

MARKSCHEME

November 2000

DESIGN TECHNOLOGY

Higher Level

Paper 2

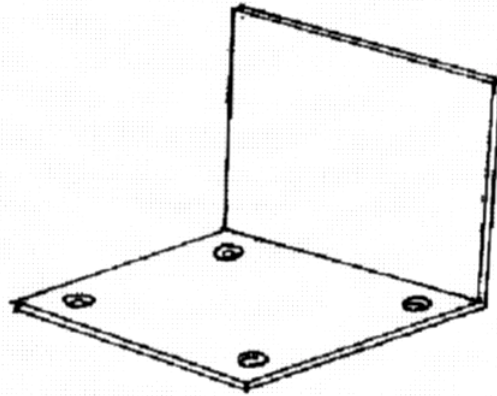
SECTION A

1. (a) (i) Award [**1 mark**] for 7.94 mm (**[0 marks]** for omission of units)
(ii) Award [**1 mark**] for 79.38 mm (**[0 marks]** for omission of units)
(iii) Award [**1 mark**] for 33.27 mm (Dimension B Spring 3)
[**1 mark**] for 33.27 mm* -12.7 mm
[**1 mark**] for 20.57 mm*

Total [**3 marks**]

(*Allow the mark if the calculation set-up is correct and the answer is correct but the value is taken incorrectly from the table.)

- (b) (Award up to [**2 marks**] for an acceptable sketch of the type shown below, either isometric or oblique or false perspective, showing a right angle bracket. Add the third mark if the spring mechanism is shown.)



- (c) (Award [**1 mark**] for any of the following up to a maximum of [**2 marks**] plus [**2 marks**] for quality of explanation.)
- Mechanism is available.
 - Mechanism allows the belt to be stowed away when not in use.
 - Mechanism allows the user to move about whilst still retained by the belt.
 - Mechanism can be attached to the car easily.
 - Mechanism can be hidden inside the trim of the car making it more aesthetically acceptable.
 - Mechanism is able to last the lifetime of the vehicle.
 - Allows for a wider belt for comfort and safety.
- (d) (Award [**1 mark**] for each advantage; up to a maximum of [**4 marks**])
- Nylon can be woven into a fabric
 - Nylon is resistant to abrasion
 - Nylon can be designed to have high tensile strength
 - Nylon can be woven into an in-elastic fabric
 - Nylon is resistant to chemicals that could degrade
 - Nylon can be made into a fabric that is aesthetically acceptable to the user yet has the required strength to restrain in the event of an accident
 - Nylon is easy to manufacture and readily available
 - Nylon can be coloured or patterned
 - Nylon is waterproof

2. (Award [**1 mark**] only for correct answer)
amorphous

3. (Award [**1 mark**] per distinct point up to a maximum of [**4 marks**])

[**2 marks**] for explanation of differences between thermoplastics and thermosets in terms of their structure including a diagram of the bonding.

[**2 marks**] for the explanation of how molecular structure affects recyclability.

4. Award [**2 marks**] for a statement that identifies the fact that whilst injection moulding can produce a large quantity of one article it requires a mould which could be a one-off production process.

OR

Award [**2 marks**] for identifying the fact that to design an artefact for injection moulding often involves the manufacture of prototype models that can be one-off production.

5. (a) (Award [**2 marks**] for each reason from the list up to a maximum of [**2 marks**].)

- To have a new product for the market place.
- To enable the product to be manufactured more economically.
- To take advantage of the availability of new processes and new materials.
- To generate consumer demand for the product.
- To create more profit.
- To maintain or increase market-share
- To ensure the product meets current safety standards or legislative requirements.

- (b) (Award [**2 marks**] for each reason from the list up to a maximum of [**2 marks**].)

- To own the 'latest' model.
- To have a more energy efficient model.
- To have a device that is easier to use.
- To have a device that is easier /cheaper to service / maintain
- To have a better product.
- To have a more fashionable product.

6. (a) (i) Award [**1 mark**] for 'comparator', no other answer acceptable.

- (ii) Award [**1 mark**] for identifying the fact that the voltage is divided in the ratio of the resistance, *i.e.* ($\frac{10}{25} \times 9$)
Award [**1 mark**] for the correct answer 3.6 volts. ([**0 marks**] if units are omitted)

- (b) Award [**1 mark**] for a statement that essentially says the variable resistor sets the voltage at which the comparator will switch. Award a further mark if the statement elaborates and states that the variable resistor forms a voltage divider with the thermistor to allow a voltage variation to develop at the non-inverting terminal of the op-amp or words to that effect.

SECTION B

Please note that for this section each question has an additional [3 marks] available for the construction of the answer.

7. (a) (i) *(Award [1 mark] for stating a suitable form of energy and [1 mark] for how it powers the motor.)*
- Electric motor powered by photovoltaic cell
 - Electric motor powered by rechargeable batteries – batteries are recharged by a renewable source, *i.e.* photovoltaics, water, wind or tidal.
- (ii) *(Award up to [2 marks] for a statement that contains evidence of any of the factors given below.)*
- Formative evaluation is required to feedback into the design process to enable suitable modifications to be made.
 - Formative evaluation is required to compare the actual product with the specification.
 - Evaluation is a key part of, and the trigger for, the iterative nature of the design process (cycle).
 - Specifically in relation to the mechanical toy, evaluation is required to ensure that the mechanical aspects of the design function as the specification expected.
- (b) (i) *(Award [1 mark] for each distinct element correctly identified from the list below up to a maximum [2 marks].)*
- Sintering produces a very precisely-sized article.
 - Sintering produces a finished article with no further processing required.
 - In this context small, precise, magnets are needed in large quantities, sintering is the most cost-effective way of producing them.
 - Small magnets are made from ceramics and sintering is the only way of producing the shape needed in that material.
- (ii) *(Award up to [2 marks] for a description that contains two of the elements listed below.)*
- Since the article is a toy then the finish must be non-toxic **[1 mark]**.
 - Manufacturing processes of shaping the truck body will leave burrs and sharp edges that must be removed to prevent injury and allow the finish to coat the edges **[1 mark]**.

(c) The candidate is expected to do **three** things:

1. Analyse the brief and extract the relevant phrases.

- Hand held
- In car entertainment
- 10 year old child
- Amusement

([1 mark] for each distinct point; up to [3 marks])

2. From the analysis the following points should be evident.

- Anthropometric data will be required of the hands of 10 year old children.
- The sizes of suitable rechargeable batteries will be needed.
- The environment for the toy means that small and loose items are unsuitable.
- The environment would mean that the toy may be dropped, therefore, the case or container must be strong enough to withstand shocks.

([1 mark] for each distinct point; up to [3 marks])

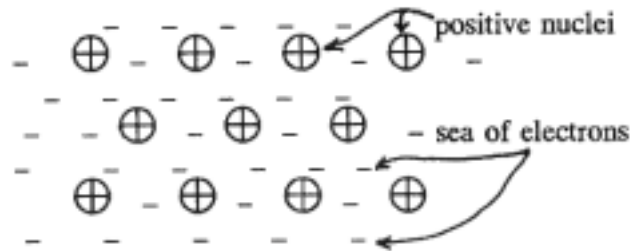
3. Justification of the elements with a specification.

- The anthropometric data will reveal how large the game can be so that it may be held and operated by a child. Range of data should be considered.
- Candidates should look at the energy storage of batteries against size to give reasonable working time.
- Case materials and manufacturing methods should justify the use of the specific material mentioned.
- Candidates should show that consideration has been given to the environment when specifying the game.
- Must be safe in use and manufacture.

([1 mark] for each distinct point; up to [3 marks])

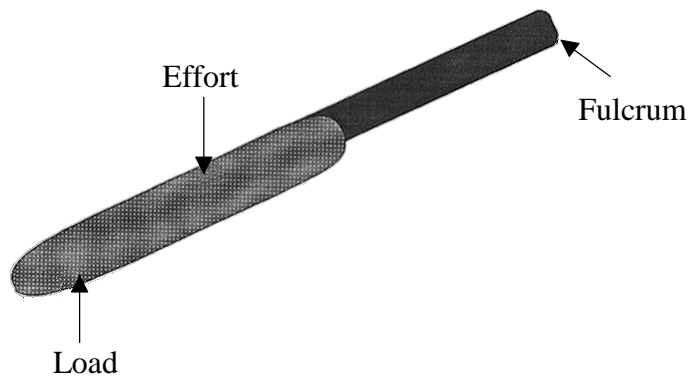
(Award up to [3 marks] for the analysis, [3 marks] for the specification derived from the analysis and [3 marks] for the justification. Total of [9 marks]. Thus a candidate that merely lists three points of the specification with no justification would achieve a maximum of [6 marks].)

8. (a) (i) Award [1 mark] for label/description of sea of electrons. Allow [1 mark] for label/description for metallic atoms.



- (ii) (Award [1 mark] for a correct statement.)
- Good corrosion resistance.
 - Will hold a sharp edge.
 - Can be shaped by wasting and moulding.
 - Can be polished and requires no protective coating.

- (b) (i) (Award [1 mark] for each label in the correct place on the diagram.)



- (b) (ii) (Award [1 mark] for each correct statement along the lines of the following, to a maximum of [2 marks])
- Deflection is the movement of a component in response to a force that does not exceed the elastic limit of the material at right angled to the applied force.
 - Stiffness is the property of a material that resists deflection
 - A knife blade is, by necessity, very thin in one plane so that it can cut, the depth of the blade is designed to provide stiffness.
 - The stiffness can be as a result of the material chosen or the cross-sectional shape of the blade created by the designer. Usually a combination of the two.

- (c) Award [2 marks] for each statement that can be identified from the table below to a maximum of [8 marks], If reference is made to only one of the two materials then maximum is [4 marks], the candidate must compare the two. [1 mark] for a balanced answer.

Material	Manufacture	User
Thermoplastic	Use injection moulding to manufacture. Mould costs to be considered. Usually made in large quantities. Material costs a small proportion of total costs.	Cheap, disposable and often hard to use. Practical rather than a pleasure to use (any hedonistic response).
Stainless Steel	Use moulding (drop-forging) and wasting (grinding / polishing) techniques to manufacture. Material costs are a much higher proportion of total costs.	A more costly investment. Nicer to use than Thermoplastic. Aesthetically better than Thermoplastic. Re-usable.

9. (a) (i) (Award [**1 mark**] for a statement in their own words.)
- ‘(Product life cycle) refers to the introduction, growth, maturity and decline and refers to the general pattern of the production and profitability of a product.’
- (ii) (Award [**1 mark**] for each correct statement up to a maximum of [**3 marks**])
- Designing is part of the product cycle not the whole.
 - The designer must be aware of the life cycle of the product designed.
 - The designer is not in control of the product cycle.
 - The designer is responsible for producing a suitable solution not for the commercial exploitation of the product.
 - The designer should build into the specification, elements that effect the product life, *e.g.* durability, planned obsolescence *etc.*
- (b) (Award [**2 marks**] for each clear, justified statement up to a maximum of [**4 marks**])
- Range of facilities (machine *etc.*) on which the car will be built will influence.
 - Type of facilities available *i.e.* press tools, jigs, robots.
 - Number of facilities, *i.e.* how many parts concurrently *etc.*
 - Maximum/minimum size of component that can be made on any particular machine.
 - Capital expenditure can be influenced by the design but not controlled by the design.
 - The corporate image of the company will influence, *i.e.* large, volume, or high quality.
- (c) (Award [**2 marks**] for each explanation to a maximum of four explanations, [**1 mark**] for a statement rather than an explanation)
- Mild steel is cheap.
 - Mild steel is easily shaped (malleable).
 - Mild steel is easily connected (by fusion and fasteners).
 - Plastics are difficult to make in large sizes except by rotor-moulding which does not produce aesthetically pleasing results.
 - Plastics and mild steel are both energy expensive to produce.
 - Mild steel requires finishing to provide corrosion resistance and provide aesthetic appeal and resistance to damp conditions.
 - Plastic is self-coloured and requires no corrosion protection.
 - Composite materials are cheap to manufacture (low capital cost), simple moulds *etc.*
 - Composites are self-coloured and corrosion resistant.
 - Plastic and composite materials resist damp conditions.
 - Plastics and composites have a hedonistic problem in that they could be considered inferior to steel for durability and strength.
 - Composite materials are light/strong or have a good strength/weight ratio.
 - Mild steel is easier to repair than either composite or plastic but is more easily damaged.
 - Award [**1 mark**] for a balanced discussion covering a good range of factors.
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