GCSE
DESIGN AND TECHNOLOGY
8552/W

Unit 1 Written Paper

Mark scheme

June 2020

Version: 1.0 Final

206G8552/W/MS

Mark schemes are prepared by the Lead Assessment Writer 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 associates 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 associate understands and applies it in the same correct way. As preparation for standardisation each associate 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, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Glossary for maths

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

[a, b]	Accept values between a and b inclusive.
For π	Accept values in the range [3.14, 3.142]
Their	Accept an answer from the candidate if it has been inaccurately calculated but is subsequently used in a further stage of the question.

Questions which do not ask students to show working

As a general principle, a correct response is awarded full marks.

Qu	Part	Marking Guidance		Total marks	AO
1		**A**	Biomass	1 mark	AO4
2		**B**	To have a short lifespan	1 mark	AO4
3		**C**	To switch equipment on or off	1 mark	AO4
4		**B**	Photochromic pigment	1 mark	AO4
5		**D**	Woven fabric	1 mark	AO4
6		**A**	Due to improvements in new materials	1 mark	AO4
7		**A**	An increased use of robotics has led to a reduction in manual jobs	1 mark	AO4
8		**D**	Turbine	1 mark	AO4
9		**D**	Pulley	1 mark	AO4
10		**A**	Can be drawn into a long length	1 mark	AO4

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>11</td><td>1</td><td>Name one alloy.

1 mark for a correct specific named alloy.

Indicative content:

Brass
Bronze
Duralumin
Pewter
Steel (accept any specifically named steel eg die steel (tool steel), high speed steel (HSS), stainless steel)

Accept all other valid responses.</td><td>1 mark</td><td>AO4</td></tr>
<tr><td>11</td><td>2</td><td>Explain why metals are alloyed.

<table><tr><td>2 marks</td><td>Two correct simple points of explanation or one point explained in detail possible using a specific example of use.</td></tr><tr><td>1 mark</td><td>One correct simple point of explanation.</td></tr><tr><td>0 marks</td><td>No attempt or nothing worthy of credit.</td></tr></table>
Indicative content:

• Where a mixture of at least 2 metals are combined to give enhanced properties
• To produce a tough corrosion resistant material eg stainless steel
• Titanium can be alloyed with other metals like aluminium and vanadium for increased strength, better corrosion resistance and easier workability
• Alloying metals can improve working properties and improve aesthetics

Possible reference to examples of use to enhance explanation:

• Stainless steel – cutlery to make hard wearing and corrosion resistant
• Brass – copper and zinc for brass musical instruments due to workability into different forms and profiles

Accept all other valid responses.</td><td>2 marks</td><td>AO4</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>12</td><td>1</td><td>Composite materials such as foil and polymer lined boards are used in food and drink packaging.

Give one advantage and one disadvantage of using composite materials for packaging.

1 mark for one correct advantage and one correct disadvantage.

Indicative content:

Advantages:

• Improve resistance to water absorption
• Improve insulation properties
• Improve ability to preserve contents
• Improve strength and stability of the container

Disadvantages:

• Not always recycled by some local collection services hence may be incinerated or end up in land fill
• Do not degrade easily if littered
• Difficult to separate different materials from each other for recycling at the end of a containers life

Accept all other valid responses.</td><td>2 marks</td><td>AO4</td></tr>
<tr><td>12</td><td>2</td><td>Table 1 shows the number of food and drink containers successfully recycled by a manufacturer in 2010 and 2017.

What is the percentage increase in recycling of composite food and drink containers between 2010 and 2017?

<table><tr><td>1 mark</td><td>For recognising a 14 billion tonne increase in containers recycled ie 46-32 billion tonnes</td></tr><tr><td>1 mark</td><td>14 ÷ 32 × 100 = 43.75%

Accept 43.8%</td></tr></table>
Alternative method

<table><tr><td>1 mark</td><td>46 ÷ 32 = 1.4375</td></tr><tr><td>1 mark</td><td>Answer 43.75%

Accept 43.8%</td></tr></table></td><td>2 marks</td><td>AO4</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>13</td><td></td><td>
Figure 4 shows a system diagram for an alarm.

Complete the diagram by naming one component that could be used in each block.

<table>
<tr><th>Suitable inputs</th><th>Suitable processes</th><th>Suitable outputs</th></tr>
<tr>
<td>• Light sensors
• Temperature sensors
• Pressure sensors
• Switches
• Pressure pad

Accept any switch/sensor used to activate or deactivate system, eg:

• PIR sensor
• Sensor + qualification
• Motion sensor
• SPST switch
• Key switch
• Reed switch
• Key pad</td>
<td>• Microcontrollers
• Timers
• Decision making

Accept trade names for specific components and:

• PIC chip
• Genie chips
• Picaxe
• Arduino
• Crumble
• Genie
• Counter
• Transistor
• Microprocessor
• Transistor
• Time delay
• Monostable
• Astable</td>
<td>• Buzzers
• Speakers
• Lamps

Accept specific components:

• Bell
• LED
• Siren
• App notification on phone</td>
</tr>
</table>
</td><td>3 marks</td><td>AO4</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>14</td><td></td><td>
Name one specific commercial manufacturing process and describe what it is used for.

Name of process

Using notes and/or sketches describe the process you have named above.

1 mark for a correctly named specific process

1 mark for a simple descriptive point
2 marks for a detailed response with two credit-worthy points made

Indicative content:
<table>
<tr><td>Papers and boards</td><td>Offset lithography
Screen printing
Digital printing

Die cutting</td><td>Printing design and information on paper and card.

Cutting out of nets.
Making perforations.
Creasing of card.</td></tr>
<tr><td>Timber based materials</td><td>Routing

Turning

Lamination

Machine morticing</td><td>Production of grooves, rebates and joints.

Turning cylindrical objects and shapes.

Bonding layers of veneers or laminas together to create a large flat board or a complex curved shape using a former.

Cutting square or rectangular holes in a piece of timber to create joints. (Also note that mortices often have round ends so must be considered if in answer).</td></tr>
<tr><td>Metal based materials</td><td>Milling

Casting</td><td>Horizontal or vertical milling of a flat surface, groove, rebate or hole.</td></tr>
</table>
</td><td>4 marks</td><td>AO4 1a
AO4 1b</td></tr>
</table>

		Welding	Redistribution of metal in molten form to fill a mould or cavity.	
		Brazing	Redistribution of at least 2 pieces of metal along and edge/spot/seam to create a permanent joint.	
		Sintering	Use of solder to join two or more pieces of metal together without physically melting them. The compression of powdered metals in a die using heat and extreme pressure to create a solid product in final shape.	
	Polymers	Injection moulding	The heating and injection of molten polymer into a mould to produce a 3D shape.	
		Extrusion	Where molten polymer is extruded through a die to produce a consistent shaped profile.	
		Vacuum forming	Heating of sheet polymer so that it softens and can be shaped in a mould by extracting the air between the material and the form.	
		Calendaring	Manufacture of thin thermoplastic film.	
		Rotational moulding	Used to manufacture hollow 3D products using an enclosed mould containing thermoplastic polymer in powder form.	
		Blow moulding	Polymer in tube form is extruded (parison), the end sealed and hot air blown in to forcing the polymer out into a mould to create a hollow shape.	
	Textile based materials	Weaving	Fabrics are woven on looms to produce large rolls of cloth in either plain or repeating patterns.	
		Dying		

				Fibres are dyed commercially before weaving to establish a fibre colour dying can be done by batch dying in a tank or continuous dying using various tanks and rollers to move the fabric along.		
			Printing	Roller printing, screen printing and digital printing all transfer images to the fabric.		
			Machine sewing	Specialist sewing techniques like the overlock stitch can be used to create a tough and durable edge, hem or seam.		
		Electrical and mechanical systems	Pick and place assembly	Used to select and position individual components in pre-determined positions quickly and consistently on a PCB.		
			Flow soldering/ Reflow soldering	Used in surface mounting of electrical components. Components are located on a PCB on pre-soldered pads. PCB is then placed in a reflow oven where the solder melts connecting the component to the PCB.		
			Wave soldering	Circuit boards have pre drilled holes with components located in position. PCB board then moves on a conveyer belt over a molten solder wave, bonding the components to the PCB as the solder cools.		
			PCB manufacture Etching	Different to photoresist PCB manufacture done in school by spraying the etch directly onto a developed PCB board.		
			PCB lacquering	Application of a polymer layer to protect PCB from corrosion, dust and dirt.		
		Accept other valid responses.				

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>15</td><td></td><td>
Explain why each factor below would need to be considered by a manufacturer when sourcing materials/components.

A maximum of 2 marks explaining why each factor needs to be considered when selecting materials or components

<table>
<tr><td>2 marks</td><td>Two simple points of explanation given or one clarified in greater detail</td></tr>
<tr><td>1 mark</td><td>A simple correct point of explanation given</td></tr>
</table>

Indicative content:

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

<table>
<tr><td>Bulk buying</td><td>Economies of scale – buying in bulk will allow for reduced material/components costs and these can be passed on to the customer for a more competitive price. Manufactures will secure discounts that can be passed on to the customer.
Stock forms – buying exactly the quantity of materials required for a product or range of products knowing they can be used without waste
Standard components – bought in bulk to secure discounts and reduce final product cost</td></tr>
<tr><td>Ethical factors</td><td>Finite v renewable – avoid unnecessary consumption of finite resources that will run out. Use sustainable materials where possible.
Provenance – where do the materials come from? Are they from an ethical source eg Forest Stewardship council (FSC) or Fairtrade.
Working conditions – the promotion and support of people and communities in developing countries to ensure they are not exploited, having a detrimental impact on education, health and general well-being.</td></tr>
</table>

Accept other valid responses.
</td><td>2 x 2 marks</td><td>AO4</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>16</td><td>1</td><td>
The products/components shown below are manufactured from different materials.

Choose one product/component and complete Table 2 below.

One mark for each of:

• Specific main material
• Stock form
• Appropriate finishing technique

Indicative content:

Content is illustrative and other correct responses should be rewarded.

<table>
<tr><th colspan="3">Product: Metal can opener</th></tr>
<tr><th>Specific main material used</th><th>Stock form used in manufacture</th><th>Appropriate finishing technique</th></tr>
<tr><td>Steel
Stainless steel</td><td>Sheet
Strip
Bar</td><td>Polymer over-moulding
Left as finished/ polished finish
Powered coated</td></tr>
<tr><td colspan="3"></td></tr>
<tr><th colspan="3">Product: Card shoe box</th></tr>
<tr><th>Specific main material used</th><th>Stock form used in manufacture</th><th>Appropriate finishing technique</th></tr>
<tr><td>Solid white board
Corrugated cardboard</td><td>Sheet</td><td>Offset lithography Printing</td></tr>
<tr><td colspan="3"></td></tr>
<tr><th colspan="3">Product: Textile shopping bag with logo</th></tr>
<tr><th>Specific main material used</th><th>Stock form used in manufacture</th><th>Appropriate finishing technique</th></tr>
<tr><td>Cotton drill
Denim
Hessian
Calico</td><td>Roll</td><td>Dying
Screen printing
Digital printing
Stain resist finish
Water resist finish</td></tr>
</table>
</td><td>3 marks</td><td>AO4</td></tr>
</table>

		Product: Wooden toy **Specific main material used** / **Stock form used in manufacture** / **Appropriate finishing technique** Beech, Pine, MDF, Plywood / Plank, Board / Cellulose, Lacquer, Varnish, Oil **Product: Polymer gears** **Specific main material used** / **Stock form used in manufacture** / **Appropriate finishing technique** Most gears are made from Nylon and Polyacetal Also accept: Polyphenylene sulfide (PPS) Thermoplastic polyester, long fibre reinforced plastic and liquid crystal polymers (LCP). / Granules Also accept named gear stock forms eg spur, bevel, helical, worm, bevel, hypoid, crown gear / Pigment added during injection moulding Left as finished in mould Accept other valid responses.		

16	2	A number of calendars are being made. Given the sizes provided in **Figure 5** and **Figure 6**, how many calendar pages can be made from one sheet? **Indicative content:** 1 mark: Correct calculation 280 × 4 = 1120 mm 210 × 4 = 840 OR 1187 ÷ 280 = 4.2 (so 4 sheets one way) And 841 ÷ 210 = 4 the other way OR (1187 x 841) ÷ (280 x 210) = 16.9773 = 16 pages max OR	2 marks	AO4

	998267 ÷ 58800 = 16.9773 = 16 pages max.
1 mark	Calculation that pages will fit in a 4 × 4 arrangement allowing 16 pages to be made from each sheet

16	3	What percentage of material is waste after cutting the pages calculated in Question **16.2**? Give your answer to **two** decimal places.	3 marks	AO4

1 mark	Step 1: Total sheet area = 1187 × 841 = 998 267 Total area of their answer from 16.2 = their 16 × 280 × 201 = 940 800
1 mark	Step 2: Total waste = 57 467 mm^2 – their 940 800 = their 57 467
1 mark	Step 3: Percentage waste = their 57 467 ÷ 998 267 × 100 = their 5.7567% = their 5.76%

Alternative method 1

1 mark	Step 1: Vertical waste portion their 67 × 841 = 56 347 mm^2 Horizontal waste portion = their 1 × their 1120 = 1200 mm^2
1 mark	Step 2: Total waste = their 57 467 mm^2 Total sheet area = 998 267 mm^2
1 mark	Step 3: Percentage waste = their 57 467 ÷ 998 267 × 100 = their 5.7567% = their 5.76%

Alternative method 2

1 mark	Step 1: Vertical waste portion their 67 × their 840 = their XXX mm^2 Horizontal waste portion = their 1 × 1187 = their 1200 mm^2

		1 mark: Step 2: Total waste = XXX mm^2 Total sheet area = 998 267 mm^2 1 mark: Step 3: Percentage waste = their XXX ÷ 998 267 × 100 = their 5.7567% = their 5.76%		

Qu	Part	Marking Guidance	Total marks	AO
17		Responsible design should consider social issues in the design and manufacture of products. Analyse and evaluate the types of pollution caused by the manufacture, use and disposal of products. Give examples in your answer. 7–8 marks: A fully detailed analysis **and** evaluation of oceanic **and/or** atmospheric pollution and the impact it can have on the environment. Several good examples to support response. 5–6 marks: A good analysis of both oceanic **and/or** atmospheric pollution and the impact on the environment. Some evaluative points given in response to analysis information presented. Good example(s) to support response. 4–3 marks: Basic analysis of oceanic **and/or** atmospheric pollution. Expect an imbalance in response between the two types of pollution requiring consideration in the question. One or no evaluative point. Simplistic or vague attempt to include examples in response. 1–2 marks: One or two limited points considering oceanic and/or atmospheric pollution. Very limited analysis, evaluation and no examples. 0 marks: No attempt or nothing worthy of credit. **Indicative content:** The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above. **Analysis** – identification of component characteristics of each type of pollution	8 marks	AO4

Evaluation – judgment on impact of each type of pollution on the environment

Oceanic pollution	• Pesticides and fertilisers being washed from the land by rain and carried by rivers into the sea. • Chemicals and toxic materials like mercury and lead find their way into oceans. These then can enter to food chain and poison water supplies. • Plastic which does not degrade is carried by rivers into the sea creating large pools of rubbish in the deep oceans where sea currents converge. • Pollution of the seas from oil spills during extraction and tanker accidents. • Oil and sewage pollution whilst better than in previous years, can still contaminate and pollute ecosystems and marine life eg coastlines. • Micro beads – no longer legal to use in cosmetics as from January 2018 in the UK (also banned in Europe and North America). Big problem due to size of less than 1 mm diameter is that they cannot be removed by water treatment making it all the way into the oceans to the detriment of sea life and ecosystems.
Atmospheric pollution	• Acid rain – the combination of nitrogen oxide and sulphur dioxide combine and fall as acid rain which when carried by prevailing winds fall raising acidity levels in lakes killing fish and marine life and also raising acidity in the soil destroying plant based life. • Carbon monoxide contributes extensively to greenhouse gasses and raising the global temperature. • Carbon dioxide emissions form vehicles using fossil fuels is known to lower air quality affecting the heath of the young, elderly and those with chronic breathing issues. • Particulates – when released into the atmosphere they can cause ‘global dimming’ restricting light to the surface of the earth.

	• Lower air quality – impact on human health particularly the young, old, people with asthma, heart and lung problems. Net impact on increase health care costs and mortality rates. Affected groups are told to stay indoors on days identified as ones with poor air quality.

Accept other valid responses.

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>18</td><td></td><td>
Explain why the two methods below are used to manufacture products in different volumes.

Give specific examples of products in your answer.

Maximum of 3 marks for each production method.

<table>
<tr><td>3 marks</td><td>Two simple/One detailed point of explanation and specific example (s) to further clarify response.</td></tr>
<tr><td>2 marks</td><td>One detailed/Two simple points or one simple point of explanation and a specific example to further clarify response.</td></tr>
<tr><td>1 marks</td><td>One simple point of explanation or appropriate specific example to clarify response.</td></tr>
<tr><td>0 marks</td><td>Nothing worthy of credit.</td></tr>
</table>
Indicative content:

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

Mass

• Used to produce products in tens of thousands/ large production runs eg TVs, fridges, microwave ovens.
• Highly suited to products that can be made using automated manufacturing techniques requiring minimal human involvement eg packaging and leaflets.
• Where a large number of identical products are known to be needed, making it worthwhile setting up a dedicated production line.
• Used where efficient material use is paramount to ensure a cost effective product with minimal waste/ zero defects to keep product costs low eg mobile phones.

Batch

• Suited to small quantities of a product or slight variations of a product eg perishable goods like food, chemicals (adhesives & paint), home furnishings (wallpaper and tiles) some medical supplies etc.
• Batches can be in single figures or several hundred depending on what the product is eg set of dining chairs, bridesmaid dresses
• Extensive use of jigs, templates and moulds to assure consistency across a batch.
• Opportunities for CAD/CAM to allow flexibility in manufacturing different batches of products.
</td><td>2 x 3 marks</td><td>AO4</td></tr>
</table>

		• Quick change over between one batch of products and another without time consuming human involvement eg manufacture from a CAD file. • Economies of scale as some materials/ components can be sourced/purchased in bulk. Accept other valid responses.		

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>19</td><td></td><td>
Choose one of the companies from Table 3.

Outline the design features and/or manufacturing techniques that have made your chosen company successful.

You should refer to specific products in your answer.

<table>
<tr><td>5–6 marks</td><td>Thorough description of a wide range of design features and/or manufacturing techniques provided for one company. Two or more clear examples provided to support response.</td></tr>
<tr><td>3–4 marks</td><td>A good description with consideration of some design features and/or manufacturing techniques provided for one company.</td></tr>
<tr><td>1–2 marks</td><td>Limited description identifying generic products associated with one company rather than design features and/or manufacturing techniques.</td></tr>
<tr><td>0 marks</td><td>Nothing worthy of credit/ a company not in the question has been discussed</td></tr>
</table>

Indicative content:

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

Alessi
Unique products produced with a distinctive design flavour.
Heavy focus on kitchen products and products for the household.
Products make extensive use of stainless steel mixed with brightly coloured polymers.
Artistic design
A focus on high quality – hand
crafted objects made with the help of machines
Fun design imprinted with characterful features
Products designed to be aesthetic as well as functional with varying degrees of success:
• Whistling bird kettle 1985 by Michael Graves
• Juicy Salif 1990 by Philippe Starck
• Anna G corkscrew 1994 by Alessandro Mendini
• Condiment set 1978 by Ettore Sottsass

Apple
Computers, portable music and phones:
• Apple 2 and 3 PCs in the 1970s
• Apple Macintosh computers in 1980s
• Macintosh mouse 1984
</td><td>6 marks</td><td>AO4</td></tr>
</table>

- iMac G3 1998 designed by Jonathan Ive with cases in distinctive and various colours to catch attention
- Mini desktops – the Power Mac cube 2000
- PowerBook 100 1991 – miniaturised parts of the desktop range to create a lap top with integrated mouse
- iPod Generation 1 2001 with click wheel technology for ease of track selection
- iPod shuffle 2005 – random track selection
- MacBook Pro 2006 with aluminium case. The benchmark for all other manufacturers
- iPhone 2007 with touch screen technology. Apps from the Apple shop

Braun
A company forever linked with the work of German industrial designer Dieter Rams and his 10 principles for good design:

1. Innovative
2. Useful
3. Aesthetic
4. Understandable – good design that does not need an instruction booklet!
5. Unobtrusive
6. Honest
7. Long lasting
8. Design down to the last detail
9. Environmentally friendly
10. As little design as possible

A range of electrical and electronic products designed with simple lines, function in mind and intuitive design:

- Portable radios
- Digital bedside radio/alarm clocks
- Battery powered/electric shavers eg Braun sixtant razor 1962
- Hair and skin care products eg hairdryers
- Health products eg blood pressure monitors

Dyson
Electrical and electronic products using imagination and innovation to create stylish products that are also highly functional

- DC01 – the first dual cyclone vacuum cleaner 1993.
- Washing machine CR01 2000 with twin opposing drum technology for a quicker more thorough wash supposedly.
- Dyson digital motor 2004 – with high speed impeller. Used in later iterations of cleaners for improved efficiency.
- Dyson ball vacuum cleaner DC15 2005 – for improved manoeuvrability. Traditional cleaners have fixed wheel s and only go in straight lines.
- First Hand held cleaner 2006 – DC16 using root cyclone technology.
- Airblade AB01 2006 – hand dryer with airblade technology. Works by scraping water off washed hands, hygienic and drying hands in 10 seconds approx.

- Air multiplier fan AM012009 – no blades and multiplies air flow by 15 times.
- Dyson digital slim cordless vacuum cleaner 2018 – no cord connectivity. Power provided by high output lithium ion batteries effective for whole house cleaning.

Gap
Established in the late 1960s (American fashion) in response to different fashion requirements for customers between childhood and adulthood – the gap:

- Men – trousers, shirts, shorts
- Women – dresses, maternity
- Children – baby and kids

Empowering women – PACE (Personal Advancement and Career Advancement) launched 2007. Used to support women in the apparel industry where barriers to education have impacted on progression and development into leadership and management in the workplace and also personal and professional growth. Used as appositive promotional point for gap product.

Products designed and marketed with sustainability in mind – great durable products designed using new technology and product innovation, reducing the impact on people and the planet of what we wear.

By 2020 eliminate the use of wood derived fabrics sourced from ancient and endangered forests.

By 2021 100% of cotton will be from sustainable cotton sources including Better Cotton Initiative (BCI).

By 2020 80% of Athleta materials will be made from sustainable fibres.
By 2020 25% of Athleta's products will be made using techniques that save water.

Primark
A focus on 'fast fashion' designed for rapid change beyond seasonal but also social, especially for teenagers and young adults.

Clothes are marketed as cheaply as possible and this has led to complaints about irresponsible design as some items are worn only once.

Products made sell themselves ie little advertising.

Manufactured products don't use expensive hangers, tags or labels that add to the product cost.

Suppliers are asked to pack clothes like t-shirts so they are ready to go on shelves straight away.

Designs and products go beyond just clothing.

		• Homeware • Sweets and confectionary **Under Armour** A primary focus on sportswear and footwear. Designed originally to enhance performance by keeping athletes comfortable and cool. Origins based in the identified need of sports tops that did not become wet during exercise- led to the development of a synthetic 'moisture wicking' fibre that kept the participant dry Has moved into the design and manufacture of casual clothing. Examples of specific materials used in products like shorts, socks, trainers, tops are: • Heatgear – Original product. Regulates body temperature, keeps you cool. • Coldblack – reflects heat when it is hot • Coolswitch – pulls heat away from the body during exercise • Iso-chill – dissipates heat from the body to keep you cool. **Zara** A focus on 'fast fashion designed for rapid change beyond seasonal patterns, but also social change for particularly young girls and teenage girls. Prides itself on keeping up with fashion, high quality at reasonable prices. Products sold based on customer trends • Men's clothing • Women's clothing • Kids clothing (Zara kids) Life label (Join life) – recycling scheme. Home pick up of unwanted clothes. Clothes they go for recycling and /or reuse to finance social projects. Use of REFIRRA – a fibre made from recycled cotton and wool from sustainable forests. Working to ensure all products are sustainable throughout raw materials used, design and production. Accept other valid responses.		

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>20</td><td>1,2,3</td><td>
Figure 7 shows three different kettles.

Analyse and evaluate the kettles in terms of the three features identified below.

You should not use an analysis or evaluation point more than once.

Award up to 4 marks for each of the three parts of the question.

<table>
<tr><td>3–4 marks</td><td>Well described and justified analysis containing full evaluation, drawing on conclusions having considered both positive and negative factors.</td></tr>
<tr><td>1–2 marks</td><td>Brief points mentioned but not fully explained. Analysis present but limited evaluation/ conclusions drawn. May have focused solely on either positive or negative factors.</td></tr>
<tr><td>0 marks</td><td>No attempt or nothing worthy of credit.</td></tr>
</table>
Indicative content:

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

NB Do not reward repeats ie where some candidate may try to use the same response multiple times in 20.1/20.2/20.3

<table>
<tr><td>Ergonomics</td><td>
• Ergonomic handle on polymer kettle allowing firm safe grip
• Polymer construction is an insulator and prevents transfer of heat and burns
• Carrying handle is away (opposite side) from steam outlet on polymer kettle unlike other two when hot steam rises and may burn you
• Polymer could make use of thermochromic pigment to indicate when contents are hot
• Whistling kettle gives audible sound when water is boiling
• Polymer kettle has viewing window so user can see if kettle needs re filling
• Awkward carrying position with handle over the top of the main kettle body
• No viewing window on cast iron kettle
• Cast iron kettle lid may prove difficult to reseat especially if hot and it has expanded
• Spout of cast iron kettle not as easy to control flow due to shape
</td></tr>
</table>
</td><td>12 marks</td><td>AO4</td></tr>
</table>

	• Iron is a conductor so hot to the touch including the handle
Functionality	• No trailing flex with the iron stove top kettle – less chance of being pulled off stove surface • Hinged lid on polymer kettle for ease of closure and resealing • Docking unit means kettle flex an plug do not go anywhere near water which would be a possible risk of electric shock • Light weight for elderly and less able body to carry and manipulate • Thermostatic trip when the water has boiled, preventing kettle from boiling dry • Cast iron kettle can be used over an open fire or hearth • Cast iron kettle is heavy and could be dropped leading to scalding • Risk of electric shock if kettle develops a fault or water accesses the electrics • Rising steam could burn users hand on the cast iron kettle • Difficult to gauge how much water you are boiling, which may lead to heating too much water • Polymer kettle MUST be near an electrical point • Whistling kettle MUST be near a gas/electric/inductive hob
Innovation	• Viewing window so you can see exactly how much water you are boiling • Viewing window has water level marks to indicate precise capacity • Trip switch to turn polymer kettle off and save electricity • Polymer kettle acts as an insulator and will keep the water hotter for longer requiring less frequent boiling • Use of lighter materials • Use of materials that insulate and keep the water warmer for longer • The polymer and whistling kettle consider the safety more effectively • The polymer and whistling kettles consider the ease of use more effectively than the cast iron kettle • The use of new materials has allowed for kettle development to consider the aesthetics of the product rather than just the function • Modern kettles consider energy efficiency far more than the cast iron style kettle • Just plug into electricity supply

	• Cast iron kettle will require more energy to heat and energy will be lost more readily into the surrounding environment from the hob plate • The polymer kettle MUST have a (240v) electric supply to work

Accept other valid responses.

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>21</td><td></td><td>
Describe the following two types of investigation.

Give examples to show how they help when designing. These can be examples of use

Primary research:
<table>
<tr><td>3 marks</td><td>Correct definition of primary research and two or more named examples of primary research</td></tr>
<tr><td>2 marks</td><td>Correct definition for primary research and one correct example of primary research</td></tr>
<tr><td>1 mark</td><td>Simple definition point or one correct example of primary research</td></tr>
</table>
Indicative content:

The guidance provided is illustrative and not exhaustive. Credit any specific points made in support of the band descriptors above.

DO NOT credit vague responses like to identify needs and wants.
<table>
<tr><td>Definition of primary research:</td><td>• Involves the collection of research first-hand
• Information you have collected yourself
• Completed by the author of the research
• All forms of field research</td></tr>
<tr><td>Examples of primary research:</td><td>• Interviews – telephone, social media and face to face
• Questionnaires
• Material testing
• Product analysis
• Measuring – useful sizes
• Surveys
• Focus groups</td></tr>
</table>
Secondary research:
<table>
<tr><td>3 marks</td><td>Excellent definition with clear understanding of secondary research and two or more named examples of secondary research.</td></tr>
<tr><td>2 marks</td><td>Correct definition for secondary research and one correct example of secondary research.</td></tr>
<tr><td>1 mark</td><td>Simple definition point or one correct example of secondary research.</td></tr>
</table>
</td><td>2 x 3 marks</td><td>AO4</td></tr>
</table>

Indicative content:

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

Definition of secondary research:	• Involves the use of data and research collected by another person or 3rd party • Data and information presented by another person • Use of material someone else has initially collated and put together • Also known as desk research
Examples of secondary research:	• Use of books, magazines, periodicals • Looking at the work of other designers and companies • Published anthropometric and ergonomic data • Materials/component catalogues • TV programmes and social media outlets • Consumer sources eg watchdog

Accept all valid responses.

22	1	A designer has been asked to design a prototype toy suitable for use by a child between 3 and 5 years of age. They are using the data in **Table 4**. Complete the **two** missing values in **Table 4** for popularity votes.	1 mark	AO4

1 mark	One mark for **both** missing popularity vote values if correct. **NO MARKS IF ONE LEFT BLANK OR ONE OUT OF TWO INCORRECT**

Indicative content:

Type of toy	**Popularity votes**	**Popularity votes as a percentage**
Role play	65	26%
Construction	40	16%
Letters and numbers	85	34%
Jigsaws and puzzles	25	10%
Soft toys	35	14%
Total	**250**	**100%**

22	2	Use your values from Question **22.1** to complete the bar chart below and label the *x* axis.	3 marks	AO4

1 mark	Step 1 – 1 mark for *x* axis
1 mark	Step 2 – 1 mark for correct size of letters and numbers bar **(ft their answer from 22.1)**
1 mark	Step 3 – 1 mark for correct size and placement of soft toys bar **(ft their answer from 22.1)**

Indicative content:

x axis label:

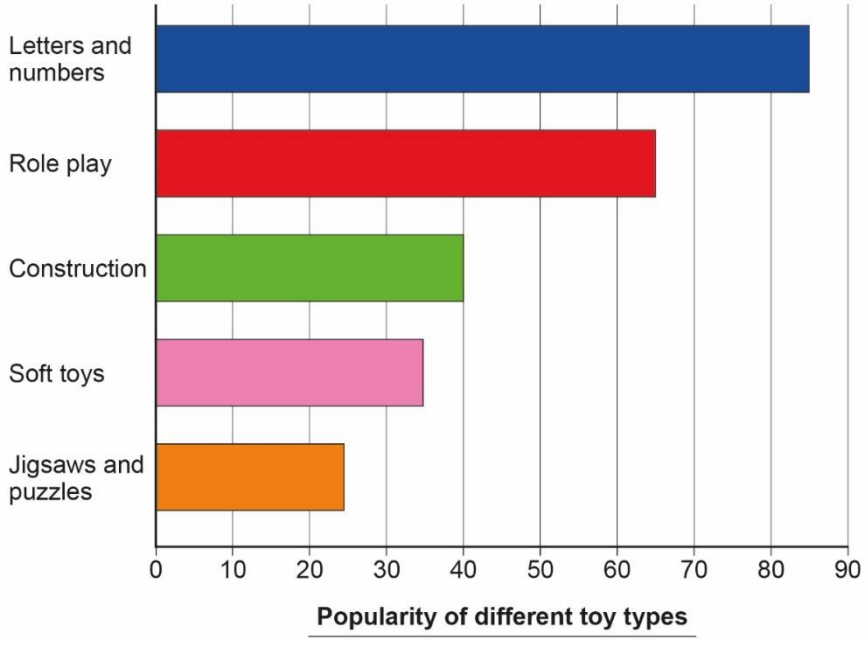
Accept:
Popularity of different toys
Popularity votes
Not:
Popularity votes as a percentage

Note: The graph below shows the correctly completed missing bars (in blue and pink) if a student has provided the correct values in 22.1.

If a student has provided incorrect values for 22.1 but their bar chart correctly matches their values, they should receive the mark(s).

Completed graph:

Correctly completed missing bars shown in blue and pink below:



Qu	Part	Marking Guidance	Total marks	AO
23		Give **five** detailed specification points to help with the designing of a toy for use by 3 to 5 year-old-children. 1 mark: One mark for each design specification point given appropriate for a toy suitable for use by 3 to 5 year old children. **Indicative content:** The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptor above. 1. It must amuse/entertain the child 2. Bright and colourful to engage the interest of the child 3. It must not contain any small parts that could be easily swallowed 4. There should be no sharp edges that could cause cuts to the child 5. There should be no pointed pieces that could stab/puncture the skin 6. Any finish (paint) applied must not be toxic/harmful in chewed/ingested 7. If the toy contains a battery it should be secured and not possible for a child to remove – battery directive (labelling bit) 8. There must be no gaps where a child could put a finger and trap it 9. Materials that are tough and durable need to be used to ensure it does not break if dropped or thrown 10. Materials need to be easy to clean (sanitise) because the child may chew it, drop food on it. **A credit worthy point must not be vague. Zero mark responses would be:** • **It must be strong** • **It must not be too big** • **It must be made from cheap materials** • **Easy and simple to use** Accept other valid responses.	5 marks	AO4

Qu	Part	Marking Guidance	Total marks	AO

<table>
<tr>
<td>24</td>
<td>1</td>
<td>
Figures 8 and 9 show a front and side view of a bug box used to encourage insects to visit a garden.

Complete a two-point perspective drawing of the bug box in the space provided below.

<table>
<tr><td>1 mark</td><td>A recognisable attempt at a 3-dimensional drawing e.g. 3 connected elevations/sides to object.</td></tr>
<tr><td>1 mark</td><td>Clear evidence of some perspective/ foreshortening.</td></tr>
<tr><td>1 mark</td><td>Drawing is recognisable as the bug box in the indicative content below (does not have to show hook or overhang of roof).</td></tr>
<tr><td>1 mark</td><td>Inclusion of hook or extension to the front edge of the roof.</td></tr>
</table>
Indicative content:

Responses with bug box drawn above, on or below a horizontal plane between two vanishing points (horizon line) are acceptable – see images opposite:
</td>
<td>4 marks</td>
<td>AO4 2c</td>
</tr>
</table>

24	2	Calculate the size of angle **X** in **Figure 10** to the nearest whole degree to ensure an accurate fit of the two roof pieces. Show your working/construction.	4 marks	AO4

Trig Method	
1 mark	85 seen
1 mark	Step 1 – correct use of tan formula: Tan Y = opp/adj
1 mark	Step 2 – correct substitution of correct size of opposite and adjacent lengths: Tan Y = 70/85
1 mark	Step 3 – Tan^{-1} 0.8235294117 = 39.47 (degrees) Subtraction of angle from 90 degrees to give angle **X**: 90 – 39.47 = 51 degrees (Accept 50 degrees)

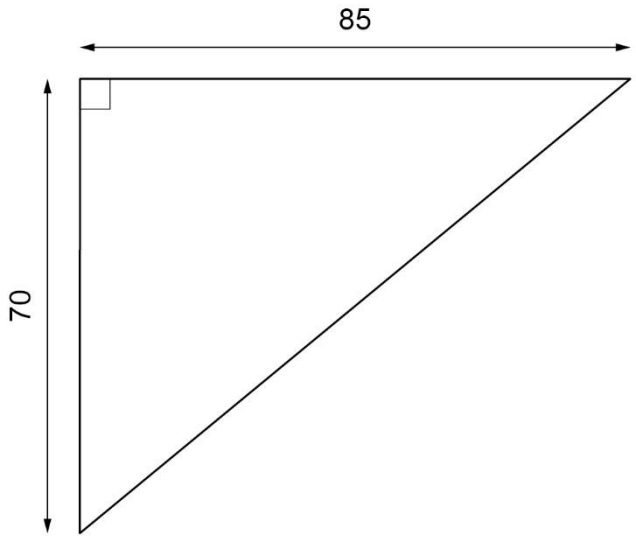
Alternative Trig Method	
1 mark	85 seen
1 mark	Step 1 – correct use of tan formula: Tan X = opp/adj
1 mark	Step 2 – correct substitution of correct size of opposite and adjacent lengths: Tan X = 85/70
1 mark	Step 3 – Tan^{-1} 1.214285714 = 51 degrees (Accept 50 degrees)

Drawn/constructed method	
1 mark	85 seen
1 mark	Constructing a triangle with sides 85 mm × 70 mm
1 mark	Accuracy of drawing
1 mark	Measuring interior angle with protractor to arrive at 39 – 40 degrees and subtracting that angle from 90° (Accept 50 – 51 degrees)

Alternative drawn/constructed method	
1 mark	85 seen
1 mark	Constructing a triangle with sides 85 mm × 70 mm

1 mark	Accuracy of drawing
1 mark	Measuring their angle X (Accept 50 – 51 degrees)

See drawing below:



Accept other valid responses.

Qu	Part	Marking Guidance	Total marks	AO
25		During manufacture it is important to use materials efficiently and minimise waste. Explain how each of the following improves material management.	2 x 3 marks	AO4

3 marks	Two or more correct explanation points clearly made in detail.
2 marks	Two or more simple explanation points lacking depth and understanding or one correct explanation point given in detail.
1 mark	One simple correct point for technique is given demonstrating limited understanding.
0 marks	Nothing worthy of credit.

Indicative content:

		The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above. **Nesting of shapes and parts/lay planning** • A process for planning and working out the best way to maximise the effective use of material and minimising waste as much as possible. • By placing similar shapes and parts next to each other to minimise waste. • Strategic way of planning material use and minimising waste. • Looking for patterns in nesting eg inverting shapes being cut out if they are triangular to save material by placing parts as close together as possible. • Tessellation is a process by which parts are placed together in interlocking and repeating patterns to minimise waste. • Consideration of standard forms and sizes of available material to ensure materials are sourced in the most cost-efficient form to minimise waste. **Cutting techniques** • Allow for the width of saw cuts eg 2mm with a dovetail saw to ensure the process of cutting does not accidentally reduce the size of material being cut out. • Failure to consider material removed by saw cuts will make shapes/parts being cut out possible too small (out of tolerance) and having to be rejected ie material wasted. • Seam allowance to allow for an effective join to be formed along the edges of fabric materials to be joined. • Use of different coloured lines for cut and score/crease lines in paper and boards to ensure fold flaps and glue flaps are created to ensure effective assembly. • Use of red line for cut and black lines for engrave/raster lines on a laser cutter to avoid errors in pre-cut checks. Accept other responses.		

<table>
<tr><th>Qu</th><th>Part</th><th>Marking Guidance</th><th>Total marks</th><th>AO</th></tr>
<tr><td>26</td><td></td><td>Describe how materials can be formed when making a prototype.

<table><tr><td>3 marks</td><td>A thorough understanding of what ‘forming’ is and how it can be used in prototype construction in a material area(s) studied by the candidate.</td></tr><tr><td>2 marks</td><td>Basic understanding of ‘forming’ and how it is used in prototype construction in a material area(s) studied by the candidate.</td></tr><tr><td>1 mark</td><td>Very limited understanding of ‘forming’ naming a forming process or giving an example of where it would be used in a prototype construction in a material area(s) studied by the candidate.</td></tr><tr><td>0 marks</td><td>Nothing worthy of credit.</td></tr></table>
Indicative content:

The guidance provided is illustrative and not exhaustive. Credit any worthy points made in support of the band descriptors above.

Note: responses may consider deforming of reforming. Both processes involve a change in material shape without adding or removing material.

Timber based materials

• Timber strips can be steamed to make them more pliable and easier to bend.
• The timber fibres are softened and bent without tearing or rupture eg stair hand rails, musical instruments.
• Thin strips of timber can be laminated using a suitable adhesive using a former.
• Pressure is applied until the adhesive curs/set and a change in shape is made.

Metal based materials

• Bars and tubes can be bent found a former to change shape from a linear length.
• Metals can be heated (annealed) to make them easier to bend.
• Metals can be forged. Heating until red hot and shaped on an anvil.
• Metals can be formed using casting processes where the metal is heated until molten and poured into a cavity or mould to make 3d products.
• Metals can be pressed using extreme pressure eg car body panels.

Papers and boards</td><td>3 marks</td><td>AO4</td></tr>
</table>

		• Accurate folds can be produced using creasing bar on a paper or board first. • Scoring can be used to cut fibres weakening a piece of paper of card making it easier. • Perforations 'push' material apart (creating small holes) making it easier to tear and separate material eg tissue box lid. • Scoring, creasing and perforations are all forming processes making it easier to perform a shape or direction change in a piece of paper or card. **Polymers** • Simple bends can be created by heating a piece of thermoplastic polymer in a straight line (using a line bender) where a bend is needed. • 3D shapes can be created using vacuum forming over a former by heating a polymer sheet and creating a permanent form when it cools. • Plug and yoke method can be used to form a shape in polymer sheet. • Injection moulding of polymers to create profiles and 3D products. • 3D printing to create a 3D prototype **Textiles** • Drape forming of felt based products like hats. • Gathering – uses a sewing technique to increase the 'fullness' of a material or prototype eg curtains. • Pleating – similar to gathering, but where textiles are folded and held by stitching along an edge. Accept other valid responses.		