



MARKSCHEME

May 2013

DESIGN TECHNOLOGY

Higher Level

Paper 2

15 pages

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Subject Details: Design Technology HL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A (total [**40 marks**]) **ONE** question in Section B [**20 marks**]. Maximum total = [**60 marks**].

1. A markscheme often has more marking points than the total allows. This is intentional.
2. Each marking point has a separate line and the end is shown by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets () in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking indicate this by adding **ECF** (error carried forward) on the script.
10. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

SECTION A

1. (a) (i) Award [1] for stating the maximum weight for the occupants and their luggage when using the Transition for flying.
460lbs (1430 – 970); [1]
- (ii) Award [1] for calculating the amount of driving hours on the road available before refuelling if the Transition is driven at maximum speed.
 $35 \text{ mpg} \times 23 \text{ gall} = 805 \text{ miles}, \frac{805}{65} = 12.38 \text{ hours (accept 12.4 hours);}$ [1]
- (iii) Award [2] for an estimation of the maximum safe flying time for the vehicle before refuelling [2 max].
 $\frac{23}{5} = 4.6 \text{ hrs ;}$
extra fuel used for take-off so less than 4.6 hrs; [2]
- (b) (i) Award [1] for each of two distinct points in an outline of **one** potential barrier for the successful innovation of the Transition as a global product, other than price [2 max].
legislation;
different countries have different legislation for vehicles on the road/in the air and may not allow the Transition to be driven/flown;

training;
the company may not find it cost-effective to offer the training course in some parts of the world;

safety;
consumers may not be convinced that it is safe to drive / to fly; [2 max]
- (ii) Award [1] for each of two distinct points in an outline of **one** advantage of the vehicle for consumers who mainly want to use The Transition for flying [2 max].
storage;
it can be driven from the airstrip and stored at home/no need to pay to store it near the airstrip for next use;

emergency use;
it can still be used as a car if necessary;

convenience;
it can be driven to any suitable airstrip rather than have to store it at one location;

cost;
the consumer saves on the rental costs of storing it at an airstrip/in a hangar; [2 max]

- (c) (i) *Award [1] for stating the scale of production for the Transition.* *[1]*
batch;
- (ii) *Award [1] for each distinct correct point in a suggestion of a potential market segment for the Transition [3 max].*
wealthy people;
who want to use it for leisure;
or for business trips;
- companies;
purchase it to transport executives/clients;
and employ/hire a pilot;
- family members/friends;
who cannot afford it on their own;
but are willing to share the cost/not use it exclusively;
- golf is a popular sport in the US;
golfers often want to play on different courses which are a long distance from each other;
so the purchase of the Transition could be very appealing for such consumers (*allow other suitable activities*);
- people who are attracted by novelty designs/technological innovations (technogeeks);
and can afford expensive luxuries;
see it as a status symbol; *[3 max]*

- (d) (i) *Award [1] for stating the type of evaluation strategy the manufacturer would have used to prove the reliability of the engine for the Transition [1 max].* performance test; [1]
- (ii) *Award [1] for each distinct point in a suggestion of **one** reason why the vehicle is equipped with a full vehicle parachute rather than the passengers having individual parachutes [3 max].*
there is limited space in the cockpit of the vehicle;
making it difficult to wear a parachute while flying;
no time/room for two people to don their parachute;

flying at a lower altitude;
less time to escape;
not enough time to put on the parachute and exit the vehicle;

the vehicles parachute is packed professionally;
individuals do not need to be trained to pack their own parachutes;
this increases the reliability of the parachute/prevents deaths;

no need for a roof release;
which would complicate the design;
add costs to the vehicle;

safety;
controlled landing of the craft with occupants inside;
offers protection to occupants rather than jumping; [3 max]
- (e) (i) *Award [1] for each of two points in an outline of why the manufacturers refer to “48 inches from the floor to the pilot’s shoulder” [2 max].*
potential customers can consider the dimension in relation to their own body size;
to determine whether they would fit comfortably into the cockpit of the aircraft; [2]
- (ii) *Award [1] for each point in an outline of one reason why maintenance costs will be high for the vehicle, [2 max].*
the vehicle needs to be maintained for road-worthiness;
and it needs to be maintained for flight;

legislation varies in different countries related to aircraft and cars;
therefore the vehicle needs to meet all legislation for both in order to be used legally;

the vehicle will contain a wide range of components;
some relating to use on the road and some for flying;

mechanical parts will be subject to different forces;
depending on use for flying or on the road; [2 max]

2. (a) Award [1] for stating what is meant by work hardening a metal.
plastically deforming a metal to increase its strength; [1]

(b) Award [1] for each distinct correct point in a comparison between work hardening and alloying in terms of increasing the strength of a material [3 max].

alloying increases strength by mixing a stronger material with a weaker material;
work hardening increases the strength of a metal by deforming it plastically/hammering it;
alloying is a primary process, work hardening is a secondary process; [3 max]

3. (a) Award [1] for each of two distinct points in an outline of one reason why hardwood timber may be considered as a non-renewable resource [2 max].

hardwood trees are slow growing;
they cannot be replaced in a short time;

when hardwood trees are cut down;
deforestation leads to the erosion of soil, which makes it difficult to replenish the timber/forest;

ecosystems of hardwood forests have developed over a long time;
cutting down the trees destroys the ecosystem and it takes centuries to re-establish; [2 max]

(b) Award [1] for one each of two distinct points in an outline of one way in which active solar collection can help reduce the energy used in a domestic building [2 max].

active solar collection is when energy from the sun is used for a specific application for example, heating a water tank;
this reduces the need to use non-renewable energy for the same application;

can be used as part of a hybrid system;
which reduces the non-renewable energy consumed; [2 max]

4. (a) Award [1] for stating the formula used to calculate strain in a material.
$$\text{strain} = \frac{\text{change in length}}{\text{original length}};$$
 [1]

(b) Award [1] for each distinct correct point in an explanation of why a glass bottle dropped on a hard surface smashes but a metal drink can dropped from the same height, dents [3 max].

glass is brittle so cracks propagate easily causing fracture of the material;
metal is tough and deforms plastically;
resulting in permanent deformation of the material (dent); [3]

5. (a) *Award [1] for each of two distinct points in a description of a cantilever beam [2 max].*
a beam which is rigidly supported/fixed at one end;
while the other end is free (unsupported); [2]
- (b) *Award [1] for each of two distinct points in an outline of **one** limitation of the use of a cantilever beam in relation to size [2 max].*
the beam cannot be very long;
as it is unsupported at one end it will deflect easily under a heavy load/body load/increased moment; [2]
6. (a) *Award [1] for stating the primary source of energy used in the Industrial Revolution:*
coal; [1]
- (b) *Award [1] for each distinct correct point in an explanation of why steam power replaced water power during the Industrial Revolution in relation to efficiency of energy conversion [3 max].*
steam power was more efficient than water power;
even though only 30 % efficient/still not very efficient;
the efficiency was still a major improvement/enough to power a wide variety of machines/coal was in plentiful supply; [3]

SECTION B

7. (a) (i) *Award [1] for either of the two distinct points in which the Ridgeblade wind turbine may be considered a key feature of a living building and [1] for a brief explanation, [2 max].*
operates pollution free;
generates no waste;
- harvests energy needs on site;
adapted specifically to site/climate; [2]
- (ii) *Award [1] for each of two distinct points in an outline of one way in which the choice of surface finishes for the Ridgeblade wind turbine could help it blend into the environment [2 max].*
produce/customize it in a range of colours/textures;
which match different roof tiles/suit local culture; [2]
- (b) (i) *Award [1] for stating the mechanical motion involved in the performance of the Ridgeblade wind turbine and [1] for a brief explanation [2 max].*
rotary;
as the blades are turned; [2]
- (ii) *Award [1] for each distinct correct point in a comparison of the Ridgeblade wind turbine with a conventional wind turbine in relation to safety [3 max].*
the blades are enclosed for the Ridgeblade wind turbine;
less danger of birds flying into the blades than with a conventional rooftop wind turbine;
but birds may use the enclosed space for nesting/roosting when not in use and get injured when it starts up;
- conventional rooftop wind turbine stands tall of the roofline;
susceptible to damage from high winds/could fall off the roof and injure people;
the Ridgeblade turbine is much more compact/slimline and far less likely to be blown off the roof; [3 max]

- (c) (i) Award [1] for each of two distinct points in an outline of **one** advantage to the local environment of the design of the Ridgeblade wind turbine [2 max].
no/less pollution;
chemical/visual/noise; [2 max]
- (ii) Award [1] for each distinct correct point in the suggestion of **three** possible barriers to diffusion into the marketplace for the Ridgeblade wind turbine. [3 max] per barrier [9 max].
cost;
it is much more expensive than competitive products;
many consumers will not have the money to pay for it/will prefer to pay for a cheaper turbine;

consumer choice;
consumers may prefer to invest in alternative forms of renewable energy;
for example, solar power;

architecture;
in many parts of the world pitched roofs are not common;
so the Ridgeblade global market is reduced;

finance;
the company may not have the financial resources to pay for expensive marketing/advertising;
so people are not aware of the product;

local planning laws;
laws vary in different countries/locations;
some authorities may not allow rooftop wind turbines;

novelty;
buyers wary of new product;
may prefer more traditional forms of electricity generation;

orientation of the building;
may compromise the efficiency of the turbine;
not able to maximize on the amount of wind available / uneconomic; [9 max]

8. (a) (i) *Award [1] for each of two advantages of using an adhesive to join together the components of the Penguin Donkey [2 max].*
strong;
cost-effective;
hidden from view;
easy to join; [2 max]
- (ii) *Award [1] for naming a suitable adhesive to join the components and [1] for a brief explanation [2 max].*
PVA/cascamite/natural/animal glue;
suitable for joining wood to wood; [2]
- (b) (i) *Award [1] for each of two distinct points in an outline of **one** performance test the manufacturer could employ to ensure quality assurance for the consumer [2 max].*
load the rack with heavy books/magazines;
test strength/stiffness over a long period of time;

tensile tests on joints;
to ensure the glue is strong enough; [2 max]
- (ii) *Award [1] for each distinct correct point in an evaluation of the importance of strength and stiffness in the design of the Penguin Donkey [3 max].*
it needs to be strong enough to resist external loads;
which may include non-paperbacks and other objects;
needs to be stiff enough not to deflect when loaded; [3]
- (c) (i) *Award [1] for each of two distinct points in a description of the importance of the technique of abrading to the manufacture of the Penguin Donkey [2 max].*
the surface/edges of the wood needs to be abraded to make it smooth;
so there is no danger of splinters;

abrading enhances the grain pattern of the timber;
so improves the appearance/decorative quality of the surface; [2 max]

- (ii) Award [1] for each of three distinct points in an explanation of **three** advantages of using laminated timber to produce the Penguin Donkey. [3 max] for each advantage [9 max].

available in large sheet sizes;
so the curved components;
can be cut from one sheet;

good strength to weight ratio;
so the product is easy to move around;
and will be robust in use;

different surface veneers could be used;
to give consumers a choice;
of colour/texture to match the surrounding environment;

product is designed with tight curves;
laminated timber can be used in thin sections;
and bent around a former to produce the curves;

cost-effective to manufacture;
laminated timber is readily available;
and easy to cut with machines;

[9 max]

9. (a) (i) Award [1] for listing the two sub-divisions into which metals are classified [2 max].
ferrous; [2]
non-ferrous;
- (ii) Award [1] for each of two distinct points in a description of how the rate of cooling of a metal controls grain size [2 max].
slow cooling allows larger grains to form; [2]
rapid cooling produces smaller grain size;
- (b) (i) Award [1] for each of two distinct points in an outline of the manufacturing technique used to join the linkages in the Socrates corkscrew.
use of fasteners/fastening/permanent joining technique; [2]
rivets (pop-rivets);
- (ii) Award [1] for each of three distinct points in an explanation of how the use of linkages in the Socrates corkscrew enhances the mechanical advantage of the corkscrew [3 max].
the linkages act as a series of levers; [3]
the ratio of the length of the effort arm to the length (one unit) of the load arm (two units) is the mechanical advantage;
so the force on the cork is approximately doubled and it is easier to pull the cork out of the bottle;
- (c) (i) Award [1] for identifying the scale of production for the Socrates corkscrew and [1] for a brief explanation [2 max].
batch; [2]
the high price limits the market to those who can afford it/willing to pay for it;
- (ii) Award [1] for identifying an aspect on which to compare, [1] for a point relating to price and [1] for a point relating to value when assessing the Socrates corkscrew for value for money. [3 max] per aspect [9 max].
€120 is a high price for the Socrates corkscrew compared to other corkscrews available;
but the Socrates does not operate in a similar way to most corkscrew;
so it has novelty value for some consumers;
- Socrates has many components;
which need to be manufactured separately and joined together;
so it is more expensive to produce than most of its competitors and provides better quality for consumers;
- the finish to the metal;
is costly to produce;
but provides consumers with an aesthetically pleasing object;
- the quality of the materials and the surface finish;
should provide a long product life;
so consumers will have value for money over an extended time period; [9 max]