IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

M07/4/DESTE/SP3/ENG/TZ0/XX/M+

MARKSCHEME

May 2007

DESIGN TECHNOLOGY

Standard Level

Paper 3

21 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.
- Words that are <u>underlined</u> are essential for 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 a characteristic and **[1]** for a description of the characteristic **[2 max]**.*

durable;
withstands knocks and rough treatment;
hard/tough/strong; ***[2 max]***

(b) *Award **[1]** for each distinct point in an appropriate explanation **[3 max]**.*
alternating cross grain structure gives multi dimension flexibility;
build up of laminates can be moulded to shape;
increased strength to weight ratio;
attractive grain patterns;
various laminates could be used to give certain characteristics;
glues could make the product water resistant; ***[3max]***

A2. *Award **[1]** for each distinct point in an appropriate description **[2 max]**.*
man made-material;
the desired properties can be designed into the material; ***[2 max]***

A3. *Award **[1]** for each distinct point in an outline **[2 max]**.*
exposure to oxygen and water form oxides which cause rusting in ms;
coating with a non porous material is required if using ms;
stainless steel is corrosion resistant;
stainless steel is stronger; ***[2 max]***

A4. *Award **[1]** for the identification of two advantages **[2 max]** and **[1]** for each distinct point in a discussion of the two advantages **[4 max]**. **[6 max]** in total.*

economic;
glass raw materials have a very high melting point;
scrap glass lowers the melting point;
less energy is used;

time;
a lower temperature is required which is reached faster when scrap is added;
takes less time to melt the glass;

environment;
using less energy;
less waste/landfill produced; ***[6 max]***

Option B — Microstructures and macrostructures

B1. (a) *Award **[1]** for each point in a description of an arrangement of particles **[2 max]**.*
carbon atoms attached to hydrogen atoms;
regular arrangement;
tetrahedral arrangement; ***[2 max]***

(b) *Award **[1]** for each distinct point in an appropriate explanation **[3 max]**.*
tetrahedral structure;
fixed and cannot move;
each carbon atom covalently bonded to four other carbon atoms;
rigid multi-triangular structure; ***[3max]***

B2. *Award **[1]** for each distinct point in an appropriate description **[2 max]**.*
thermosets are appropriate because
they are insoluble;
the bonds formed are strong/durable;
good chemical resistance;
unaffected by heat;
thermosets have a rigid 3D structure/primary cross link bonds between the chains; ***[2 max]***

B3. *Award **[1]** for naming the physical property and **[1]** for a point in an outline **[2 max]**.*
physical property: hardness;
alloying introduces foreign atoms which effect hardness;
foreign atoms interfere with the movements of atoms in the crystals during plastic deformation and hardens the material;
less atom movement because of foreign atoms hardens the material; ***[2 max]***

B4. *Award **[1]** for the identification of two composites **[2 max]** and **[1]** for each distinct point in their evolution over time **[4 max]**. **[6 max]** in total.*

Composites ***[2 max]***
select two composites from
- wattle and daub;
- mortar;
- reinforced concrete;
- GRP;
- CRP;
- high temperature superconductors;
- students may choose other composite materials not mentioned in the guide;

Points related to evolution ***[2 max for each composite]***
wattle and daub
- originated from primitive buildings;
- made of poles and earthen walls;
- walls made of wattles woven from wood;
- wattles covered with combination of mud/dung/straw/leaves;
- used as early as the iron age;
- used in many countries;

mortar
- may be called cement;
- developed from use of clay as a binding agent;
- Egyptians discovered lime and gypsum;
  - used in the pyramids;
  - 3000BC;
- Romans developed a very durable mortar;
  - used volcanic ash as additive;
- in the 1700's mortar made with limestone and clay;
- in the 1800's Portland cement was patented;

reinforced concrete
- in the late 1800's, metal was added to concrete to reinforce it structurally;
  - first used in flower pots;
- developed concurrently in the US and Europe;
- the low tensile strength of concrete is compensated by the steel;
- 1889 – first concrete reinforced bridge;

GRP
- initially developed as timber replacement for plywood in aircraft;
- first developed in World War 2;
- first general application was in boatbuilding;
- being overtaken by carbon fibre because of its lower weight;

CRP
developed in the 1960's;
developed for its increased strength;

high temperature superconductors
superconductors discovered in 1911;
superconductivity first observed in mercury;
by 1975 more than 2000 superconducting materials had been discovered;
1986 – first ceramic compound superconductor created;
there is still no adequate explanatory theory; ***[6 max]***

Option C — Appropriate technologies

C1. (a) *Award **[1]** for each distinct point in a description **[2 max]**.*
human power is an alternative to the conventional type of power;
electricity is the conventional source; ***[2 max]***

(b) *Award **[1]** for each distinct point in describing contexts in which the drill would be appropriate **[3 max]**.*
a region where labour is cheap;
may create local jobs;
an area where there is no electricity;
an area where electricity is unreliable;
an area where electricity is very expensive;
the power source is understandable to/maintained by the people who use it; ***[3max]***

C2. *Award **[1]** for each distinct point in a description of renewable energy **[2 max]**.*
human energy is renewable;
human energy can be naturally replenished in a short period of time; ***[2 max]***

C3. *Award **[1]** for naming one way energy could be used and **[1]** for a distinct point in an outline **[2 max]**.*
minimize waste;
less energy used in its disposal;

optimize the efficiency of manufacturing systems;
less energy wasted through inefficiencies;

maximize the sustainable use of renewable energy;
energy source becomes more sustainable;

minimize the use of non renewable energy;
sources then become more sustainable; ***[2 max]***

C4. *Award **[1]** for the identification of each barrier **[2 max]** and **[2]** for each distinct point in a discussion of the two barriers **[4 max]**. **[6 max]** in total.*

cost of manufacturing may not be viable;
- recycling may incur greater manufacturing costs;
- selling price of the product would be increased and maybe not marketable;

cost of collection;
- increased costs incurred in collecting the recycled raw material;
- transportation; sorting; waste disposal costs;

raw material;
- separation of raw materials;
- source of raw materials may not be reliable;
- raw materials may be inappropriate – too much ink or glossy paper;

manufacturing capacity;
- initial high set up costs to include recycled paper;
- source of material to ensure consistent manufacturing capacity may be insecure;

quality;
- quality of recycled paper may be inferior;
- virgin paper may be of a higher quality;

attitudes;
- consumers may not be in favour of recycling;
- may be considered too much trouble to recycle; ***[6 max]***

Option D — Food technology

D1. (a) *Award **[1]** for each of two points in a list of processes **[2 max]**.*
primary processing – wheat into flour;
secondary processing – flour into bread; ***[2 max]***

(b) *Award **[1]** for a statement of an organoleptic property, and **[1]** for a distinct point in an appropriate outline **[2 max]**.*
texture;
soft/hard;

taste;
sweet/savoury;

smell;
fresh;
mouth-watering;

appearance;
looks fresh;
attractive;
healthy; ***[2max]***

D2. *Award **[1]** for the identification of a macronutrient and **[1]** for the identification of a micronutrient **[2 max]**.*
micronutrient – vitamin A/calcium/iron/sodium;
macronutrient – fat/carbohydrate/protein; ***[2 max]***

D3. *Award **[1]** for the identification of information that should be included on a bread label and **[1]** for each point **[2 max]** in an explanation. **[3 max]** total.*

date;
retailer can rotate stock;
consumer will know how fresh the bread is;

storage and usage information;
consumer can keep it in appropriate conditions;
bread remains safe to eat;
appropriate temperature and humidity conditions;

warnings;
ingredients that may have side effects for some people;
for example gluten or nuts;

volume/mass;
consumer will know number of servings;
consumer will be able to do comparison shopping;

ingredients;
preservatives;
food additives;
materials; ***[3 max]***

D4. *Award **[1]** for each distinct point in an explanation of a balanced diet **[3 max]** and **[1]** for each point in how bread can contribute to that balance **[3 max]**. **[6 max]** in total.*

balanced diet ***[3 max]***
optimum amounts of protein/starch/fat;
balance of micronutrients (vitamins and minerals);
balance of macronutirents (protein and carbohydrates);
adequate energy;
adequate essential fatty acids;
sufficient fibre;
adequate and optimum will vary from person to person; different age and lifestyle;
no single food provides the balance needed;
need to eat a range of foods;

bread's contribution ***[3 max]***
some breads high in fibre;
bread is a fuel food;
bread is high in carbohydrate;
bread is rich in B vitamins;
needs to be eaten with food from other groups, *e.g.* protein rich foods, meat and nuts;
needs to be eaten with protective foods with a range of vitamins; ***[6 max]***

Option E — CAD, manufacture and production

E1. (a) *Award **[1]** for each point in a description **[2 max]**.*
cutting design is done on a computer CAD system;
CAD converted into programmed instructions;
programmed instructions are sent to the CAM cutting machine; ***[2 max]***

(b) *Award **[1]** for the identification of an advantage and **[1]** for each distinct point in a discussion of the advantage **[2 max]**.*
reprogrammability;
similar designs can be reproduced with little set up work;
no set up work required for repeat designs;

accurate cutting;
no human error involved in cutting;
minimize wastage;
multiple identical items;

high volume production;
machine can run 24/7;
more orders can be filled;

low manpower requirements;
only one person needed to run the machine;
machine can be left to complete processes unattended; ***[3max]***

E2. *Award **[1]** for the point of comparison (aspect) and **[1]** for an elaboration of that point **[2 max]**.*
skills;
workers would require a different set of skills;

production;
production would be more efficient with CNC;

quality;
CNC would provide more consistent quality;
quality assurance would be greater;

waste;
more accurate cutting;
amount of wastage could be minimized with CNC cutting;

time;
CNC cutting is faster. ***[2 max]***

E3. *Award **[1]** for each distinct point in a description **[2 max]**.*
CNC machine would enable fast production response when an order is placed;
CNC machine would provide a bank of designs to select from for production;
CNC machine is efficient and so would contribute to JIT efficiency; ***[2 max]***

E4. *Award **[1]** for the identification of each change **[2 max]** and **[2]** for each distinct point in a discussion of the two changes **[4 max]**. **[6 max]** in total.*
expectations;
consumers expect products to be customized to their own requirements;
user centred design;
expect custom made products at mass production prices;

individual needs;
individual needs are met quickly;
individual needs are responded to accurately;

relationship with manufacturer;
customers have closer relationship with manufacturer;
intermediate stage of retailers is eliminated; ***[6 max]***

Option F — Invention, innovation and design

F1. (a) *Award **[1]** for each distinct point **[2 max]**.*

lightweight camera;
convenient and immediate printing;
no use of chemicals;
no wasted prints;
instant viewing of pictures;
reasonable cost;
options of discarding, printing or saving;
appeal of new technology;
two products in one; ***[2 max]***

(b) *Award **[1]** for the identification of a reason, and **[1]** for each distinct point in the explanation of a reason **[2 max]**.*

very complex technology;
unlikely that one person would have the breadth and depth of understanding;
one person generally only skilled in a limited range of areas;

broad expertise required;
invention would involve expertise from a range of areas;
unlikely that one person would have all the expertise required;
lone inventors usually work alone;

cost;
very expensive research and development;
more than one person could afford;

high risk;
no guarantee of success;
risk too great for an individual to take; ***[3 max]***

F2. *Award **[1]** for the identification of a benefit, and **[1]** for a point in the outline **[2 max]**.*

potentially large profits;
potentially higher sales;
able to sell initially at a higher price;
image;
gain a perception as the market leader;
gain image as an innovative/technology company;
attract a higher skilled workforce;
competition;
initially no other competition in the market; ***[2 max]***

F3. *Award **[1]** for the identification of a reason and **[1]** for a distinct point in describing the reason **[2max]**.*

printing process;
- traditional process used a range of chemicals;
- inkjet process produces less chemical wastage and resulting damage;
- cartridges can be recycled/refilled;

energy;
- use less energy;
- good for the environment;

materials;
- traditional process uses more paper; ***[2 max]***

F4. *Award **[1]** for the identification of a technological development and **[1]** for the identification of a social development and **[1]** for each distinct point in a discussion of the two developments **[4 max]**. **[6 max]** in total.*

technological development

wheels;
- lighter;
- pneumatic;
- wire spokes;
- quickly removable;

gears;
- hub gears;
- chain gears;
- automatic;

brake systems;
- more effective;
- denser rubber;
- levers and links mechanisms more effective;

materials technology;
- lighter;
- stronger;
- alloys;

suspension systems;
- seat suspension;
- shock absorbers;
- pneumatic suspension;

production;
- mass production techniques keep the price low;
- automation;

social development

aesthetics;
- bike design suits its function – racing/mountain/street;

fashion;
- popular recreational activity;
- traditional activity for many children;

environmental consideration;
- transport alternative;
- establishment of country and city bike paths;
- promotion by “greenies”;

healthy lifestyle;
- cycling promoted as part of a healthy lifestyle;
- exercise promoted as a way to keep fit;

[6 max]

Option G — Health by design

G1. (a) *Award **[1]** for a definition.*
not harmful or toxic to living tissue and so able to be introduced into the human body; ***[1 max]***

(b) *Award **[1]** for a material.*
metals;
polymers;
ceramics;
glass; ***[1 max]***
accept appropriate specific materials from within these groups

(c) *Award **[1]** for each distinct point in an appropriate explanation **[3 max]**.*
tested for biocompatibility;
tested in this specific application;
tested to ensure not harmful to living tissue;
tested for toxicity to human tissue; ***[3max]***

G2. *Award **[1]** for each distinct point in a description **[2 max]**.*
lenses can be thinner;
spectacles weigh less;
more comfortable for the user; ***[2 max]***

G3. *Award **[1]** for the identification of one way and **[1]** for an elaboration **[2 max]**.*
people for whom the chair was designed tested the chair;
tested for ease of operation;
tested for weight;
manoeuvrability;
ergonomics; ***[2 max]***

G4. *Award **[1]** for the identification of each effect, one related to people and one to the environment, **[2 max]** and **[1]** for each distinct point in a explanation of the two effects **[4 max]**. **[6 max]** in total.*

people
health effects;
- people breathe in pollutants;
- causes asthma;
- headaches;
- nausea;

environment
acid rain;
- exhaust pollutants combine with atmospheric moisture;
- moisture falls to earth and damages vegetation;

air quality;
- pollutants in the atmosphere;
- result in poor quality air;

greenhouse effect;
- pollutants in the atmosphere;
- prevent re-radiation of sun's energy; ***[6 max]***

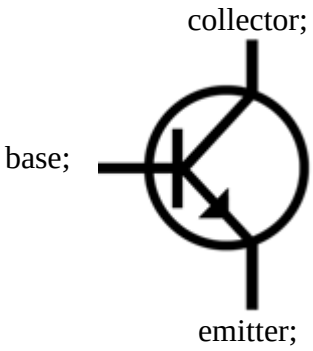
Option H — Electronic products

H1. (a) *Award **[1]** for the answer*
12 volts; ***[1 max]***

(b) *Award **[1]** for each distinct point in an appropriate description **[2 max]**.*
transistor
sending the signal to LED5;
regulates current flow; ***[2max]***

H2. *Award **[1]** for each distinct point in an explanation **[3 max]**.*
tank fills up with liquid;
liquid causes circuit to be connected;
current proceeds through resistor to LED;
when container is full, the buzzer circuit is activated and buzzer sounds; ***[3 max]***

H3. *Award **[1]** each for identifying the three components **[3 max]**.*



[3 max]

H4. *Award **[1]** each for the identification of two impacts **[2 max]** and **[1]** for each distinct point in a discussion of the two impacts **[4 max]** which may include a product example **[max 2 for examples]**. **[6 max]** in total.*
communication;
people are more connected;
communication can be instantaneous;
phones, cameras;

mobility;
people can work in different places;
work tools can travel with people;
laptop computers;

improved health;
small electronics can enhance the lifestyle of people;
disabilities may be easier to deal with;
pacemakers, hearing aids; ***[6 max]***