



**General Certificate of Education (A-level)
June 2012**

**Design and Technology:
Product Design**

PROD3

(Specification 2550)

Unit 3: Design and Manufacture

Final

Mark Scheme

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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NB. This mark scheme is intended as a guide to the type of answer expected but it 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 as well as 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:** The candidate has a basic but possibly confused grasp of the issues.
Few correct examples are given to illustrate points made.
- Intermediate:** The candidate does not have a clear idea of what s/he is writing about.
The candidate has some knowledge but there is limited clarity of understanding.
Some correct examples given to illustrate points made.
- High:** The candidate knows what s/he is writing about but there is some confusion.
The candidate has a thorough understanding of the issues and has provided relevant examples to support the knowledge shown.
The candidate knows what s/he is writing about and provides clear evidence of understanding.

Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	01		<p>Destructive testing 2 from:- hardness, tensile strength, toughness, ductility/malleability</p> <p>The tests described may be laboratory or quite basic workshop tests, do not discriminate between them in terms of difficulty although the description of laboratory tests will invoke more complex/detailed answers which are therefore rewarded more highly. (for clarity see pages 121/138 of text book)</p> <p>Hardness: softer metal is more easily filed, indent with dot punch (use same force /regard size of dent) / Brinell, Vickers, Rockwell tests.</p> <p>Tensile: clamp sample in vice and apply force to bend/ tensile testing machine</p> <p>Toughness clamp sample in vice and strike with hammer/Izod, Charpy, Houndsfield tests.</p> <p>Ductility clamp sample in vice and attempt a right angle bend, cracks on outside suggest limited ductility on inside limited malleability/similar to tensile testing machine.</p> <p>Reward labelled sketches as appropriate. Generally +2 if annotated/labelled.</p> <p>Should recognise:</p> <ul style="list-style-type: none"> - what property is being measured? - what is the set up? - how is consistency achieved? <p>Do not reward if the test does not match the property.</p>	2 x 6 marks	<p>Low: Simple statements, which show weak/poor understanding of the properties and processes of testing involved.</p> <p>Sentences and paragraphs may not always be well connected. Arguments may stray from the point or be weakly presented. There will be a number of errors of grammar, punctuation and spelling. (0 – 2 marks)</p> <p>Inter: Shows understanding of properties but lacks detail of tests and no recognition of the need to standardise tests with consistent forces etc.</p> <p>Candidates express moderately complex ideas clearly and with reasonable fluency, through well linked sentences and paragraphs. Arguments are generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling. (3 – 4 marks)</p> <p>High: Good understanding of properties and varied range of methods described with both detail and depth of understanding to achieve accurate results and comparisons.</p> <p>Candidate has expressed complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are relevant and well structured. There are few, if any, errors of grammar, punctuation and spelling. (5 – 6 marks)</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	02		<p>Explanation of composite materials 2 from 3 (For clarity reference text book Page 20-29)</p> <p>Fibre-reinforced composites- fibres such as glass and carbon (GRP/FRP etc) to reinforce polyester and epoxy resins. <u>Uses</u> - aerospace, automotive and marine applications e.g. racing / sports car bodies, canoes/boats, motorcycle helmets.</p> <p>Particle-based – Concrete (aggregate/stone + cement + sand) <u>Uses</u> - construction work, buildings, bridges, garden ornaments. Cermets (metals + ceramic particles) tungsten carbide <u>Uses</u> cutting tools.</p> <p>Sheet-based – plywood, blockboard, chipboard, MDF, <u>Uses</u> furniture, building construction,</p> <p>MDF/Chipboard may be accepted as a “particle” board as well as a sheet composite, e.g. Nitonol (nickel and titanium)</p> <p>NB: Accept a specific (named) alloy (i.e. micro-particle composite) providing that the answer shows understanding of why/how constituent parts are combined.</p> <p>NB: Kevlar is NOT a composite unless it is combined with a resin (FRP) fibre reinforced plastic.</p>	2 x 8 marks	<p>Low: Materials named are generic or incorrect, simple statements, which show weak/poor understanding of the materials and applications.</p> <p>Sentences and paragraphs may not always be well connected. Arguments may stray from the point or be weakly presented. There will be a number of errors of grammar, punctuation and spelling. (0 – 3 marks)</p> <p>Inter: Accurate materials and shows understanding but lacks detail, generalised statements with basic factors with some appreciation of application.</p> <p>Candidates express moderately complex ideas clearly and with reasonable fluency, through well linked sentences and paragraphs. Arguments are generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling. (4 – 6 marks)</p> <p>High: Precise and accurate named materials and provides both detail and depth of understanding of how these apply to a specific use.</p> <p>Candidate has expressed complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are relevant and well structured. There are few, if any, errors of grammar, punctuation and spelling. (7 – 8 marks).</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2	03		<p>Use of materials affecting manufacture and function/use of different colanders.</p> <p>The mark allocation of 28 marks rather than a 2 x 14 is so that marks are not prescribed to either the different type of colander or to the two elements of manufacture or function, this may be left to the interpretation by the candidate according to their knowledge of the subject content.</p> <p><u>Methods of manufacture</u></p> <p>Figure 1. Aluminium or stainless steel colander manufactured by press forming or spinning after holes have been cold punched. Base will be attached separately by spot welds or rivets.</p> <p>Figure 2. Polypropylene manufactured by injection moulding re-cyclable and uses property of pp to flex many times without fatigue.</p> <p><u>Function and use</u></p> <ol style="list-style-type: none"> 1. Traditional form/ colour, bulky in terms of storage and washing / dishwasher. 2. Can be coloured, fold flat for storage, easy washing / care. 3. Figure 1 has a base which raises the colander off a surface to allow drainage. Stainless steel is hard to prevent indentation /scratching. Aids hygiene.It is round which aids rotation of contents. <p>Figure 2 – square corners prevent movement. Plastic can have additive (micro ban) for hygiene.</p> <p>Reward suggestions for improvements – handles, etc.</p>	28	<p>Low: Inaccurate materials or non specific materials, confused or shows limited understanding of the materials in terms of use of materials from a production and/or function point of view. Only a small number of basic features included.</p> <p>Sentences and paragraphs may not always be well connected. Arguments may stray from the point or be weakly presented. There will be a number of errors of grammar, punctuation and spelling. (0 – 8 marks)</p> <p>Inter: Accurately named materials, reasonable to good knowledge of materials which are appropriate and demonstrate appreciation of manufacture and application.</p> <p>Candidates express moderately complex ideas clearly and with reasonable fluency, through well linked sentences and paragraphs. Arguments are generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling. (9 – 18 marks)</p> <p>High: States full and accurately named materials with comprehensive understanding of application to both manufacture and function/use in each case.</p> <p>Candidate has expressed complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are relevant and well structured. There are few, if any, errors of grammar, punctuation and spelling. (19 – 28 marks)</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
3	04		<p>Relationship of materials and selection influenced by quantity and process of production, two from one-off, batch of 100 and volume production of 10,000 of a named product. (for clarity text book ref. Page 211)</p> <p>Candidates are free to make their own selection of a product and both the materials and processes which render them appropriate. They must identify and justify the correct application and include details of method of processing the stated materials.</p> <p><u>Examples :-</u></p> <ul style="list-style-type: none"> • One-off product. Bespoke, hand-made furniture/ dining table etc – solid hardwood/ teak/ oak. Individual unique markings, grain pattern, noted for quality and expense. Produced by individual or small team craftsman focused design and make to customer brief using hand tools or limited machinery taking time and at a high cost for long life span product. • Batch of 100. Product may be similar – i.e. furniture but produced for small chain outlet or available to supply within short time frame from stock. Uses a combination of solid wood and veneered man-made board, utilises jigs, patterns and formers and more complex machinery. Tailoring, off-the-peg, ceramics etc. May be same product – school chair to cover batch as well as volume production. • Volume of 10,000 Use of thermoplastic polymers, mild steel, aluminium etc used for wide variety of products, motor vehicles. Use of injection moulding, press forming, CAM and CNC for both accuracy and repetitive production at low cost after initial high set up costs. 	2 x 14 marks	<p>Low: Non-specific or some inaccuracy in naming materials. Fails to show accurate appreciation of why/when/how the material would be used in application stated.</p> <p>Sentences and paragraphs may not always be well connected. Arguments may stray from the point or be weakly presented. There will be a number of errors of grammar, punctuation and spelling. (0 – 4 marks)</p> <p>Inter: Specific and accurate examples given which are appropriate and demonstrate reasonable to good appreciation of selection and method of processing.</p> <p>Candidates express moderately complex ideas clearly and with reasonable fluency, through well linked sentences and paragraphs. Arguments are generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling. (5 – 9 marks)</p> <p>High: Accurate and appropriate examples which show excellent knowledge and understanding of materials and processes to achieve quantity required.</p> <p>Candidate has expressed complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are relevant and well structured. There are few, if any, errors of grammar, punctuation and spelling. (10 – 14 marks)</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	05		<p>Link between aesthetics and the success of a named product.</p> <p>The quality of the answer may depend, to some degree, upon the candidates' choice of product. Some products being noted for aesthetic style e.g. Apple products, use of white / chrome.</p> <p>Expect reference to colour, shape, form, link to specific design movement – Bauhaus form follows function, Memphis – use of primary colours, bizarre style mix of materials, Arts and Crafts use of nature for decoration.</p> <p>Effect of materials on pattern, texture, grain, reflection etc. Use of leather/glass/chrome, retro style, carbon fibre, smart materials, polymers.</p> <p>Colour on ideograms. Do not reward answers which stray from the question and discuss “good design” in wider terms.</p> <p>Answers do not have to respond to the opening statement “function, cost, etc”</p> <p>The question asks – how aesthetics have played an important part in the success of a specific product, e.g. Salif lemon squeezer may not be a successful product in use but has become successful as an ornament.</p>	12	<p>Low: Strays from the question regarding aesthetics or has very few points to make. Examples are weak and provide few aesthetic features with mostly generic statements.</p> <p>Sentences and paragraphs may not always be well connected. Arguments may stray from the point or be weakly presented. There will be a number of errors of grammar, punctuation and spelling. (0 – 3 marks)</p> <p>Inter: Specific examples used are appropriate and provide a reasonable focus for aesthetic issues, including some which show study and knowledge of design at an Advanced level. There may be some repetition of features.</p> <p>Candidates express moderately complex ideas clearly and with reasonable fluency, through well linked sentences and paragraphs. Arguments are generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling. (4 – 7 marks)</p> <p>High: Varied and appropriate examples which show good appreciation of aesthetics as applied to products in a wide context. Shows depth of study at this level.</p> <p>Candidate has expressed complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are relevant and well structured. There are few, if any, errors of grammar, punctuation and spelling. (8 – 12 marks)</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	06		<p>An open question on candidates' choice of product to show knowledge and application of new technology and materials. Quality of response will again be influenced by the selection of the specific product.</p> <p><u>Products:</u> Anticipate products as varied as mobile phones, MP3 players, televisions, cameras, computers, vacuum cleaners, motor vehicles etc.</p> <p><u>Materials:</u> – anticipate synthetic and smart materials, modern materials, polymers, to improve both processing through machines / CAM etc and function, lighter, more durable etc.</p> <p><u>Technology:</u> Electronics, transistors, digitalisation, portable power supply/battery technology, nanotechnology, ICT etc.</p>	16	<p>Low: Example is generic and provides only a limited range of issues which do not cover all that is required by the question. Knowledge appears to be at a basic level with few facts or limited detail.</p> <p>Sentences and paragraphs may not always be well connected. Arguments may stray from the point or be weakly presented. There will be a number of errors of grammar, punctuation and spelling. (0 – 5 marks)</p> <p>Inter: Specific example used is appropriate and provides a reasonable focus for a variety of issues which shows a reasonable knowledge of the improvements which affect each of the three elements in turn.</p> <p>Candidates express moderately complex ideas clearly and with reasonable fluency, through well linked sentences and paragraphs. Arguments are generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling. (6 – 10 marks)</p> <p>High: Specific example given is highly appropriate in that it enables candidates to demonstrate breadth and depth of knowledge across each of the elements of manufacture, function and use.</p> <p>Candidate has expressed complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are relevant and well structured. There are few, if any, errors of grammar, punctuation and spelling. (11 – 16 marks)</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	07		<p>Explanation of the criteria for the design of street furniture.</p> <p>The list of criteria should include :</p> <ul style="list-style-type: none"> • Aesthetic to suit environment – urban/ rural, traditional/contemporary • To provide an ergonomic, practical function. • Ease to maintain and anti -vandal proof. • Cost of manufacture and installation. <p>The above may not be hierarchic and may not be exhaustive.</p>	8	<p>Low: Short list of criteria and only limited detail in the explanations given.</p> <p>Sentences and paragraphs may not always be well connected. Arguments may stray from the point or be weakly presented. There will be a number of errors of grammar, punctuation and spelling. (0 – 2 marks)</p> <p>Inter: Reasonable list of criteria and satisfactory explanations provided.</p> <p>Candidates express moderately complex ideas clearly and with reasonable fluency, through well linked sentences and paragraphs. Arguments are generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling. (3 – 5 marks)</p> <p>High: Comprehensive list of criteria and sound, detailed explanations in support.</p> <p>Candidate has expressed complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are relevant and well structured. There are few, if any, errors of grammar, punctuation and spelling. (6 – 8 marks)</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	08		<p>Ability to apply the criteria stated at [07] to analyse varied street furniture in photographs.</p> <p>Straight forward analysis and explanation to justify the criteria. To an extent the answer at [07] will have an effect upon the quality of [08]</p> <p>Note: Marks on paper are 20 and so do not look to consider the two products equally or separately. They will have different aspects to introduce to the answer. Also they may not necessarily address the criteria stated at 07 in a logical or equal way to gain reward.</p>	20	<p>Low: Candidate shows only basic understanding of the application of their criteria and how they apply to the featured items, issues will be quite basic and/or few in number.</p> <p>Sentences and paragraphs may not always be well connected. Arguments may stray from the point or be weakly presented. There will be a number of errors of grammar, punctuation and spelling. (0 – 7 marks)</p> <p>Inter: Candidate has a reasonable understanding and knowledge of the varied criteria and how they have been satisfied by the various items. Shows a good appreciation of the importance of various aspects of design in this application.</p> <p>Candidates express moderately complex ideas clearly and with reasonable fluency, through well linked sentences and paragraphs. Arguments are generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling. (8 – 13 marks)</p> <p>High: Candidate fully appreciates the importance of each of a variety of relevant criteria and how they have been satisfied in a variety of contexts. Each one is covered in detail and shown with reference to an appropriate product.</p> <p>Candidate has expressed complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are relevant and well structured. There are few, if any, errors of grammar, punctuation and spelling. (14 – 20 marks)</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
6	09		<p>The essence of the question is how success of a product depends upon development and innovative design. Explanation of 4 different aspects of design / manufacture linked to the introduction and evolution of two specific, individual products. The named product is not important; it is simply a vehicle for the candidate to explain the statement. Each of the bullet points may not be represented equally.</p> <ul style="list-style-type: none"> • <u>Technology push</u>- Product specific e.g. Sony Walkman cassette player, new technology introduces a type of product that had not been seen before and so had no ready market but becomes successful following advertising and marketing or alternatively fails as the product is not really needed at that time. • <u>Market pull</u> – Products launched as a result of market research or consumer demand for a new or improved product. • <u>Planned obsolescence</u> – intentional introduction of a new/improved product before the decline in sales of the existing one. • <u>The influence of fashion</u>- Obvious link to clothing but also interior design, new trends, colours etc. <p>Naming a product doesn't specifically generate a mark.</p>	2 x 14 marks	<p>Low: Simple statements with some confusion and poor explanations non-specific to product, some inaccuracies.</p> <p>Sentences and paragraphs may not always be well connected. Arguments may stray from the point or be weakly presented. There will be a number of errors of grammar, punctuation and spelling. (0 – 4 marks)</p> <p>Inter: Shows understanding but lacks detail, Generalised statements with minor inaccuracies.</p> <p>Candidates express moderately complex ideas clearly and with reasonable fluency, through well linked sentences and paragraphs. Arguments are generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling. (5 – 9 marks)</p> <p>High: Wide and varied number of issues described with both detail and reference to the specific application, appropriate to explain the terms.</p> <p>Candidate has expressed complex ideas extremely clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. Arguments are relevant and well structured. There are few, if any, errors of grammar, punctuation and spelling. (10 – 14 marks)</p>