



General Certificate of Education

Design and Technology: Product Design (5551/6551)

Unit 1(3D Design) PD1D

Mark Scheme

2005 examination - June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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Design and Technology: Product Design

3D Design Unit 1 (PD1D)

Quality of Written Communication

The following marks are allocated to the quality of the candidate's written communication. Make a separate assessment of the candidate's overall ability as demonstrated across the paper using the criteria given below.

<i>Performance Criteria</i>	Marks
The candidate will express complex ideas extremely clearly and fluently. Sentences and paragraphs will follow on from one another smoothly and logically. Arguments will be consistently relevant and well structured. There will be few, if any, errors of grammar, punctuation and spelling.	4
The candidate will express moderately complex ideas clearly and reasonably fluently, through well-linked sentences and paragraphs. Arguments will be generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling.	3
The candidate will express straightforward ideas clearly, if not always fluently. Sentences and paragraphs may not always be well connected. Arguments may sometimes stray from the point or be weakly presented. There may be some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.	2
The candidate will express simple ideas clearly, but may be imprecise and awkward in dealing with complex or subtle concepts. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling may be noticeable and intrusive, suggesting weaknesses in these areas.	1

NB This mark scheme is intended as a guide to the type of answer expected but is not intended to be exhaustive or prescriptive. If candidates offer other answers which are equally valid **they must be given full credit.**

Many responses at this level are assessed according to the **quality** of the work rather than the number of points included. The following level descriptors are intended to be a guide when assessing the quality of a candidate's response.

(low mark range)
The candidate has a basic but possibly confused grasp of the issues. Few correct examples are given to illustrate points made. Description may be unclear.
(mid mark range)
The candidate has some knowledge but there will be less clarity of understanding. Some correct examples given to illustrate points made. Description better but unclear or confused in parts.
(high mark range)
The candidate has a thorough understanding of the issues and has provided relevant examples to support the knowledge shown. This candidate's answer shows clear evidence of understanding.

Question 1

(a) (i) Any two suitable specific materials e.g.

- Mini disc case-ABS, Polycarbonate, HIP, etc. (Accept aluminium). **Not** acrylic or thermoset.
- Pencil case-Nickle plated steel, aluminium, stainless steel etc
- Drinks bottle – PET LD PE, PP, HD PE etc.
Not PVC, acrylic, or thermosets.

Award 1 mark if material not quite suitable but would work or basic terminology e.g. steel, mild steel.

(2 x 2 marks)

(ii) Marks will be awarded as follows:

- Basic explanation with a few points e.g. it's 'strong', won't rust. Candidates may list generic properties, some irrelevant and it is not clear how they relate to the product.
- Better explanation with a number of correct points linked to product / application

(1 – 2 marks)

E.g. "it's malleable, easy to press form into pencil case shape, it doesn't corrode so it will maintain a good finish".

Candidate may still use some generic properties, expanding upon some.

(3 – 4 marks)

- Full explanation with all points linked to product / application. Candidates will clearly relate the material properties to the product function, appearance or manufacturing aspects.

E.g. "PET is a food grade plastic and therefore safe to make a drinks bottle from. The polymer is not affected by the contents of the bottle. PET is a thermoplastic and can be readily blow moulded. It can also be recycled".

(5 – 6 marks)

(Max 3 marks if basic list of generic properties given).

(2 x 6 marks)

- (iii) • Basic diagram of a suitable manufacturing process with a few points labelled. (1 – 3 marks)
- (1 mark for stating correct process)**
- Better diagram of a suitable manufacturing process with all points labelled and some explanatory notes. (4 – 6 marks)
 - Detailed diagram with all points labelled and a good explanation of the process. (7 – 9 marks)

Suitable manufacturing process include:

Mini disc player case – Injection moulding. (Pressure die cast if aluminium). Good answers will include clear diagram of injection moulding machine or die casting moulds and use a step by step description of stages in process. Accept Press Forming.

Pencil Case - Press formed (possible reference to piercing / blanking). Expect to see clear diagram of male / female dies on press with material clamped. Step by step notes explaining process. Some may refer to how stock material is punched to create the blank for pressing and may illustrate this. If folded and brazed, or welded – Low Mark Range.

Drinks bottle – Blow moulded (doesn't need to be 'extrusion' blow moulded) (possible reference to injection moulded top). Good answers will show clear diagram of parison being extruded into cavity, introduction of compressed air into parison, forcing plastic to move to the outer mould cavity, forming bottle shape.

(2 x 9 marks)

(b) Explanation may include:

- Lighter weight giving better fuel economy
- Speed of production – one piece moulding, no finishing
- Speed of assembly as self –tapping screws, click fastenings or adhesives can be used.
- Withstand minor impacts e.g. car bumper, door strips etc
- Recyclable as plastic parts are labelled clearly.
- Lower energy costs for manufacturer as fewer machines are required to make polymer based products.
- Durability as plastic parts will not corrode.
- Sound proofing properties of some polymers / foams.
- Lower cost substitute for wood dashboard / door trims.
- Self colouring so painting not needed.

1 -2 marks for each valid point.

(6 marks)

(Max 3 marks for generic list)

Question 2

- (a) (i) Suitable materials for part A include: beech, birch or similar veneers or may have GRP included as a veneer within the lamination. Accept aero ply, 'Bendy wood', flexi ply.

Award 1 mark if not quite suitable but would work e.g. pine veneers or no reference to veneers but material is suitable e.g. plywood etc. No marks for solid timber plank.

(2 marks)

- (ii)
- Basic explanation with a few points e.g. it's 'strong', 'flexible'. Candidate may list generic properties and not link them with the function, aesthetic or manufacture of the skateboard. (1 – 2 marks)
 - Better explanation with a number of correct points linked to product / application e.g. "it's flexible, won't break when you stand on it, it's durable and withstands wear and tear. Candidates may supplement this with some generic properties (3 – 4 marks)
 - Full explanation with all points linked to product / application.

Candidate will demonstrate a clear understanding of the requirements for materials suitable for the manufacturing of skateboards. Most properties will be linked to product function, life expectancy, aesthetics and so on.

(5 – 6 marks)

(max 3 marks if basic list of generic properties given).

(6 marks)

- (iii) Suitable description of laminating process using notes and diagrams.

Process to include:

- Cutting of veneers to basic overall shape of skate board.
 - Steaming veneers to make them more pliable (not essential).
 - Application of synthetic resin (e.g. cascamate, aerolite) to inside surfaces, clamping in an appropriate mould / vacuum bag system, over waxed / sealed mould, and leaving to dry.
 - Completely dry, trim excess off, sand and apply a finish
- Basic diagram of a suitable manufacturing process with a few points labelled
(1 mark for stating correct process) (1 – 3 marks)
 - Better diagram of a suitable manufacturing process with all points labelled and some explanatory notes. (4 – 6 marks)
 - Detailed diagram with all points labelled and a good explanation of the process (7 – 9 marks) (9 marks)

- (b) (i) Suitable materials for part B include: aluminium, duralumin, finished mild steel, ABS, PP, nylon, etc. (2 marks)
Not acrylic, PVC, HIPs or thermostats.

Accept more exotic alternative such as: aluminium / magnesium alloy or titanium and more basic materials such as pressed mild steel.

- (ii) Accept any casting method including: sand casting, die casting, gravity die castings, investment casting. Accept injection moulding if a polymer is describe in (i). Accept press forming if pressed steel referred to in (i). Each process should be explained using notes and diagrams.

(1 mark for stating correct process)

- Basic diagram of a suitable manufacturing process with a few points labelled. May show basic cope and drag casting box. Very little detail about method of pouring into runner observing excess metal going up the riser, etc. (1 – 3 marks)
- Better diagram of a suitable manufacturing process with most points labelled and some explanatory notes. Candidates may realise volume production is required and therefore describe injection moulding or gravity die casting. Drawings will be basic but largely correct. Notes will show step by step operation of process. (4 – 6 marks)
- Detailed diagram with all points labelled and a good explanation of the process. Expect to see all stages of injection moulding or alternative described in detail. Good answers will explain about the need to use a hydraulic ram to push the material into the mould cavity, split moulds, water cooling of moulds and ejector pins to remove product from mould cavity. (7 – 9 marks) (9 marks)

Question 3

(a) Figure 3 – Metal lamp (accept a polymer as candidates may not realise it is metal).

- Look for specific materials e.g. Aluminium alloy, stainless steel, etc.
- Reference to perhaps better durability but may dent if dropped
- Better answers will show metal product involves more processes, increasing cost.
- Specific manufacturing method-spun press formed parts
- Use of standard components, fasteners, springs, etc.
- Need to finish metal
- May refer to metal shade getting hot
- Reference to earthing/electrical conductivity of metal.
- Heavier product – more stable.

May refer to number of parts, joints, components, increasing complexity and cost.

1 – 2 marks per relevant point. (max 10 marks)

Figure 4 – Plastic lamp

- Look for specific materials such as ABS, etc. May refer to bars made from chromed steel, stainless steel, etc – used to conduct power and adjust lamp.
- Reference to useful properties of polymer such as electrical insulation, ease of moulding styling features, no need to add finishes.
- Manufactured by injection moulding – good answers will explain why injection moulding is used
- Made in large volumes – budget item.
- Fewer parts / components – quicker to manufacture.

1 – 2 marks per relevant point (max 10 marks)

Award marks as follows:

- Basic answer with one or two relevant points. Materials may not be entirely appropriate and little attempt to explain manufacturing process. Little or no reference to cost of production beyond “plastic is cheap”. (1 – 3 marks)
- Some understanding of the benefits and drawbacks of each material. The main properties of the material are linked to the function of the product. Basic reference to how materials influence manufacturing method. (4 – 6 marks)
- Very good answer covering most of the reasons why each material is used, linked to the product function, aesthetic issues and manufacturing method. Clear and logical answer, comparing and contrasting the materials and manufacturing (7 – 10 marks) (2 x 10 marks)

process of each product.

(b) Reference to

- Applied paint finishes (must be specific e.g. cellulose or acrylic based primers and top coat sprays), / powder coat painting (sprayed on to electrically charged product to help adhesion, baked in oven to ‘cure’ paint).
- Anodising aluminium – to create a hard coloured surface to aluminium products. E.g. ‘Maglite’ torch.
- Chrome / nickel / silver, plating. Used to make steel or other metal products such as tableware, more attractive by giving the material a desirable, non-corroding finish.
- Plastic coating – coating steel products with P.E. powder creates a coloured finish that is durable, e.g. garden tools.

Candidates may describe how the finish is applied or the properties/function of the finish.

1 -2 marks per relevant point

No marks for simply “paint”

(2 x 4 marks)

Question 4

- (a)
- (i) Beech – school furniture, toys, outdoor furniture, kitchen utensils, chopping board or any other suitable application.
 - (ii) PP – Children’s play equipment e.g. slides, play house or any other suitable application.
 - (iii) UF – Electrical fittings e.g. sockets, plugs, etc or any other suitable application.
 - (iv) Brass – pipe fittings, water taps and valves, 3 pin plugs, boat fittings, door furniture – handles, letter box covers, etc.

1 mark per appropriate application

(4 x 1 marks)

(b) Answers may include:

- (i) Beech:
Extremely durable, ideal for use in damp conditions such as a kitchen. Resistance to water and therefore not damaged by washing. Very hard – ideal to make the framework for school furniture. Solid timber allowing option to make with traditional wood joining methods. Beech resist scratches to surface improving hygiene on products such as chopping boards.
- (ii) Polypropylene – self coloured, requiring no further finishing, maintenance free for outdoor play equipment. Non toxic and non splintering making a safe play material. Not affected by rain / water but can fade with sunlight over time. Thermoplastic, lending itself to blow moulding or rotational moulding of large hollow objects.
- (iii) UF – Thermoset plastic resistant to heat that may be generated in event of electrical fault. Hard, scratch resistant plastic, giving a durable product that will last daily use for a number of years. Can be made relatively quickly in large volumes using compression moulding techniques.
- (iv) Brass – Has excellent casting properties, melting at 850 degrees C-ideal for die casting required for volume production of identical components. Machines well, allowing creation of screw threads, etc. Does not corrode but will tarnish. Excellent colour and shine for decorative purposes. Good electrical conductivity – required in the 3 pin plug

Explanation of why materials are suitable for each application

- Basic explanation with a few basic points e.g. it's 'strong', 'flexible'. (1 – 2 marks)
- Better explanation with a number of correct points linked to product / application e.g. 'it's flexible, won't break when you stand on it, durable'. (3 – 4 marks)
- Full explanation with all points linked to product / application. (5 – 6 marks) (6 marks)

(max 3 marks if basic list of generic properties given) (4 x 6 marks)