MARKSCHEME

May 2007

DESIGN TECHNOLOGY

Standard Level

Paper 2

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

Subject Details: Design Technology SL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A (total 20 marks) **and any ONE** question in Section B (20 marks each). Maximum total = 40 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 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 penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

SECTION A

1. (a) (i) *Award **[1]** for the method of calculation and **[1]** for the correct answer. Note: no units are required as the answer is a ratio, so do not subtract 1 mark for missing units.*
600 mm diameter on real sign is represented by 120 mm on poster;
120:600 = 1:5 / $\frac{1}{5}$ / 0.2 / 20%; ***[2 max]***

(ii) *Award **[1]** for total height of paper required and **[1]** for determining minimum ISO paper size required*
40 + 60 + 120 + 60 + 120 + 60 + 120 = 580 mm;
Minimum height of ISO paper is 594 mm for A1 landscape format; ***[2 max]***

(b) (i) *Award **[1]** for stating one advantage of using computer-aided design to discuss ideas for the design with the client.*
The design can be changed quickly in response to the client's comments;
The drawings can be stored digitally;
Can store different versions of the design;
The CAD software can be interfaced with CAM (printer in this case) so final design can be manufactured;
Don't have to produce a physical model;
The drawings can be produced quickly by experienced CAD designers;
The design can be emailed to the printer for comment;
The client can see the design clearly and interact with the designer; ***[1 max]***

(ii) *Award **[1]** for each discrete point in an explanation of why an iterative process is used to achieve the final poster design.*
The client can become part of the design process;
The discussion with the client will generate feedback to the designer;
The designer will incorporate ideas from the client and continue to refine the design;
The designer and client will continue in discussion until both feel an appropriate solution has been developed; ***[3 max]***

(c) (i) *Award **[1]** for stating a disadvantage of the Do Not Enter sign in Figure 3 over the one included in Figure 2 for use in an international context.*
It has words in English and will not be understood by non-English speakers; ***[1 max]***

(ii) *Award **[1]** for each of three distinct points in an explanation.*
The colour and shape of the sign become part of the message so the signs are more easily interpreted by drivers and other road users;
The signs can be readily understood so they enhance road safety;
If different signs/colours were used in different countries it would be confusing for drivers moving from one country to another; ***[3 max]***

2. (a) *Award **[1]** for a definition of green design to the effect of:*
Designing in a way that takes account of the environmental impact of a product through its product life. ***[1 max]***

(b) *Award **[1]** for each distinct point in a discussion of why some manufacturing companies have adopted pro-active approaches to their environmental policies.*
There are a growing number of green/ethical consumers;
Hence there is a growing market for environmentally responsible manufacturers;
Corporate social responsibility is perceived as a positive attribute by potential customers;

Lightweighting products results in reduced material costs;
Also reduces distribution costs;
Saves money;

Adoption of clean technologies can reduce manufacturing pollution;
This is beneficial to the environment;
It also reduces the likelihood of incurring fines;

Companies can phase in clean technologies at their own pace;
They can do it within the normal lifecycle of machinery;
If they want to be forced by legislation it may cost them a lot of money; ***[3 max]***

3. (a) *Award **[1]** for a definition of planned obsolescence to the effect of:*
Planned obsolescence is a conscious act to ensure a continuing market or to ensure that safety factors and new technologies can be incorporated into later versions of the product; ***[1 max]***

(b) *Award **[1]** for each distinct point in an explanation of how eco-labelling would help a consumer anticipate potential problems relating to the disposal of a refrigerator when it becomes obsolete.*
The eco-label tells the consumer that the product can be easily dismantled and the parts reused/recycled when it becomes obsolete;
The eco-label would carry information about the materials comprising the refrigerator so that the consumer will know how to deal with the materials on disposal;
The eco-label would provide advice about handling the refrigerant on disposal of the refrigerator; ***[3 max]***

SECTION B

4. (a) (i) *Award **[1]** for any appropriate reason why the rocking horse is suited to craft production*
Simple design;
Easily constructed;
Lots of fine detail *e.g.* mane;
Materials appropriate for handcrafting *ie*. wood;
Can be easily customized to individual customer needs. ***[1 max]***

(ii) *Award **[1]** for each correct advantage for using freehand drawings to communicate ideas about potential changes to the rocking horse design to individual clients.*
Cheap;
Fast;
Promotes creativity;
Does not need specialist equipment;
Can be annotated to communicate design thinking;
Easily understood by a non-technical audience; ***[2 max]***

(iii) *Award **[1]** for identifying a safety criterion that could be used to evaluate the rocking horse and **[1]** for a brief explanation.*
Surface finish;
No sharp edges/splinters;

Weight that can be supported;
does it match weight of standard child;

Ensure the structure is robust enough;
This will enable it to withstand the weight of the highest percentile child;

The height of the horse;
Is it too tall that the child would hurt him/herself if s/he fell;

Component size;
None of the components would be small enough to be able to be swallowed by a child;

Ensure there are no finger traps;
No gaps where a child could catch his/her fingers;

Restructuring the extent that the horse rocks;
This would prevent the child tipping over the head of the horse;

Component size/construction;
None of the components would be small enough/come loose to enable them to be swallowed by a child;

Stain/Finish;
Non-toxic materials should be used for children’s toys; ***[2 max]***

(b) (i) *Award **[1]** for each appropriate mechanical property that makes wood a suitable material for the rocking horse.*
High stiffness;
High hardness;
High toughness; ***[2 max]***

(ii) *Award **[1]** for identifying an advantage of using laminated timber rather than a single piece of timber for the production of the rockers and **[1]** for a brief explanation.*
Stronger that a single piece of solid timber;
Plys of wood are joined at right angles to each other so laminated timber is very strong;

No finishing required;
Reduces labour costs and time associated with finishing.

Able to form the complex shapes required for the rockers easily;
The use of a mould makes complex shapes easy to produce;

Can combine different materials;
This can make the material cheaper/stronger;

Cheaper than large pieces of solid timber;
Laminated materials can combine small cheap pieces into a larger piece cost effectively;

Large pieces of solid timber can be difficult to source;
Laminated materials can combine smaller pieces of material to produce a single larger piece; ***[2 max]***

(c) (i) *Award **[1]** for identifying a way in which craft production can be considered a clean technology and **[1]** for a brief explanation.*
Low volume;
Only manufactured when needed thus less timber used;

Low waste;
Craftsperson would plan how best to use the material;

Low energy utilization;
Hand tools used;

Low pollution;
Due to low energy consumption and materials used; ***[2 max]***

(ii) *Award **[1]** for identifying an appropriate manufacturing process and up to **[2]** for each distinct points of explanation **[3 max]** for each of three manufacturing processes used in the production of the rocking horse.*
Note: The list of processes shown below is not exhaustive.
Wasting, e.g. cutting and machining;
To cut the pieces of wood to the desired shapes, e.g., for the head, body, legs, etc.;
This is likely to be achieved with a jig saw to achieve the curved shapes required for the rocking horse;

Wasting, e.g. abrading;
Sanding wood pieces to achieve smooth surface ready for finishing with varnish;
This might be achieved by hand using sand paper or might involve an electrical sander;

Joining, e.g. legs to body or head to body using screws;
Drill hole in appropriate position using hand or electrical drill;
Screws may be sunk into wood and concealed using dowel;

Shaping, e.g. steam bending of the wood for the rockers;
Wood that has been dried and seasoned would need to be steamed in a steam box (for at least an hour per inch of thickness);
Clamping to an appropriately shaped "former" to achieve and maintain shape while wood cools and dries;

Weaving, e.g. of horse's hair to form mane;
Long pieces of hair may be woven to form the mane and then glued to the horse's head;
Alternatively clumps of hair may be punched into holes in the wood and glued in to present its easy removal by being pulled out during use;

Joining, e.g. by stitching or riveting; to produce the bridle and reins;
Pieces of leather or other similar material may be stitched together;
Stitching may be by hand or machine; ***[9 max]***

5. (a) (i) *Award **[1]** for an appropriate definition to the effect of:*
A group of people generating divergent ideas to try and solve a problem. The ideas may be random. No criticism is allowed as evaluation of the ideas comes at a later stage; ***[1 max]***

(ii) *Award **[1]** for identifying one way in which brainstorming might be used to contribute to the incremental design of the tent and **[1]** for a brief explanation.*
Sharing ideas with experienced product users can highlight weaknesses in existing designs (constructive discontent);
These weaknesses can be turned into opportunities to enhance the design incrementally;

Brainstorming with a group of experienced hikers draws on their experiences of hiking and of good solutions to problems they have seen in other tent designs;
These good ideas can be incorporated into the design and will ensure that the design is fit for purpose; ***[2 max]***

(iii) *Award **[1]** for each of two ways in which mathematical modelling might be used in the design of the tent.*
Mathematical models would allow the designer to calculate external forces, such as from wind and rain, to predict how the tent might perform in different conditions;
Mathematical modelling might be used to calculate the different quantities of materials that would be needed to make the tent;
Mathematical modelling might be used to calculate the cost of producing the tent; ***[2 max]***

(b) (i) *Award **[1]** for identifying a mechanical property and **[1]** for a brief explanation of why it is relevant to the selection of material for the metal hoop.*
Ductility;
The ability for the material to be drawn into a thick wire to form the metal hoop;

Stiffness;
The ability of the material to withstand pulling forces and to support the weight of the tent without collapsing. However the hoop must bend without breaking to form the hoop;

Toughness;
So it doesn’t crack; ***[2 max]***

(ii) *Award **[1]** for identifying a mechanical property and **[1]** for a brief explanation of why it is relevant to the selection of material for the guy lines.*
Tensile strength;
The guy lines need to be able to withstand pulling forces, such as the wind, without snapping;

Elasticity;
The material does not need to be too elastic else a pulling force, such as the wind, will stretch it and it will not hold the tent down; ***[2 max]***

(c) (i) *Award **[1]** for identifying an advantage of using CAD/CAM in the production of the tent and **[1]** for a brief explanation.*
Reprogrammability;
Similar designs can be reproduced with few set up changes;
No set up work required for repeat design;

Accurate cutting;
No human error involved in cutting;
Minimize wastage;

Low manpower requirements;
Only one person needed to run the machine;
Machine can be left to complete process unattended; ***[2 max]***

(ii) *Award **[1]** for identifying an appropriate manufacturing process and up to **[2]** for each distinct points of explanation **[3 max]** for each of three manufacturing processes used in the production of the tent. **Note:** The list of processes shown below is not exhaustive.*
Wasting, e.g. cutting;
To cut the pieces of fabric to the desired shapes for the various parts of the tent;
This is likely to be achieved by hand cutting with scissors for one-off/scale production or using an electrical cutting device if the tent is being produced by batch production;

Joining, e.g. by stitching or gluing;
Pieces of fabric will be stitched together - seamed;
Stitching is likely to be using an industrial sewing machine;

Shaping by extrusion, e.g. the material to produce the metal hoop;
Forcing metal through ever smaller dies till it reaches the right cross section to produce the metal hoop;
Ductility is a key consideration in this;

Weaving (splicing), e.g. the ends of the material used for the guy lines;
If not woven the ends of the rope may fray;
Weaving probably achieved by hand; ***[9 max]***

6. (a) (i) *Award **[1]** for each appropriate advantage of using an exploded isometric drawing to communicate the aspects of the guttering system to potential customers.*

Enables customers to see the individual components and how they combine into a system;
Can be easily interpreted by non-technical people;
Cheap to produce; ***[2 max]***

(ii) *Award **[1]** for each distinct point in an explanation of how fixed costs contribute to the final cost of the components of the guttering system.*

Fixed costs are totalled;
The breakeven point is determined and divided into the fixed costs;
Variable costs + a proportion of fixed costs depending on the breakeven point + profit = final cost of component; ***[3 max]***

(b) (i) *Award **[1]** for identifying an appropriate mechanical property of thermoplastic that would determine the spacing of the gutter support brackets in the guttering system of the house and **[1]** for a brief explanation.*

Stiffness;
The gutter must not bend under the weight of water it may be carrying from the roof to the downspout even when the gutter is full/the stiffer the thermoplastic component is the further spaced can be the gutter support brackets; ***[2 max]***

(ii) *Award **[1]** for each distinct point in a description of why the component labelled B in Figure 6 cannot be manufactured using extrusion.*

The component in figure A does not have a regular cross-section – it is a bent pipe;
Extrusion produces shapes of consistent cross-section and therefore is not suitable for manufacturing the part labelled A; ***[2 max]***

(c) (i) *Award* ***[1]*** *for identifying a way in which the use of thermoplastic for the components of the guttering system meets the design objectives of green products and* ***[1]*** *for a brief explanation.*
Thermoplastic has a low melting point;
It meets the design objectives for green products since it can be shaped using the minimum of material and energy;

Thermoplastic can be recycled;
Therefore it meets the design objectives of green products since full account can therefore be taken of its end disposal as it can be recycled and used in other products;

Thermoplastic does not create noise or smells;
Therefore using thermoplastic meets the design objectives for green products by minimizing nuisances such as noise or smell;

Thermoplastic does not corrode;
Therefore very durable, low maintenance; ***[2 max]***

(ii) *Award* ***[1]*** *for identifying an appropriate manufacturing process and up to* ***[2]*** *for each distinct points of explanation* ***[3 max]*** *for each of three manufacturing processes used in the production of components for the modular guttering system.* ***Note:*** *The list of processes shown below is not exhaustive.*
Shaping by extrusion of material;
This will produce components with regular cross-section;
It requires a die of the appropriate shape to result in the requisite component profile;

Wasting, e.g. cutting;
To cut the pieces of extruded material to the desired lengths for the various components;
This is likely to be achieved by cutting with a hot knife;

Shaping by injection moulding / casting;
To produce components with complex shapes;
Requires an injection moulding machine fitted with an appropriate mould produced by one-off production;

CAD/CAM for the production of moulds/dies for injection moulding/extrusion;
One-off production is used for mould/die production;
The mould is then used for volume production of components; ***[9 max]***