max per issue, 6 max].*

both processes allow for the individual requirements of the consumer in relation to
fit/design;
mass customization is usually cheaper as the system provides economies of scale;
even for one-off production;

craft production will be carried out by skilled craftsmen;
who will have a wide range of skills;
such craftsmen will be able to exploit the characteristics of a specific material in order
to make the most of pattern/drape;

CNC machines/CAM will carry out pre-programmed manufacturing techniques with
mass customization;
craftsmen will be able to employ a variety of manufacturing techniques to create a
high-quality item;
craft production has higher labour costs compared to mass customization;
consumers who can afford to pay the high price for craft production will appreciate the
quality and consider it better value-for-money; **[6 max]**

24. *Award **[1]** for each distinct correct point in each of three reasons why the fashion industry for clothing developed rapidly in the 20th century **[3 max per reason, 9 max total]**.*

technological improvements in manufacture;
mass production of clothing was possible which made clothing items much less expensive;
and so more affordable for ordinary people;

technological improvements in transport;
raw materials could be imported cheaply;
and finished products exported cheaply;

formation of large companies for manufacture/retailing;
economies of scale could be achieved;
creation of shops/stores in urban areas;

expansion of advertising and other media;
allowed for advertising campaigns to reach many people;
and people were influenced by fashion shown in films;

working women;
in industrialized countries many women worked in factories;
so had their own money to spend on products other than for the family;

changing social attitudes;
spending money to buy clothes to create more choice for consumers of what to wear for an occasion;
became more acceptable/desirable;

increasing relocation of factories to developing country locations;
cheaper labour/costs;
resulted in cheaper products; **[9 max]**

Option E — Human factors design

25. (a) *Award [1] for stating the type of data scale represented by the comfort rating scale in Figure E1.*

ordinal; **[1]**

(b) *Award [1] for why the responses from the user trial are qualitative and [1] for a brief explanation [2 max].*

responses are subjective / open to interpretation / based on users' opinions;
comfort relates to a number of different factors; **[2]**

N.B. comfort may be affected by factors such as body size, posture, size of chair etc.

(c) *Award [1] for each of three distinct correct points in an explanation of why a designer might choose to represent qualitative information from the trial quantitatively [3 max].*

purely qualitative data can be difficult to analyse effectively;
it may need to be converted to a form that can be more easily analysed;
quantitative data is universally understood;
allows for patterns and trends to be determined;
data can be easily compared for different chair designs; **[3 max]**

26. (a) *Award [1] for a definition of paper prototype in the context of developing the human/computer interface for a mobile phone to the effect of:*

paper version of the mobile phone interface that is manipulated by a person who does not explain how the interface works; **[1]**

(b) *Award [1] for stating the role of the facilitator in a paper prototyping session and [1] for a brief explanation [2 max].*

explains the purpose of the session to the user;
and how to interact with the paper prototype; **[2]**

27. (a) *Award [1] for which percentiles the designer would use for the three height positions of the ironing board and [1] for a brief explanation [2 max].*

5th, 50th and 95th adult percentiles;
to cover the majority of the users/population WTTE;   **[2]**

Do not accept 5th–95th percentile or if 50th percentile is not explicitly mentioned.

(b) *Award [1] for one reason for providing the ironing board in three different board widths and [1] for a brief explanation [2 max].*

types of clothes to be ironed;
some clothes will fit the board better depending on the width;

efficiency;
more fabric can be ironed on a wider board/small board will take more time to iron wide fabrics;

consumer choice;
depending on ironing techniques/styles consumers can choose the board which best suits them;

cost;
the manufacturer can differentiate the cost of the boards based on size;

reduced living/storage space;
smaller boards required;   **[2 max]**

Do not accept any references to arm length.

28. *Award [1] for why accurate dynamic anthropometric data is difficult to obtain and [1] for a brief explanation [2 max].*

dynamic data relates to how people use products;
people use products in different ways and the sample size in the test may not represent all aspects of the user population;   **[2]**

29. *Award [1] for each distinct point in a suggestion of each of two ways in which human factors specialists determine adequate product safety [3 max per suggestion, 6 max].*

behavioural testing;
perform some activity with the product/system;
to understand the risks involved for users;

conceptual testing;
evaluate safety instructions/warning messages;
without having to expose users to potentially hazardous conditions;

fault analysis;
examination of failures;
leading to their elimination through re-design;   **[6 max]**

30. *Award [1] for each distinct correct point in each of three design constraints which might compromise the user interface for a new product [3 max per constraint, 9 max total].*

cost;
a designer may not have the scope to include controls/features which would make the product easier to use;
because the goal of the design brief is to design a cost-effective product which competes well in the market;

aesthetics;
the style of the product may dictate where controls/features are placed;
in order for the product to stand out/appeal in the marketplace;

inadequate user research to underpin the design;
the designer may have overlooked important aspects of the user-interface;
causing memory burden/lack of intuitiveness;

spatial considerations;
the space within which the interface must fit into the product;
this may be too small to be easy to use;   **[9 max]**