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MARKSCHEME

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DESIGN TECHNOLOGY

Higher Level

Paper 2

15 pages

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

SECTION A

1. (a) (i) *Award **[1]** for stating the dimensions (in metres) of the smallest rectangular box that the bicycle shown in Figures 2 and 3 could be delivered, **[1 max]**. Award **[0]** if no units are included.*

0.97m by 0.85m by 0.3m; ***[1 max]***

(ii) *Award **[1]** for each of two correct distinct actions required to fold the bicycle.*

Loosen/lift/undo clamp:
Remove wheel; ***[2 max]***

(iii) *Award **[1]** for whether the folded bicycle can be laid flat in the storage area of one, both or neither of the cars shown in Table 2.*

The folded bicycle can be laid flat in the storage area of the Mini but not the Smart car; ***[1 max]***

(b) (i) *Award **[1]** for each of two correct distinct points in a description of how stiffness is important in the design of the frame of the bicycle.*

Stiffness is the ability of a structure resists deflection;
The bicycle frame must be stiff enough to resist deflection due to the external load of its rider during use; ***[2 max]***

(ii) *Award **[1]** for identifying how using rounded rectangular cross-section metal tubing contributes to the stiffness of the bicycle frame.*

The rounded rectangular cross-section will act like an I-beam and is stiffer than circular cross-section tubing;
It is better able to resist deflection by an external load acting down on the structure as it has more material in the line of the applied force; ***[2 max]***

(c) (i) *Award **[1]** for each of two correct distinct advantages of using extrusion for the manufacture of the metal tubing for the manufacture of the frame of the bicycle.*

No finishing required;
Reduces waste
Volume production;
Hollow shape;
Good stiffness;
Reduces costs;
Provides a constant wall thickness and diameter;
Give high strength to weight ratio; ***[2 max]***

(ii) *Award **[1]** for each distinct point in a description of why the design of the folding bicycle is an example of incremental design;*

Some aspects of the design are developed, *e.g.* the design of the frame;
Others are not developed but remain unchanged from previous bicycle designs; ***[2]***

(d) (i) Award ***[1]*** for stating how many frame sizes Manufacturer A needs to produce to cover the full range of rider heights form 160 cm to 210 cm.

Two; ***[1]***

(ii) Award ***[1]*** for each of three correct distinct points in an explanation of the disadvantage to Manufacturer B of producing an increased number of frame sizes to cover the range of rider heights.

Increased tooling costs;
Increased stock storage/stock control;
More assembly jigs required;
More skilled workforce required. ***[3 max]***

(e) (i) *Award **[1]** for each of two ways in which the manufacturers might ensure that for any given frame size that the bicycle safely and comfortably accommodates its rider.*

User trial;

Performance testing;

Adjustment of the seat stem will accommodate riders of different leg lengths;

Handle bar can be adjusted to accommodate different size riders; ***[2 max]***

(ii) *Award **[1]** for an advantage of a user trial in collecting ergonomic data for bicycle design and **[1]** for a disadvantage of a user trial.*

Advantage:
Users are non-specialists so user trials are cost effective;
User trials are readily available;
Users may carry out tests in unexpected ways so truly challenge the design;

Disadvantage:
A number of products need to be produced for users to test;
Interpretation of collected data may be difficult; ***[2 max]***

2. (a) *Award **[1]** for a definition to the effect of:*

Building up a thick layer of material using thin layers of the material joined with adhesives; ***[1]***

(b) *Award **[1]** for each distinct correct point in a discussion of the advantage of using lamination as a manufacturing technique.*

No finishing required;
Able to produce complex shapes and surfaces, especially curved shapes through use of former;
Can suit large surfaces;
Can combine different materials;
Can produce a very flexible/springy shape;
Enhanced strength to weight ratio over unlaminated material. ***[3 max]***

3. (a) *Award **[1]** for stating one way in which mild steel can be treated to prevent rusting.*

Galvanizing;
Painting/painting with specific product e.g. hammerite or oil-based paint;
Plastic coating;
Vitreous enamel;
Electroplating. ***[1 max]***

(b) *Award **[1]** for each distinct, correct point in an explanation of why cotton is treated to make it suitable for use in a garment for use in various applications.*

Cotton is very absorbent (due to capillarity of liquid between the fibres of the cotton) thus it needs to be treated to make it waterproof;
Cotton is also degraded by ultraviolet rays, moisture and air pollutants and so must be treated to protect it from these;
Cotton is highly flammable and must be treated to reduce its flammability, *e.g.* for application in night attire or for theatre curtains; ***[3]***

4. (a) *Award **[1]** for a definition to the effect of:*

A measure of a material's ability to resist the flow of electricity through it; ***[1]***

(b) *Award **[1]** for each of distinct correct point in an explanation.*

The different resistivities ensure that the socket works but its users are safe;
Some parts of the socket, *e.g.* the conducting wires, must have a low electrical resistivity so they can conduct electricity;
Some parts of the socket must have a high electrical resistivity so they do not conduct electricity and will protect users from electrical shock; ***[3]***

5. (a) *Award **[1]** for each of two distinct correct points in a description of how designers use brainstorming in the development of a design.*

Brainstorming is used for the generation of ideas;
They involve groups of people who are encouraged to think 'outside the box' and so be innovative – no criticism is allowed;
Ideas are built upon and combined to produce new ones; ***[2 max]***

(b) *Award **[1]** for a correct point about convergent thinking and **[1]** for a corresponding point about divergent thinking.*

Convergent thinking is analytical and solution focused;
Divergent thinking is conceptual and problem focused;

Convergent thinking is mainly used during research stage and during evaluation;
Divergent thinking is mainly used in the ideas generating phase and during design development; ***[2 max]***

6. (a) *Award **[1]** for a definition to the effect of:*

A conscious act either to ensure a continuing market or to ensure that safety factors and new technologies can be incorporated into later versions of the product; ***[1]***

(b) *Award **[1]** for each distinct point in an explanation of how designing for planned obsolescence influences a designer's choice of materials.*

Durability of materials;
Materials need to last long enough but not too long;
Specification of material critical to achieving appropriate product life;

Ease of recycling;
Materials need to be cheap to recycle;
It must not cost more to recycle that the cost of virgin raw materials; ***[3 max]***

SECTION B

7. (a) (i) *Award **[1]** for each of two advantages of 2D and 3D freehand drawings to designers.*

Ease of production;
Speed of production;
Low cost of production;
Easily understood by non-designers;
Can be annotated to record design detail;
No specialist equipment required; ***[2 max]***

(ii) *Award **[1]** for each of three distinct correct points in an explanation of why designers use a variety of drawing and modelling techniques to represent ideas.*

Different models are required to represent different aspects of a design;
Different models may be used at different stages of a design;
Some models are better understood by non-expert audiences, *e.g.* potential consumers may understand a physical model;
Some models are more appropriate for communicating detail to manufacturers, *e.g.* an orthographic drawing as a production drawing; ***[3]***

(b) (i) *Award **[1]** for each of two reasons for the selection of a thermoplastic for the manufacture of the body of the hairdryer.*

Easy to injection mould;
Can be coloured easily in injection process;
Good surface finish;
Cheap;
Easy to recycle at end of product life; ***[2 max]***

(ii) *Award **[1]** for each of two distinct correct points in a description of the structure and bonding of a thermoplastic.*

Linear chain molecules covalently bonded;
Weak secondary bonding between the chains; ***[2]***

(c) (i) *Award **[1]** for identifying a way in which injection moulding can be considered as an example of a clean technology and **[1]** for a brief explanation.*

Conserves natural resources;
As wasted materials can be easily recycled;

Generates low levels of pollution;
So minimal negative impact on environment;

Efficient use of energy;

As only material used in product is heated; ***[2 max]***

(ii) *Award **[1]** for each of three distinct points in a discussion of each of three ways in which the design of the hairdryer could be modified to minimise its environmental impact – one relating to production, one to utilization and one relating to disposal, **[3 max]** per way.*

Production
Manufacturers should select clean technologies;
Clean technologies reduce consumption of natural resources, minimise waste and pollution;
Lean production minimises the complexity of the production operation and increases its efficiency;

Utilization
High energy efficiency of motor;
Reduces wastage of energy in use;
Energy production a major cause of pollution and consumption of natural resources;

Disposal
Use of standard parts to encourage reuse;
Standard parts which can be used in other products are worth salvaging;
Non-standard parts are not worth salvaging and are much more likely to become landfill;

Use of easily recyclable materials;
Cost of recycling must not exceed cost of virgin raw materials;
If virgin raw materials are cheaper then recycling is unlikely resulting in landfill;

Product labelling
Indicates material from which a product/component is made;
This will make it easier for a consumer to recycle;

The product must be easy to disassemble;
This will encourage its reuse/recycling;
The parts can be easily separated;

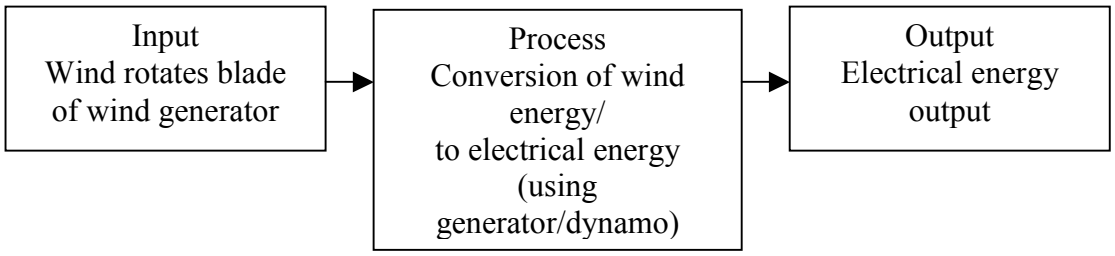
The materials must not be toxic on disposal;
Some materials breakdown on disposal to give toxic by-products; ***[9 max]***

8. (a) (i) *Award **[1]** for identifying an appropriate reason why wind farms may cause constructive discontent and **[1]** for a brief explanation.*

Wind farms are noisy;
Designers may redesign turbines so that they run less noisily;

Wind farms are considered by some to be unsightly;
Designers may redesign the turbines so that they are perceived to be less unsightly; ***[2 max]***

(ii) *Award **[1]** for each box of an input-process-output model appropriately labelled.*



[3]

(b) (i) *Award **[1]** for identifying each of two fixed costs.*

Capital cost of plant;
Installation costs of units;
Research and development costs;
Design costs; ***[2 max]***

(ii) *Award **[1]** for each of two variable costs.*

Labour costs;
Preventative maintenance;
Cost of selling electrical energy to national grid; ***[2 max]***

(c) (i) *Award **[1]** for each of two characteristics of an appropriate technology.*

Wind farms offer a flexible solution and can continue to be adapted;
Low running costs;
No chemical pollution emitted;
Should enhance the quality of life; ***[2 max]***

(ii) *Award **[1]** for each distinct correct point relating to issues at community, national and international level in relation to the introduction of a large scale wind farm, **[3 max]** for each level.*

Community level
Is it what the wind farm-adjacent community want;
Does the policy identify protection for communities potentially affected by the proposed development;
Will its location affect the future development of the community;
Will the site for the wind farm affect access to resources for community development;
Will the wind farm negatively impact on existing economic development activities, *e.g.* tourism;

National level
Is the wind farm consistent with the national energy policy;
Does the development represent the best use of land resources;
Is the development cost-effective with reasonable time for return on investment;

International level
Will the development significantly and positively impact on the country's production of greenhouse gases and other pollutants;
Is the development consistent with developments in adjacent countries;
Is the development consistent with long-term international developments; ***[9 max]***

9. (a) (i) *Award **[1]** for each distinct correct advantage volume production.*

Fast efficient production process;
Reduced labour costs;
Improved productivity;
Can run 24 hour cycles;
Improved quality control; ***[2 max]***

(ii) *Award **[1]** for each distinct correct point in an explanation of how industrial robots offer greater flexibility to automated production systems.*

Robots can be reprogrammed;
This allows different versions of the same basic model to be produced;
Physical components can be changed to alter the activity being undertaken (*e.g.* washing machines not tumble dryers); ***[3]***

(b) (i) *Award **[1]** for distinct correct point in a description of a metallic bond. Use of diagram showing positive nuclei in a sea of electrons is very acceptable.*

Positively charged nuclei in a sea of electrons;
The outer electrons are free and can flow through the crystalline structure; ***[2]***

(ii) *Award **[1]** for an advantage and **[1]** for a disadvantage of using stainless steel for the panels of the tumble dryer.*

Advantages:
Rigidity;
Strength;
Resistance to damp environments;
Attractive appearance;
Ease of cleaning;

Disadvantages:
Expensive;
Difficult to drill;
Oxidises during welding process so special welding techniques needed; ***[2 max]***

(c) (i) *Award **[1]** for each distinct point in a description of how the selection of a specific joining process affects the ease of recycling of the tumble dryer on disposal.*

Adhesive;
Ease of disassembly facilitates recycling;

Screws;
May take longer to remove and thus not facilitate recycling;

Rivets;
Not easy to remove so may preclude recycling;

Specialist plastic fixing;
May not be easy to remove unless carefully designed; ***[2 max]***

(ii) *Award **[1]** for identifying an appropriate way in which automated production impacts on the workforce/working conditions and **[1]** for each distinct correct point of explanation, **[3 max]** for each of three ways.*

Fewer jobs;
Machines do roles of humans;
More unemployment;

Deskilling of workforce;
Traditional craft skills non-longer needed;
Increased requirement for technical skills relating to maintaining of machines;

Management structures are different in automated plant;
More managers, fewer operatives;
Implications for skills and training needs;

Improved working conditions;
Humans not operating machines so fewer accidents;
Cleaner jobs, employees further away from noise; ***[9 max]***