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MARKSCHEME

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DESIGN TECHNOLOGY

Standard Level

Paper 3

20 pages

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

Subject Details: Design Technology SL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in each of **TWO** Options (total ***[15 marks]***). Maximum total = ***[30 marks]***.

General

A markscheme often has more specific points worthy of a mark than the total allows (especially for essay questions). This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each marking point has a separate line and the end is signified by means of a semicolon (;).
- An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.
- Words in (…) in the markscheme are not necessary to gain the mark.
- The order of points does not have to be as written (unless stated otherwise).
- If the candidate's answer has the same "meaning" or can be clearly interpreted as being the same as that in the mark scheme then award the mark.
- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have not achieved or what they have got wrong.
- Remember that many candidates are writing in a second language; be forgiving of minor linguistic slips. Effective communication is more important than grammatical niceties.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with **"ECF"**, error carried forward.
- Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by **"U-1"** at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

Option A — Raw material to final product

A1. (a) *Award **[1]** for each correct point from the following list **[2 max]**.*

rigidity under stress;
strength;
toughness;
ease of manufacture; ***[2 max]***

(b) *Award **[1]** for a correct reason and **[1]** for each distinct correct point in an explanation **[3 max]**.*

iron corrodes in the presence of oxygen and water;
protection can be provided by a non-porous finish to prevent oxygen and water coming in contact with the steel and hence preventing corrosion;
alternatively the steel can be treated, *e.g.* by galvanizing, to make it less susceptible to corrosion; ***[3 max]***

A2. (a) *Award **[1]** for a reason for using toughened glass and **[1]** for a brief explanation **[2 max]**.*

toughened glass shatters into many small pieces with small dull edges rather than large pieces with sharp edges;
this makes it safer if the car is involved in an accident; ***[2]***

(b) *Award **[1]** for a reason for using thermoplastic for the car headlight covers and **[1]** for a brief explanation **[2 max]**.*

it is cheaper;
manufacturing costs are relatively low/moulding is inexpensive;

it is less likely to shatter on impact;
therefore it is safer than glass; ***[2 max]***

A3. *Award **[1]** for a reason and **[1]** for each distinct, correct point in an explanation **[3 max]** for each of two reasons **[6 max]** total.*

Reason;
first point of explanation;
second point of explanation;

Non-absorbent;
does not absorb water;
therefore the carpet will not rot;

High durability;
more hard wearing than alternatives;
will last longer in use;

Cost;
nylon carpets are cheaper;
keeps down overall price of car and components; ***[6 max]***

Option B — Microstructures and macrostructures

B1. (a) *Award **[1]** for a statement to the effect of:*

a composite is a combination of two or more materials (in this case concrete and pre-stressed steel) which are bonded together to improve its mechanical properties; ***[1]***

(b) *Award **[1]** for identifying the forces at **A** and **[1]** for identifying the forces at **B** **[2 max]**.*

A is in compression;
B is in tension; ***[2]***

B2. (a) *Award **[1]** for each of three distinct, correct points in an explanation **[3 max]**.*

concrete is strong in compression and weak in tension;
steel is strong in tension and weak in compression;
putting the prestressed steel where the tension is the greatest at the bottom; ***[3]***

(b) *Award **[1]** for a definition to the effect of:*

an alloy is a mixture of two or more materials bonded together to form a new material; ***[1]***

(c) *Award **[1]** for stating a mechanical property that can be increased by alloying.*

tensile strength is increased by alloying;
hardness increased by alloying; ***[1 max]***

B3. (a) *Award **[1]** for a definition to the effect of:*

a material that is stressed above the elastic limit, will have incurred plastic deformation and if the load is removed it will not return to its original shape; ***[1]***

(b) *Award **[1]** for each point concerning the design of the bridge up to **[6 max]**.*

the load on the bridge will change the stress in the material;
strain is relative change of shape when a material is subjected to a load;
Young's modulus is the relationship between stress/strain;
Do not need bridge to deflect so need to use a stiff material;
need to choose a material with high ratio of strength to stiffness;
high range of loads acting on the bridge *e.g.* winds, vehicle loadings, materials themselves; ***[6 max]***

Option C — Appropriate technologies

C1. (a) *Award **[1]** for identifying correct values for calculation and **[1]** for the right answer (including units) **[2 max]**.*

10 000/750;
= 13.3 bulbs, *i.e.* 14 bulbs; ***[2]***

(b) *Award **[1]** for each correct step in calculation and **[1]** for correct answer (including units).*

$26 \times 10\,000 = 260\,000$ Wh or 260 k Wh;
$75 \times 10\,000 = 270\,000$ Wh or 750 k Wh;
750 – 260 = 490 k Wh saved; ***[3]***

(c) *Award **[1]** for a reason why CFLs can be considered an appropriate technology and **[1]** for a brief explanation **[2 max]**.*

CFLs use less energy;
they therefore reduce the amount of damage to the environment;

CFLs save money for the consumer in the medium term;
so they make technology more affordable to people; ***[2 max]***

C2. *Award **[1]** for stating what a reserve is and **[1]** for stating how a resource differs from it **[2 max]**.*

a reserve is the total amount of a particular material that is present on the planet;
whereas a resource is the amount of that material that has been exploited and is available for use; ***[2]***

C3. *Award **[1]** for each distinct correct point in how using CFLs would be consistent with a policy of sustainable development, **[3 max]** for each of two reasons **[6 max]** total.*

Optimize energy efficiency during use;
CFLs use less energy than incandescent bulbs;
CFLs can use renewable energy;

Minimizing waste;
CFLs last longer so their waste disposal is reduced;
CFLs fit into standard light fittings so there is no need to replace light fittings and create waste for disposal;

Longer-term characteristics than incandescent light bulbs;
product life is longer;
shifts consumers away from disposable society; ***[6 max]***

Option D — Food technology

D1. (a) *Award **[1]** for an appropriate lifestyle factor and **[1]** for a brief explanation, **[2 max]**.*

increased leisure time;
many people like to cook as a leisure pursuit and produce home made products; ***[2]***

(b) *Award **[1]** per distinct point in an appropriate description of what causes browning of bananas during food preparation **[2 max]**.*

when cells are damaged during food preparation;
enzymes (polyphenol oxidase) come in contact with (phenolic) substances (*e.g.* the amino acid tyrosine) which are oxidized to produce polymerized brown pigments; ***[2]***

(c) *Award **[1]** per distinct appropriate item from the following list **[2 max]**.*

fat content;
sugar content;
nutritional content;
ingredients;
warnings;
volume, mass details;
sell by date;
storage instructions;
serving suggestions; ***[2 max]***

D2. *Award **[1]** for an appropriate consideration and **[1]** for saying what the problem is and **[1]** for saying how it would influence the recipe **[3 max]**.*

cream has a high fat content;
high fat intake can result in heart disease;
use less cream/ try yoghurt as an alternative to reduce fat content;

high sugar content;
high sugar intake can lead to heart disease and diabetes;
use artificial sweeteners or fresh fruit instead of sugar to sweeten the ice cream; ***[3 max]***

D3. *Award **[1]** for each distinct point **[3 max]** per strategy; **[6 max]** total.*

Taste panels;
bench scale production of potential new flavour ice cream;
taste panel to test product;
comments from taste panel used to modify recipe;
product specification confirmed;

Market research;
larger volume of product made;
scaling up to full industrial scale;
structured interviews and questionnaires used to collect data;
comparison made with existing products; ***[6 max]***

Option E — Computer aided design, manufacturing and production

E1. (a) *Award **[1]** per correct input device and **[1]** per correct output device from the following lists, **[2 max]**.*

Input device;
mouse;
keyboard;
scanner;

Output device ;
printer;
CNC machine;
CAM; ***[2 max]***

(b) *Award **[1]** per distinct correct benefit of computer modelling from the following list, **[2 max]**.*

realistic image;
different views can be seen;
quicker;
can be interfaced with CAM;
can be interfaced with CNC;
texture can be added/changed;
colour can be added/changed; ***[2 max]***

(c) *Award **[1]** for identifying an appropriate advantage of CAD to designers and **[1]** for a brief explanation, **[2 max]**.*

rapid modification of designs;
enables designer to change key features or scale;

convenient storage of computer images;
they can easily be retrieved;

realistic images produced;
designers are able to present information quickly and accurately; ***[2 max]***

E2. *Award **[1]** per distinct appropriate point in an explanation of how mass customization of the model car could benefit the consumer **[3 max]**.*

mass customization combines the benefits of one-off customization with the benefits of mass production;
mass production offers economies of scale which keeps the price down for consumers; ***[3]***
customization allows the customer to specify the particular features they require;

E3. *Award **[1]** for each distinct point **[3 max]** per advantage and **[3 max]** per disadvantage, **[6 max]** total.*

Advantages;
greater consistency;
fewer errors;
leads to reduction of waste and cheaper products;

better lead time;
faster response to market demand;
competitive advantage for manufacturer leads to better profits;

better machine utilization;
flexibility of manufacturing;
greater variety of products and productivity improvements;

smaller number of employees required;
reduced labour costs;
higher profitability in the medium to long term;

Disadvantages;
high initial investment;
CAD and CAM are expensive systems;
only suitable for volume production;

changes in numbers of products;
job losses;
need for training of some employees to ensure they have the technical skills to maintain the machines;

lack of individuality of products;
lower customer satisfaction;
some customers may seek craft produced products; ***[6 max]***

Option F — Invention, innovation and design

F1. (a) *Award **[1]** for either:*

bicycle frame;
wheel; ***[1]***

(b) *Award **[1]** for each distinct point in an explanation of how producing the Lotus bicycle can be considered a pioneering corporate strategy for Lotus Engineering, **[3 max]**.*

Lotus introduced a totally new product;
the new product was in an area which the company had no experience of;
this was risky;
but potentially financially lucrative; ***[3]***

F2. (a) *Award **[1]** for identifying a reason why many governments provide cycling as part of a pro-active environmental policy and **[1]** for a brief explanation, **[2 max]**.*

cycling is a good mode of transport in relation to the environment;
as it is non-polluting;

cycling uses only human energy;
and so does not contribute to the depletion of energy resources;

cycling does not need the same space as motor transport;
so causes less visual pollution;

cycling is relatively quiet;
so does not cause noise pollution; ***[2 max]***

(b) *Award **[1]** for each distinct point in an explanation of why the design of the bicycle does not satisfy the criteria for a pro-active environmental policy **[3 max]**.*

the frame is made from carbon fibre which is a composite material;
composite materials are not recyclable;
because they are difficult to separate; ***[3]***

F4. *Award **[1]** for each distinct point in a discussion of why the Lotus bicycle has failed to diffuse into the marketplace **[3 max]** per reason **[6 max]**.*

the bicycle is a radical design in relation to shape and form;
and may be too different from existing bicycles;
this may reduce its acceptability to potential consumers;

the success of the bicycle at the Olympics;
may have created an image of it suitable for racing only;
thus it may not appeal to a wider market;

the unusual frame and wheels;
may make the bicycle difficult to maintain compared to more conventional bicycles;

the ergonomics of the bicycle;
may not suit many users;
who would find the bicycle less comfortable;

carbon fibre is an expensive material;
which may make the bicycle uncompetitive in price;
reviewing the design to reduce the cost may enhance its diffusion into the marketplace; ***[6 max]***

Option G — Health by design

G1. (a) *Award **[1]** for a definition to the effect of:*
an artificial limb, tooth or other part of the body manufactured to take the place of a missing or dysfunctional one; ***[1]***

(b) *Award **[1]** for each distinct correct point in an explanation of why user-centred design is an important element in the design of prostheses **[3 max]**.*

designers are unlikely to understand fully the issues associated with prosthesis use unless they themselves are amputees;
working with users can enhance their understanding of prosthetic design issues;
designers do not then have to rely on their tacit understanding; ***[3]***

G3. *Award **[1]** for a statement about allografts and **[1]** for a statement about autografts to the effect below **[2 max]**.*

allograft is tissue taken from the body of another person;
autograft are tissue taken from the same body as the one it is to be transplanted to; ***[2]***

G3. *Award **[1]** for each of three distinct, correct points in an explanation of how the location in which a hearing aid is worn can suit an individual's life style **[3 max]**.*

in the ear or in the canal hearing aids fit onto the ear;

good for spectacle wearers;
however they are not good for people using a telephone due to feedback;
they are less obvious and thus better for people who are more conscious of their appearance;

behind the ear aids fit behind the ear;

they are good for use in noisy situations as they can have dual microphones;
they are good for people who have difficulty handling small objects;
they are not good for spectacle wearers; ***[3 max]***

G4. *Award **[1]** for the identification of an advantage and a disadvantage **[2 max]**, and **[1]** for each distinct point in a discussion of each **[4 max]**.*

Advantages:
safety;
all cars would have minimum safety standards;
reduce deaths through road accidents;

pollution;
legislation to minimize pollution would be good for the environment;
if manufacturers promote green cars it may help justify additional expenses;

free trade;
level playing field for international trade if similar standards;
encourage international trade;

manufacturing;
encourage investment in research and development;
promote environmentally sensitive design;

Disadvantages;
cost;
pollution equipment adds to the cost of manufacture;
safety requirements add to the cost of manufacture;
manufacturers will sell more products if the cost is lower;

enforcement;
legislative cost to enforce standards;
international agreement on standards may be difficult to achieve; ***[6 max]***

Option H — Electronic products

H1. *Award **[1]** for:*

(a) component R1 = Light dependant resistor; ***[1]***

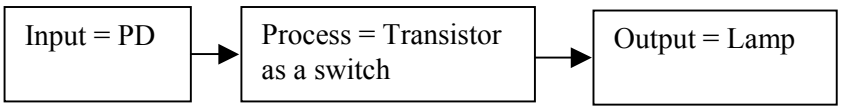
(b) *Award **[1]** for identifying the function and **[1]** for a brief description.*

components R1 and VR1 work jointly as a Potential Divider;
the joint function of these two components can be set to trigger the transistor, TR1,
so as the light level drops the transistor acts as a switch; ***[2]***

H2. (a) *Award **[1]** for each distinct, correct point in an explanation of how a systems approach could be applied to circuit design **[3 max]**.*

electronic systems can be described in terms of block diagrams;
the simplest comprises three elements Input, Process and Output;

in this circuit, the Input is Potential Divider, the Process is the Transistor as a switch and the output is the lamp. *Accept this drawn as a diagram (see below).*



; ***[3]***

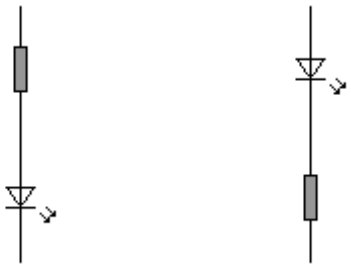
(b) a (current limiting) resistor needs to be inserted in series with the LED;

OR

(b) (current limiting) resistor needs to be inserted in series with the LED;

OR

Accept either of the diagrams below;



[1 max]

(c) the component shown as TR1 is a transistor and it is used as a switch; ***[1]***

(d) the component required to produce feedback from output to input is called a sensor; ***[1]***

H3. *Award **[1]** for identifying each of two reasons and up to a further **[2]** for a discussion on that reason.*

surface mount components;
reduce size of circuit board, thus influence characteristics of product;
positioning of circuit board could change the overall shape of the product;
miniature components allow designer to put circuit board where s/he likes within the product;

integrated circuits (such as PICs) rather than discrete components;
allow the designer more design flexibility;
fewer components reduction of production time;

mechanized assembly;
pick and place systems;
wave flow soldering and pick and place application;
reduces production costs; ***[6 max]***