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MARKSCHEME

November 2002

DESIGN TECHNOLOGY

Standard Level

Paper 3

14 pages

Subject Details: Design Technology SL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in each of **THREE** Options (total 15 marks). Maximum total = 45 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 penalised. 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 penalised 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 penalise candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

Option A – Raw material to final product

A1. (a) adipic acid;
a diamine;
the name of a specific diamine, *e.g.* hexamethylenediamine is quite acceptable; ***[2 max]***

(b) cotton is very absorbent, nylon is not;
cotton chars not melts when exposed to high temperatures whereas nylon melts; ***[2 max]***

(c) different cross-sections (shapes);
and different thicknesses can be produced during manufacture;
the required characteristics can be designed in during manufacture to meet the particular specifications for a wide range of applications and thus nylon needs little treatment post-manufacture; ***[2 max]***

A2. ***[1]*** *for each distinct appropriate point.*
superconductors are ceramic alloys made from various metal oxides, non-metal oxides and metals;
the composition of the alloy determines the temperature at which the resistivity of the material becomes zero – *i.e.* the material operates as a superconductor;
the alloys are produced by sintering; ***[2 max]***

A3. ***[1]*** *for each point.*
scrap glass of high quality is produced in the company through quality control processes where products of inferior quality from an aesthetic perspective can be scrapped;
scrap glass, again of high quality, is generated through accidental damage;
scrap glass added to the melt lowers the melting point and reduces the energy required in manufacture;
only scrap glass of appropriate quality can be added to the melt for high quality glass else the quality will deteriorate; ***[3 max]***

A4. ***[1]*** *for each distinct appropriate point up to* ***[2 max]*** *for cast iron and* ***[2 max]*** *for timber.*
Manufacturing techniques – cast iron
cast iron products are shaped by casting;
the quality of the final product is dependent on the construction of the mould;
there is no post casting processing;
features, such as joints and decorative features, have to be built into the mould;
cast iron is finished by painting to prevent deterioration in damp conditions;

Manufacturing techniques – timber
timber products are wasted by cutting;
timber components are finished by abrading;
features such as joints and decorative features are created through elaborate processing and often the component count increases;
timber is finished by treatment with preservatives and varnishes to prevent deterioration in damp conditions and attack by insects and microbial agents; ***[4 max]***

Option B – Products in context

B1. (a) renewable energy resource; ***[1 max]***

(b) wind not always blowing, this leads to discontinuity of supply;
wind units are noisy;
wind units are not aesthetically pleasing; ***[2 max]***

(c) ***[1]*** *for each distinct appropriate point*.
set-up costs for unit high but large amount of energy generated therefore cost-effective**;**
environmental impact of one large unit is less than a number of smaller units;
large units generally sited away from human habitation therefore noise problems reduced;
large units produce more electricity than small units; ***[2 max]***

B2. ***[1]*** *for each distinct appropriate point*.
continuity of sunshine unpredictable so continuity of energy supply unpredictable which is an issue for industrial applications;
peaks in energy production a problem unless energy used to feed into National Grid, similarly troughs an issue unless shortfall made up by taking energy from the National Grid; ***[2 max]***

B3. (a) a relative term that stands between traditional and modern technology; ***[1 max]***

(b) ***[1]*** *for consideration of each of alternative, intermediate and appropriate.*
it's alternative because it represents a viable alternative to the existing "mainstream" technologies
of today which in terms of the radio would be conventional battery power rather than alternative clockwork;
it's intermediate because it stands between traditional and modern technology;
it's appropriate because it's low in capital costs, involves renewable energy sources and it's not detrimental to the quality of life or the environment; ***[3 max]***

B4. ***[1]*** *for each distinct correct point up to* ***[2]*** *for performance tests and up to* ***[2]*** *for user trials.*

[1] *for one appropriate example***.**
Performance tests
for critical, *e.g.* safety features, in the car interior *e.g.* safety belts, air bags

[1] *for one appropriate example***.**
User trials
for non-critical features in the car interior *e.g.* seat adjustment, steering wheel design ***[4 max]***

Option C – Mechatronics

C1. (a) solenoids convert electrical energy;
into linear kinetic energy and are often used for relays for switching on larger electrical currents; ***[2 max]***

(b) one gear on stepper motor output shaft;
one gear on rudder; ***[2 max]***

(c) the solenoid will throw the rudder in one direction and will need to be corrected by throwing it back in the opposite direction;
thus there will be a continual need for correction to maintain direction;
the stepper motor is very much more accurate and can finely control the position of the rudder to maintain a particular path; ***[2 max]***

C2. critical damping is the closest possible to the ideal situation – a critically damped position control servo system will reach the required position within a reasonable period of time without overshooting and oscillation;
friction (inertia) and gain are appropriately matched; ***[2 max]***

C3. ***[1]*** *for identifying problem* ***[1]*** *for appropriate modification,* ***[1]*** *for showing mathematics.*

$$V_{out} = -R_{fb}\left(\frac{V_1}{R_1} + \frac{V_2}{R_2}\right)$$

$$= -50\left(\frac{2}{50} + \frac{1}{20}\right)$$

$$= -4.5 \text{ Volts};$$

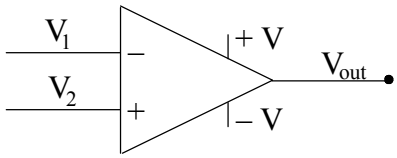
change over resistors **OR** change over voltages;

to give $V_{out} = -50\left(\frac{1}{50} + \frac{2}{20}\right)$

$= -6$ volts ***[1]***;

OR change the feedback resistor to 67 V, give the right gain; ***[3 max]***

C4. ***[1]*** *for each distinct correct point*.
an analogue signal can be digitised using an op-amp set up as a comparator circuit;
drawing of comparator circuit;



the gain from the op-amp is very large so the output will be saturated;
if $V_1 > V_2$ then the output will be high / true (1);
if $V_1 < V_2$ then the output will be low / false (0);
typical applications of comparators are to compare temperature or light levels with threshold values; ***[4 max]***

Option D – Food technology

D1. (a) it also kills food spoilage organisms; ***[1 max]***

(b) continuous processing could be used as an alternative so that the milk could effectively be poured continually along a pipe; ***[2 max]***

(c) energy considerations – if higher temperatures were used it would require more energy;
it is easier to maintain 63 °C for 30 minutes accurately than it is to maintain higher temperatures for a very short time;
could not raise temperature to 72 °C and keep it there for 15 seconds due to rate of heat transfer; ***[3 max]***

D2. ***[1]*** *for an appropriate organoleptic property and* ***[1]*** *for identifying an appropriate market for which this property is modified –* ***[2 max]****.*
texture ***[1]*** *e.g.* baby foods are prepared by homogenizing them to overcome the baby's lack of teeth ***[1]***;
taste ***[1]*** – sophisticated spicy flavours *e.g.* paprika designed for an adult market ***[1]***; ***[2 max]***

D3. (a) ***[1]*** *for appropriate definition.*
the use of a shortening agent, *e.g.* fat, to prevent the extension of the gluten network in products containing flour; ***[1 max]***

(b) shortening prevents the dough forming an extended gluten network;
and thus the biscuit has a crumbly, brittle texture; ***[2 max]***

D4. ***[1]*** *for each distinct correct point*.
the home bread making unit enables people to make home-baked and designer breads very easily even for working people;
home baked breads smell and taste better;
home baked breads are reminiscent of a better past;
home baked breads can be made when required from store cupboard ingredients "on demand"; ***[4 max]***

Option E – Computer aided design and manufacturing

E1. (a) a finite set of points (vertices) together with the edges connecting pairs of these points.
an edge can be a straight line or any other well defined space curve; ***[1 max]***

(b) wire frame modelling shows how the inside of the components are designed;
so helps the manufacturer to work out how to produce the component; ***[2 max]***

(c) first solid modelling and then wire frame modelling;
solid modelling is used to develop the concept and enables communication with consumers by showing surface features. Solid modelling relates to CAD;
wire frame modelling is used in the shift from design to manufacture. Wire frame modelling relates to CAD/CAM; ***[3 max]***

E2. ***[1]*** *for each distinct point.*
established legacy (old) equipment still in use and working reliably;
so introduction of newer (more expensive) technologies not yet appropriate;
OR environmental considerations and mechanical processes involved;
mean that a mechanical solution may be cheaper and more reliable than an electronic one; ***[2 max]***

E3. (a) ***[1]*** *for appropriate definition*.
a situation where a company keeps a small stock of components (or complete items) or items that take a long time to make just in case of a rush order; ***[1]***

(b) if there is a rush order (demand = high) the manufacturer is in a better position to respond;
if there are few or no orders (demand = low) then the manufacturer can replete stocks of components or items that can take a long time to make; ***[2 max]***

E4. ***[1]*** *for each distinct correct point. Up to* ***[2]*** *for advantages and* ***[2]*** *for disadvantages.*
Manufacturer
can offer a range of style and fabric combinations;
the manufacturer only needs to produce items which are sold;
reduction in waste of material resources;
no investment in unsold stock therefore more cost-effective;
the manufacturer should be able to produce clothes more cheaply and therefore derive a market advantage;
cuts out intermediaries therefore bigger profit margin;

Consumer
the requisite combination of fabric and design may not be on offer;
consumers usually like to try on clothes before purchasing to see how they feel;
consumers are often wary of virtual purchases;
clicks and bricks (*i.e.* a web site in support of a physical presence on the high street) is favoured over clicks alone with no physical presence on the high street;
customers cannot return clothes if they do no like when they actually arrive;
age issues in relation to use of Internet; ***[4 max]***

Option F – Invention, innovation and design

F1. (a) ***[1]*** *for each distinct appropriate point*.
family/group living scenario rather than one person living alone;
working from home rather than rushing out to work – benefits then of continuous space heating;
cooking "real" food not convenience foods (which might be better suited to Oven B);
traditional values – oven A projects a more traditional image; ***[2 max]***

(b) ***[1]*** *for each distinct appropriate point.*
opportunity to ensure that the product meets the latest safety standards;
new technologies can be incorporated in the product;
energy consumption generally enhanced in new models of product; ***[2 max]***

(c) ***[1]*** *for reason,* ***[1]*** *for brief explanation.*
mixed fuel adaptation;
means maintaining function easier;
status product;
therefore continuing demand;
still satisfies consumer;
therefore market still serves function;
appropriate;
therefore not obsolete;
dual use;
space heating and cooking; ***[2 max]***

F2. ***[1]*** *for each distinct appropriate point*.
the bicycle was first developed as a leisure/fun product;
the bicycle was not initially seen as a serious form of transport;
there were few cars;
early bikes were experimental with designers trying different sizes of wheels, *etc.*;
there was no cycle industry with a set of safety standards;
no culture of litigation at that time (could not be sued);
early bikes were very inefficient so not fast nor very dangerous; ***[2 max]***

F3. ***[1]*** *for each distinct appropriate point*.
having established a market for a product, the product can be redesigned to be better (more features, smaller, lighter, more energy efficient, cheaper *etc.*);
technological innovation spurs product innovation – technology push;
market forces require reinnovation – market pull; ***[3 max]***

F4. ***[1]*** *for each distinct correct point.*
mobile phones are unlikely to make traditional phones obsolete while:
the cost of calls is high and there are cheaper alternatives (*e.g.* cable telephones);
there is not 100 % coverage in the country under consideration;
there are perceptions of health risks associated with the use of mobile phones;
there are technophobes who resist the uptake of new technology;

mobile phones may make the traditional phone obsolete in the following scenarios:
students and other itinerants without permanent abode;

in cities where there is good signal coverage; ***[4 max]***

Option G – Health by design

G1. (a) *Statement to the effect:*
protons interact with a strong magnetic field and radio waves to generate electrical pulses that may be processed like X-rays; ***[1 max]***

(b) no X-rays or other ionizing radiation with MRI;
unlike CT;
therefore hazards reduced;
OR Could do one CT scan on the embryo;
but could not do a series of scans to follow the development of the embryo;
because of the potential side effects; ***[2 max]***

(c) ***[1]*** *for each distinct appropriate point and* ***[2]*** *for explanation*.
cost versus need;
the need for different types of equipment can vary across the world;
depending on the underlying disease patterns;
OR use of MRI requires skilled staff thus there is a training requirement;
in addition to the capital expenditure; ***[3 max]***

G2. (a) easily broken;
slow;
needs to be sterilized between patients which is problematic; ***[1 max]***

(b) ***[1]*** *for each distinct appropriate point*.
thermistors are resistors which change their resistance with temperature;
thermistors are generally non-linear in response thus careful calibration is necessary to get accurate results ;
thermistors are excellent for use in the continuous monitoring of a patient's temperature; ***[2 max]***

G3. lenses can be made thinner;
thinner lenses are lighter;
lighter lenses are more comfortable to wear; ***[2 max]***

G4. ***[1]*** *for each distinct correct point*.
orthodontists diagnose and treat all forms of malocclusion of the teeth and facial bones through the design and application of corrective appliances that apply and redirect forces to the teeth and facial bones for physiological and aesthetic reasons. Design constraints for corrective appliances include that:

the material is biocompatable ***[1]***, non toxic ***[1]*** and meets the design specification ***[1]***;
the appliance must be able to be manufactured so that is meets the design specification;
the technology should be appropriate;
the aesthetics of the appliance are appropriate, *e.g.* they match tooth colour and are suitably discrete;
the cost of the appliance is not prohibitive;
the appliance will achieve the desired result within a reasonable period of time;
the proposed treatment is consistent with the culture of the person being treated; ***[4 max]***