N11/4/DESTE/SP3/ENG/TZ0/XX/M

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MARKSCHEME

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DESIGN TECHNOLOGY

Standard Level

Paper 3

22 pages

If you do not have a copy of the current Design Technology Guide, please request one from IB Cardiff.

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 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 benefit of canning peaches.*
longer lasting; ***[1]***

(b) *Award **[1]** for each point in a list of two ways in which a consumer would decide that the fresh peach is suitable for purchase **[2 max]**.*
smells fresh;
no physical damage;
good colour;
firm/not too hard or too soft;
no microbial growth; ***[2 max]***

(c) *Award **[1]** for a comparison of fresh and canned peaches in relation to one organoleptic property **[3 max]**.*

Property	**Fresh peaches**	**Tinned peaches**	
Texture;	Fibrous;	Soft/lacking texture;	
Taste;	Sharp/fresh;	Sweet/syrupy;	
Colour;	Varied/red/orange /yellow/white;	Uniform yellow/orange;	
Smell;	Fresh/fruity smell;	Sugary smell;	***[3 max]***

A2. (a) *Award **[1]** for stating **one** reason why some metals used for food packaging need a protective coating.*
some metals will react with food; ***[1]***

(b) *Award **[1]** for outlining **one** property of glass which is important as a food packaging material in relation to nutrition and **[1]** for a brief explanation.*
inert/non-reactive;
nutritional value of the food is not affected; ***[2]***

A3. (a) *Award **[1]** for identifying one lifestyle factor which has led to the increased consumption of ready meals and **[1]** for a brief explanation **[2 max]**.*
loss of cooking skills;
many (young) people in developed countries do not have cooking skills;

working women;
women traditionally cook food and if working are less able to do so;

single occupancy households;
not worth cooking for one person;

convenience/time;
busy people want to have tasty meals with minimum fuss;

reduction of set family meal times;
erosion of family values in the western world;

pace of life;
fast food fits into a fast lifestyle; ***[2 max]***

(b) *Award **[1]** for each of two distinct correct points in a description of the role of market testing in the development of food products such as the chicken tikka masala ready meal **[2 max]**.*
to ensure that the food product meets the needs of its target market;
appropriate flavour and texture characteristics (level of spiciness, *etc*.);

to gain feedback from the target market;
in order to decide whether to make any changes to the design of the product; ***[2 max]***

A4. *Award **[1]** for identifying **one** factor that relates to the need for the primary processing of orange juice and **[1]** for a brief explanation **[2 max]**.*
food preservation;
if not processed then it will spoil and be unfit for human consumption;

oranges are often grown far from location of consumers;
orange juice needs to be processed so that it can be transported from farm to consumer;

concentration of orange juice;
reduces energy consumption/cost of distribution; ***[2 max]***

A5. *Award **[1]** for each of three distinct correct points in an explanation of each of two distinct reasons why farmers' markets have become popular in urban areas in many countries **[3 max]** per reason, **[6 max]**.*

provenance / knowing where food has come from is increasingly important to consumers;
food scares have contributed to people being wary of supermarket and mass produced foods;
buying food at farmers' markets promotes consumer confidence;

sustainability;
farmers' markets enable farmers to command a larger share of the food dollar and make their farms more sustainable;
farmers will get less for their products if they sell food to supermarkets and food wholesalers than if they sell directly to consumers;

economic reasons;
food will be cheaper and fresher at farmers' markets than in supermarkets;
this is good for consumers; ***[6 max]***

A6. *Award **[1]** for each of three distinct points in an explanation of each of three ways in which controls are used in food manufacturing to ensure the quality of a food product **[3 max]** for each factor **[9 max]**.*
specifying the quality of raw material inputs;
monitoring the quality of ingredients;
provides a consistent starting point for food processing;

monitoring of equipment/machinery;
times/temperatures of processing;
contribute to consistent product quality;

monitoring of product quality;
visual quality checks / taste panels;
ensure product meets specification;

standardisation/brand identity;
high volume product;
want to ensure consistent quality of product;

legislation;
different food legislation in different countries;
needs to meet to the strictest legislation to be sold in every country;

due diligence;
pick up any faults with the product;
avoid a food scare;

staff training;
ensure good hygiene;
prevent contamination of food;

maintenance/cleaning;
equipment needs regular maintenance/cleaning;
to prevent contamination of food; ***[9 max]***

Option B — Electronic product design

B1. (a) *Award **[1]** for stating the operational amplifier's function.*
comparator; ***[1]***

(b) *Award **[1]** for the correct value of R2 and **[1]** for the correct value for R3:*
R2 = 10 kΩ;
R3 = 20 kΩ; ***[2]***

(c) *Award **[1]** per correct row of voltages:*

Voltage of battery to be tested	Voltage at X	Voltage at Y
less than 6V	0V;	0V;
between 6 and 9V	0V;	12V;
more than 9V	12V;	12V;

[3 max]

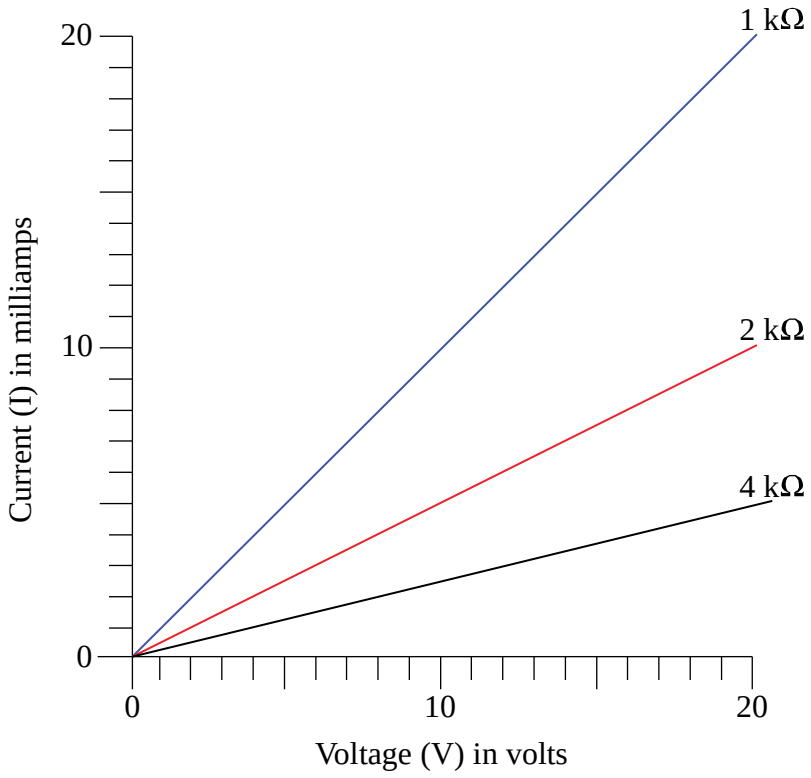
B2. (a) *Award **[1]** for stating a correct definition of the term modulation:*
the process of adding the information contained, for example, in the human voice to a suitable electromagnetic carrier. ***[1]***

(b) *Award **[1]** for each of two distinct correct points in a description of a limitation of a multi-mode optical fibre:*
a multi-mode fibre suffers from dispersion;
as there are multiple paths for light to travel through the fibre; ***[2]***

B3. (a) *Award **[1]** for stating the type of signal and **[1]** for an explanation of how the signal operates:*
a digital signal would be either on or off;
an analogue signal can be continuously varied;
this will give different values for different volume levels; ***[2]***

(b) *Award **[1]** for each point in an outline of one implication of using an open loop control system to amplify the audio signal.*
no feedback sensors to the input signal;
the volume level will not be automatically adjusted; ***[2 max]***

B4. *Award **[1]** for correctly calculating 5mA at 20V and **[1]** for drawing the line shown below:*



[2 max]

B5. *Award **[1]** for each point in a discussion of the hearing ability of the people whose audiograms are shown in Figures B4 and B5 **[6 max]**.*
Figure B4 shows severe hearing loss;
pitch/loudness show high frequency losses;
only loud sounds/speech over 65dB at low frequencies/80dB at higher frequency would be heard;

Figure B5 shows normal hearing;
a normal range of sounds can be heard over 0dB;
as frequency or pitch increases hearing loss fluctuates only slightly; ***[6 max]***

B6. *Award **[1]** each for identifying implications of the adoption of generic standards in digital electronic products for the designer, manufacturer and consumer **[3 max]** for each.*

designer:
need to know what the standards are and conform to them;
this imposes constraints on the designer;
however, designs which satisfy the generic standards will be appropriate for sale in the global marketplace;

exploit existing generic data systems;
or develop new systems;
to increase the interoperability of different devices;

manufacturer:
standardization of the electronic products/components;
improves cost-effectiveness of production;
reduction in product development times;

reduction in the use of materials;
gain product loyalty;
reduction in R&D costs;

consumer:
more consumer choice;
more competitive prices;
better value for money;

enhanced functionality and interoperability of products;
no need to purchase separate components;
reducing cost by purchasing multifunctional products; ***[9 max]***

Option C — CAD / CAM

C1. (a) *Award **[1]** for stating the type of CNC machine used to produce the prototype sign.*
CNC Vinyl cutter/CNC Plotter Cutter; ***[1]***

(b) *Award **[1]** for each of two distinct correct points in a description of how the CNC machine produces the sign **[2 max]**.*
instructions from CAD moves material through the machine on the *y* axis;
the cutter moves on the *x* axis to cut the sign; ***[2]***

(c) *Award **[1]** for identifying an appropriate issue faced by the manufacturer when choosing an appropriate CNC machine to make the sign and **[1]** for each of two distinct correct points of discussion of the issue **[3 max]**.*
type of sign/complexity of design;
number of colours required;
quality of finish required;

size of the sign;
whether the manufacturer wants to invest in a large machine so different signs can be produced;
or whether to choose a machine for one particular size; ***[3 max]***

C2. (a) *Award **[1]** for stating one reason why metals are cut at a slower rate than wood when using a CNC machine.*
metal is a harder material than wood; ***[1]***

(b) *Award **[1]** for outlining one limitation of using a three-axis CNC machine to make a 3D product and **[1]** for a brief explanation **[2 max]**.*
unable to machine underside of product;
unless material is flipped and machined again;

no undercuts in surface being cut;
due to limitation of Z axis tool positioning;

product generally requires a flat base;
for fixing to the bed of the machine; ***[2 max]***

C3. (a) *Award **[1]** for an advantage of stereolithography for the production of a prototype for the designer and **[1]** for a brief explanation **[2 max]**.*
prototype with a smooth surface;
fine detail;

excellent visual prototype for photo-shoots;
market testing and giving feedback to client; ***[2 max]***

(b) *Award **[1]** for an advantage of stereolithography for the production of a prototype for the manufacturer and **[1]** for a brief explanation **[2 max].***
low volume production of complex shapes;
cheap compared to other modeling techniques;

accuracy;
means easy assembly of parts for modular product/identical products; ***[2 max]***

C4. *Award **[1]** for each point in an outline of the contribution of Just-In-Time (JIT) to a Computer Integrated Manufacturing (CIM) system.*
product made in response to customer order;
removes need to stock finished products / materials and parts ordered as required / money is not tied up in stock materials;

efficiency;
JIT is compatible with a CIM system/helps provide customer satisfaction; ***[2 max]***

C5. *Award **[1]** for each of three distinct correct points in a suitable discussion of two benefits for the manufacturer of using the CNC router to manufacture the flat pack furniture **[3 max]** for each benefit **[6 max]**.*
to increase efficiency;
increasing speed of production;
removing human error/good quality control;

perform complicated procedures;
by using a wide range of tooling;
such as to drill/slot/profile edges;

suitable for large scale production;
cost-effective;
reduced labour costs; ***[6 max]***

C6. *Award **[1]** for each of three distinct points in a discussion of each of three advantages of using CAD when designing electronic product housing **[9 max]**.*
complexity of the design;
intricate/very detailed product;
CAD allows designer to work on these details *i.e*. zoom in to design;

CAD modeling software;
2D modeling/3D modeling;
aesthetic models;
production drawings with dimensions/sectional views;

manufacturing;
can run a simulation of CAM;
capability of manufacture of the design by CAM;
checking assembly of parts;

FEA;
virtual test for strength/stiffness;
feedback for aspects of re-design; ***[9 max]***

Option D — Textiles

D1. (a) *Award **[1]** for one type of natural yarn suitable for making felt.*
wool/animal hair; ***[1]***

(b) *Award **[1]** for identifying the property of felt which makes it a suitable material for making a hat and **[1]** for a brief explanation.*
low thermal conductivity;
conserves heat well/insulates from cold air;

low stiffness;
takes the shape of the head;

low in density;
not too heavy to wear; ***[2 max]***

(c) *Award **[1]** for each distinct point in an explanation of one reason why felt is a suitable material for the volume production of hats.*
cost effective;
easy to cut/shape;
edges do not fray/no finish required;

abundant material;
readily available throughout the world;
suitable for mechanization/automation;

can be easily dyed;
to produce a wide range of colours;
increases market potential; ***[3 max]***

D2. (a) *Award **[1]** for a definition of biomimetics to the effect of:*
the application of methods and systems found in nature to the study and design of engineering systems modern technology; ***[1]***

(b) *Award **[1]** for identifying one way in which biomimetics has contributed to the improved performance of athletes and **[1]** for a brief explanation **[2 max]**.*
biomimetic fabrics can be designed to reduce drag;
athletes can swim/run faster;

biomimetic fabrics closely follow the contours of the body;
which streamlines the body shape and enhances performance; ***[2 max]***

D3. (a) *Award **[1]** for a point and **[1]** for a distinct clarification of the point stating the most suitable method of joining the strap to the body of the rucksack.*
sewing/stitched;
easy to attach/strong/easy to repair; ***[2]***

(b) *Award **[1]** for a mechanical property of nylon and **[1]** for a brief explanation why it is suitable for the rucksack.*
good tensile strength;
product will be long lasting;

high toughness;
the fabric won't tear easily; ***[2 max]***

D4. *Award **[1]** for each correct stage in the process of how to convert a digital image into a textile design **[2 max]**.*
the image is converted into a pattern/pixelated using software;
the pattern can then be embroidered/cross stitch; ***[2]***

D5. *Award **[1]** for each distinct implication of using laser image transfer technology to produce the black and white design and colour t-shirts and **[1]** for each clarification **[3 max]** for each.*
cost;
larger image/more colours;
uses more ink;

time;
colour will take longer to print compared to the black and white;
less T-shirts per minute for volume production; ***[6]***

D6. *Award **[1]** for each issue identified and **[1]** for two points in an explanation related to branded clothing in the sports industry for the designer, manufacturer and consumer **[3 max]** per issue **[9 max]**.*

Designer:
brand identity is a constraint on the design brief;
designers need to use their creativity to produce innovative designs;
integrating colour/logos *etc*. which consumers will recognise as part of the brand;

Manufacturer:
brand identity is not an issue for cost effectiveness;
but adds value to the product;
premium prices can be charged/increasing profits;

Consumer:
consumer is influenced by the image of the brand;
brand image is promoted to the consumer by advertising/marketing/celebrities;
consumer feels part of a group/cultural identity;
increased confidence/personal image;
quality control is important;
if the quality is poor/defects occur;
the brand image will be tarnished/affected; ***[9 max]***

Option E — Human factors design

E1. (a) *Award **[1]** for stating the correct percentage of the population.*
90%; ***[1]***

(b) *Award **[2]** for outlining **one** reason why the shape of the distribution curve would change depending on the user population it represents.*
this is a model representing a specific user group;
the shape of the curve would change depending on the make-up of the user group; ***[2]***

(c) *Award **[1]** for each point in an explanation of the relevance of the shaded area of the graph to the work of the designers.*
the shaded areas represent 10% of the user population;
1^{st}–5^{th} and 95^{th}–99^{th} are extremes in the population;
therefore, can be uneconomical for volume production;

they represent niche markets;
products produced can be regarded as specialist;
they can command premium prices; ***[3 max]***

E2. (a) *Award **[1]** for stating **one** relevant health and safety consideration relating to office workers using a computer for most of the day.*
minimum dimensions of the computer workspace envelope;
computer chair must be adjustable;
no glare from the computer screen;
regular eye tests available;
RSI: wrist support; ***[1 max]***

(b) *Award **[1]** for stating the perception and **[1]** for a brief explanation of how it may affect thermal comfort.*
the temperature in the office may be constant but an individual may perceive the environment as too hot or too cold;
e.g. whether their work requires them to be static or dynamic / the type of clothes they are wearing / whether their desk is near a sunny window/door/heat emitting machine / the amount of people in the office / the type of heat source / their metabolism; ***[2 max]***

E3. (a) *Award **[1]** for outlining **one** reason why the Ergo-sof pen may be suitable for people with limited hand movement and **[1]** for a brief explanation.*
shape of the pen;
means that less pressure is applied to the hand/finger muscles / shape means that the pen or the arms of the pen grips the hand to prevent slippage; ***[2]***

(b) *Award **[1]** for each point in an outline of one advantage relating to human factors of designing the Ergo-sof pen in Figure E2 with a soft rubber finish.*
grip;
the rubber is non-slip and so adheres to the skin; ***[2 max]***

E4. *Award **[1]** for stating **one** advantage of using an appearance prototype at the design development stage and **[1]** for a brief explanation **[2 max]**.*
easy for non-design experts to see what the product will look like;
good feedback on the aesthetics of the product can be gained;

the product can be compared to similar products;
to gain feedback on whether it is better than/not as good as the competition;

feedback is gained at an early stage;
to inform the continuing design process;

easy for internal and external stakeholders;
to evaluate the potential cost effectiveness of the product; ***[2 max]***

E5. *Award **[1]** for each distinct point in a suitable comparison of two human factor considerations **[3 max]** for each consideration **[6 max]**.*
home office can be configured to suit anthropometric data of the individual user;
a commercial office would need to be suitable for a range of people;
with different body measurements;

legislation;
does not apply to the home office;
but does apply to a commercial office;
such as the amount of light/headroom *etc*.;

commercial office is used by people for different tasks;
some people are static (work at a computer) others are dynamic (move around);
different people's perception of comfort levels in relation to psychological factors (heat, light *etc*.);

health and safety;
the arrangement of furniture/fixtures needs to take into account the requirements of the different tasks/safety issues;
in the home office, people will work around their own mess; ***[6 max]***

E6. *Award **[1]** for each distinct point in a suitable discussion of how human factor data relating to clearance, reach and comfort can be used in the design of an aircraft cabin **[3 max]** for each consideration **[9 max]**.*

Reach:
overhead lockers need to be accessible to the majority of users;
so the 5th percentile would be used to decide the height;
meaning that 95% of the user population would be able to reach the lockers;

Comfort:
the size of the seats needs to be suitable for people in the 5th–95th percentile range for seat width;
and the shape of the seats needs to aid comfort/give back support;
adjustability, most aircraft seats allow limited adjustability (rake);

Clearance:
the arrangement of seats needs to ensure that there is sufficient clearance for legs when users are seated in the aircraft;
aircraft use different leg space for different seat class (economy, business class);
in economy class, the leg space is designed for people in the 75th percentile;

clearance for height of users;
so they do not hit their heads on the overhead luggage compartments when getting in and out of their seats;
passengers could sue the airline if they bang their heads on the lockers;

sufficient clearance in the aisles for cabin crew and trolleys;
the trolley needs to move down the aisle without disturbing passengers;
there is a direct relationship between the width of the trolley and the width of the aisle; ***[9 max]***