

MARKSCHEME

May 2005

DESIGN TECHNOLOGY

Standard Level

Paper 3

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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 distinct point in a description of the changes that take place in a blast furnace [2 max].*

carbon monoxide reduces iron oxide to iron metal;
calcium oxide from limestone removes silicon dioxide as slag; **[2 max]**

- (b) *Award [1] for each distinct point in a description of how iron is converted to steel [2 max].*

carbon levels in pig iron is reduced by blowing oxygen through the liquid metal;
carbon is converted to carbon dioxide which bubbles off to produce mild steel; **[2 max]**

- (c) *Award [1] for each distinct point in an explanation of why steel must be processed to make it suitable for the manufacture of the stainless steel hob [3 max].*

steel is not corrosion-resistant;
steel would not be easy to clean for long;
steel would not remain hygienic;
steel would not remain attractive; **[3 max]**

- A2.** *Award [1] for identifying a characteristic of glass that makes it suitable for the manufacture of the chopping board, and [1] for a brief explanation, [2 max].*

high hardness;
makes it resistant to scratching as the chopping board is used for chopping food;

transparent material;
attractive in kitchen – can see the colour of the worksurface through the chopping board;

easily cleaned;
therefore hygienic; **[2 max]**

A3. *Award [1] for each distinct point in each of two reasons for why the particle board is finished with a thermoplastic veneer for application in the kitchen work surface, [3 max] per reason, [6 max].*

aesthetics;

- enhance attractiveness of appearance;
- match décor of kitchen;
- particle board is unattractive material;
- comes in a range of different colours;

hygiene;

- particle board is porous;
- veneer is non-porous;
- it can be easily wiped clean and kept hygienic;

[6 max]

Option B — Microstructures and macrostructures

- B1.** (a) *Award [1] for identifying a reason why standardized tests are used and [1] for a brief explanation [2 max].*

standardised tests allow data to enable comparison between different materials;
this would enable designers to select materials of appropriate tensile strength to
suit particular applications;

[2 max]

- (b) *Award [1] for identifying one reason for the shape of the tensile strength specimen and [1] for a brief explanation, [2 max].*

to fit into the tensometer;
the splayed ends of the specimen fit between the noses of the tensometer;

the straight section is of a consistent cross section so the results of the test can be
related to the cross-section;

[2 max]

- B2.** (a) *Award [1] for each distinct point in a description of a metallic bond [2 max].*

positively charged nuclei in a sea of electrons;
outer electrons are free to flow through the crystalline structure;

[2 max]

- (b) *Award [1] for an explanation and [1] for each distinct property [2 max]
[3 max total].*

Explanation:

positive nucleus and negative electrons form bond;

Properties:

very high thermal conductivity;
very high electrical conductivity;
very low solubility in water/organic solvents;
medium hardness;
very high thermal expansion;
high tensile strength;
high stiffness;

[3 max]

B3. *Award [1] for each distinct region of the stress-strain graph [3 max] and [1] for each distinct point in an explanation of the relevance of this information to the manufacturers of body parts for cars [3 max], [6 max].*

elastic region O-B;
yield stress C;
plastic flow region; D – F;
ultimate tensile stress or breaking stress U;
fracture point F;

[3 max]

body car parts are plastically deformed into the requisite shapes;
to achieve this they must be subjected to appropriate deforming force;
the force must take the material into the plastic region so it does not return to its original shape when the force is removed;
the data enables the car body part manufacturer to know how much force should be applied;

[3 max]

Option C — Appropriate technologies

C1. (a) *Award [1] for each of two points in the reason [2 max].*

industrialized countries make the major contribution to emission;
developing countries do not make a major contribution;
it is the industrialized countries that must change their behaviour;
there are more resources in industrialized countries to control emissions; **[2 max]**

(b) *Award [1] for each distinct point in an explanation of why controlling climate change requires international agreements such as the Kyoto agreement [3 max].*

the atmosphere does not respect national boundaries;
emissions produced in one country affect other countries;
to reduce emissions in one country would not have the desired effect;
international negotiation of targets is necessary; **[3 max]**

C2. *Award [1] for identifying a disadvantage of burning fossil fuels apart from atmospheric CO₂ emissions and [1] for a brief explanation [2 max].*

emission of other atmospheric pollutants;
it is not just CO₂ that is produced by burning fossil fuels;

consumption of natural resources;
these will no longer be available for other uses apart from energy production or for future generations;
fossil fuels will become scarce and expensive for future generations; **[2 max]**

C3. *Award [1] for each renewable energy source from the list below, [2 max].*

wind;
wave;
solar;
biomass;
hydroelectric;
tidal;
geothermal; **[2 max]**

C4. *Award [1] for each distinct reason and [1] for each point in an explanation [3 max] [6 max total].*

Society

Reason: all individuals in society need to be involved;

all need to change our habits in relation to how we consume energy and goods and materials which require energy in their production;

consumer pressure can influence manufacturers to adopt more environmentally friendly practices;

insistence on recyclable materials being used for disposable products, for example;

Industry

Reason: all industries need to be involved;

adoption of clean technologies by manufacturers;

promote a shift towards less pollution;

less wastage of energy and raw materials;

all aspects of the energy industry is the key to reducing atmospheric pollution;

shift to renewable energy sources;

shift towards sustainable development;

[6 max]

Option D — Food technology

D1. (a) *Award [1] for each distinct point in a description of a balanced diet [2 max].*

adequate amounts of energy
optimum amount of protein;
adequate essential fatty acids;
adequate vitamins;
sufficient dietary fibre;
optimum amounts of starch and fat (*i.e.* not in excess);
balance from each food group (maybe represented by a pyramid);
requirements vary for different age groups; **[2 max]**

(b) *Award [1] for identifying a health issue and [1] for a brief explanation of its implications for food choice, [2 max].*

coronary artery disease/heart problems;
 select foods with lower saturated fat content to reduce fat intake;

diverticular disease or other gastro-intestinal problems;
 select higher fibre content foods;

obesity/overweight;
 select diet with lower energy content – low fat, low sugar, high fibre;

diabetes;
 carefully control carbohydrate intake;

allergies;
 choose foods known not to effect the allergy; **[2 max]**

(c) *Award [1] for each distinct point in an evaluation of the accessibility of information in Table D1 and Figure D1 [3 max].*

the pictogram is easy to read and understand;
the Table D1 requires a higher level of understanding;
information is on the can label so it is easily accessible; **[3 max]**

D2. *Award [1] for identifying one way that the packaging of food contributes to the development of brands and [1] for a brief explanation, [2 max].*

colour and style of packaging;
 makes the brand easily recognizable to the potential consumer;

use of company logo on packaging;
 makes the brand memorable to the potential consumer;

diet and nutrition information;
 increases confidence in the brand; **[2 max]**

- D3.** Award [1] for each distinct reason why local farm cooperatives and on-farm processing can enhance farm sustainability [3 max for each], [6 max].

Local farm cooperatives

local cooperatives can achieve economies of scale for farmers;
this can relate to sharing of expensive equipment, *e.g.* combine harvesters;
it can also relate to other issues, *e.g.* marketing and business development to negotiate,
e.g. with big supermarkets to develop a market for processed products;

On-farm processing

the value of farm products is increased by cleaning and cooling, processing, packaging and distribution;
most of the ‘food dollar’ comes from secondary processing of food products;
if this is undertaken by the farmer before sale then the farmer will achieve higher profits which will make the farm more sustainable;

[6 max]

Option E — Computer aided design, manufacturing and production

E1. (a) *Award [1] for outlining one impact of Rule #4 on the workforce and [1] for a brief explanation [2 max].*

- workers would learn on the job;
 - this would promote their self-esteem;
- workers would develop their understanding of scientific method;
 - they would formulate hypotheses and test them and be able to document them and so learn more effectively;
- workers are continuously thinking how they can improve their work;
 - they therefore have greater ownership of the quality of the finished product;
- increase job satisfaction;
 - feel more important and responsible;
- contribution to the company would increase;
 - development of new techniques;

[2 max]

(b) *Award [1] for each distinct point in an explanation of how Rule #2 helps to reduce waste and conserve resources [3 max].*

- material would be supplied in response to need;
- only parts which were going to be used would be ordered;
- reduces stockpiling of parts and reduces wasted warehouse space;
- ease of tracking supplies to know if anything is missing;

[3 max]

(c) *Award [1] for identifying one way in which Rule #1 contributes to the quality of the finished car and [1] for a brief explanation [2 max].*

- more consistency in production;
 - specific standards maintained;
 - there is no such thing as a Saturday car or equivalent sub-standard product;
- defect control;
 - defects can be tracked down and corrected;
 - enhanced product quality;
 - consistently high quality;

[2 max]

E2. *Award [1] for identifying one way in which virtual reality helps a car manufacturer to communicate with consumers to implement mass customization and [1] for a brief explanation, [2 max].*

- VR can present images to the customer;
- enhances communication;
- consumers can see the finished product with their choices included;
- consumers can see the different purchasing options (model, colour, accessories);
- consumer likely to be more content with their choice after purchase;

[2 max]

E3. *Award [1] for each advantage and disadvantage and [1] for each distinct point in a discussion of each [4 max], [6 max total].*

Advantages [3 max]

Storage;

savings on space;

no storage of materials and components for production and finished products;

materials and components ordered in according to requirements so do not need to be stored;

Reduced capital investment;

less capital tied up in raw materials, components and unsold products;

capital available for other developments;

Disadvantages [3 max]

Limited back-up supplies;

no guarantees for a sudden increase in demand;

possible stoppages in production;

Dependence on suppliers;

non-delivery of raw materials and components may delay production;

communication breakdown can be a major factor in this;

[6 max]

Option F — Invention, innovation and design

F1. (a) *Award [1] for identifying a reason why mobile phones are unlikely to be developed by a lone inventor and [1] for a brief explanation [2 max].*

- mobile phones are complex products;
- they incorporate knowledge from different discipline areas;
- mobile phones are expensive to produce;
- the requisite investment would be too much for one individual;

[2 max]

(b) *Award [1] for each distinct point in a comparison of a lone inventor and a product champion [2 max].*

- lone inventors:
- generally lack the business acumen;
 - are not forceful enough;
 - are not team players / work on their own;
 - spend many years on development;

- product champions:
- good at taking ideas to the marketplace;
 - considerable influence in a company;
 - work in a group;
 - are business minded;
 - promote eagerly;

[2 max]

F2. *Award [1] for identifying a lifestyle factor that has promoted the diffusion of the mobile phone into the marketplace and [1] for a brief explanation [2 max].*

- increased mobility;
 - people are traveling and want to keep in touch;
- security;
 - increase in crime and mobile phones make people feel they can call for help if required;
- more disposable income;
 - money to spend on a phone;
- fashion;
 - must have the latest phone;
 - status symbol
- convenience;
 - keep in contact anywhere;
 - use time more effectively;
- family structures;
 - both parents working, need to keep in touch;

[2 max]

F3. Award [1] for each distinct point, either the term or the explanation of the term [3 max].

technophobe;
fear of new technology and avoid it;

techno cautious;
may be encouraged to use new technology;

technophile;
love and adopt new technology;

[3 max]

F4. Award [1] for identifying each distinct point in the implications of a pioneering corporate strategy, [3 max] and similarly [1] for each distinct point relating to an imitative corporate strategy, [3 max], [6 max total].

Pioneering [3 max]

manufacturer may win or lose if product does not take off;
therefore most risky strategy;
however, there is the maximum potential for large gains;
requires most investment in research and development;
the technology developed can become a product in its own right;
may be possible to set the industry standard;
chance of gaining most of the market share;

Imitative corporate strategy [3 max]

takes advantage of research and development by companies who have adopted a pioneering strategy;
based on a strong development capacity;
less risky as exploits established markets;
lower profits but “safer” strategy;
more competition in the market;

[6 max]

Option G — Health by design

- G1.** (a) *Award [1] for identifying a lifestyle factor which leads to the popularity of extended wear lenses and [1] for a brief explanation, [2 max].*

people are traveling away from home more for business and leisure;
they do not want the hassle of carrying lens cleaning solutions and equipment or disposable lenses;

people lead busy, active lives;
they do not want to change lenses on a daily basis;

[2 max]

- (b) *Award [1] for identifying the frequency for high Dk lenses and [1] for identifying the frequency for low Dk lenses, [2 max].*

low Dk lenses have a higher frequency over time;
high Dk lenses have a lower frequency over time;
up to 40 days the pattern is not consistent;

[2 max]

- (c) *Award [1] for each distinct point in a description of why silicone hydrogel would be approved specifically for use in contact lenses rather than in isolation [2 max].*

there is no absolute biocompatibility;
materials appropriate for one application may not be safe for another application;

[2 max]

- G2.** *Award [1] for each distinct point in an explanation of the benefits of being able to reuse hearing aid shells, [3 max].*

hearing aid shells are made to fit an individual's ear accurately;
the circuitry inside is not custom-made;
as circuitry improves it can replace old circuitry in the same shell;
this saves time and money;
reuse enables energy and resources to be saved;

[3 max]

G3. Award **[1]** for each distinct point in an explanation of the role of legislation in encouraging motor vehicle research **[6 max]**.

research and development costs are expensive;
legislation can hasten improvements in vehicle technology;
legislation encourages manufacturers to invest in research and development;
legislation raises standards in relation to safety requirements through increased R&D;
consumers are forced to purchase cars which meet the new legislation so forces planned obsolescence;
legislation related to emissions or fuel efficiency will encourage R&D in those areas;
governments can direct R&D into specific areas through legislation;

[6 max]

Option H — Electronic products

H1. (a) *Award [1] for each appropriate input signal from the following [2 max].*

desired speed;
actual speed;

[2 max]

(b) *Award [1] for identifying an appropriate gate and [1] for a brief explanation, [2 max].*

OR

to achieve the truth table requires a NOR gate so an **OR** and a NOT combine to make the NOR;

[2 max]

(c) *Award [1] for each distinct point in description of how a comparator would be used in the cruise control system [2 max].*

the comparator would compare a signal relating to the speed of the car with a reference signal relating to the desired speed;
this would generate an error signal which would be used to adjust the throttle pedal;

[2 max]

H2. *Award [1] for each distinct point in an explanation of why negative feedback not positive feedback is used in the cruise control system [3 max].*

positive feedback would accentuate any differences in speed and would move the speed still further away from the desired speed;
negative feedback would reduce the error signal;
the effect of negative feedback would be to stabilize the system;

[3 max]

H3. *Award [1] for each distinct point of explanation [3 max] in each of two benefits of fuzzy logic for the implementation of the cruise control system, [6 max].*

performance;

fuzzy logic is a “crisper” way of operating;

it can reduce overshooting and oscillations around the required point;

response times are reduced;

simplicity;

fuzzy logic systems are simpler to produce;

by redefining the rules the system can be quickly reprogrammed;

different input devices and different rules can be used for different applications;

lower costs;

fuzzy logic systems are cheaper to implement;

this can make them more profitable for the manufacturer or more competitive in the marketplace;

reduction in time to market for commercial applications;

lead time is an important consideration in manufacturing;

the simplicity of fuzzy logic systems means that lead times are reduced;

this can result in manufacturers benefiting by being the first to market for a new system; **[6 max]**
