



A-level DESIGN AND TECHNOLOGY: PRODUCT DESIGN 7552/2

Paper 2 Designing and Making Principles

Mark scheme

June 2025

Version: 1.0 Final



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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

Further copies of this mark scheme are available from [aqa.org.uk](https://www.aqa.org.uk)

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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										
01		Figures 1 and 2 show two pens. Compare and evaluate the two pens shown. In your answer you should refer to material and design suitability for large-scale production. <table><tr><th>Marks</th><th>Description</th></tr><tr><td>9–12 marks</td><td>The response provides detailed comparison with evaluation of both pens, referring with technical details to the design and material suitability for large scale production. The response makes analytical judgements regarding the design of both products expanding with further detail upon the majority of the information provided.</td></tr><tr><td>5–8 marks</td><td>The response provides a good comparison of both pens referring to both reference points. The response makes clear judgements regarding the design of both products referring to most aspects of the information provided and expanding on some.</td></tr><tr><td>1–4 marks</td><td>The pens are compared in basic terms with limited use of the information provided. Responses may refer to elements such as material properties without linking these to the bullet point.</td></tr><tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr></table> A really detailed evaluation of one pen should not limit the mark, award up to a maximum of 6 marks. Indicative Content: Suitability for large-scale production Figure 1: • manufactured by injection moulding the clear pen body is produced in a single part for ease of mass production • the clear HIPS or appropriate polymer body is designed for speed of production and will shatter relatively easily, but is very low cost to form • HIPS has a low transition temperature compared to other thermoplastics reducing energy and cost for mass production • using a clear polymer for the main body means they are interchangeable for any colour ink, with only the top, bung and ink reservoir displaying the colour • all parts fit by friction removing the need for adhesives during assembly and keeping costs low	Marks	Description	9–12 marks	The response provides detailed comparison with evaluation of both pens, referring with technical details to the design and material suitability for large scale production. The response makes analytical judgements regarding the design of both products expanding with further detail upon the majority of the information provided.	5–8 marks	The response provides a good comparison of both pens referring to both reference points. The response makes clear judgements regarding the design of both products referring to most aspects of the information provided and expanding on some.	1–4 marks	The pens are compared in basic terms with limited use of the information provided. Responses may refer to elements such as material properties without linking these to the bullet point.	0 marks	No response or nothing worthy of credit.	12 marks	AO3 1a AO3 1b
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		Figure 2: • manufactured by either deep drawing or spinning (accept both, although deep drawing is most likely used) thin sheet stainless steel • the stainless steel design requires many more components than the polymer alternative • the ‘clicker’ mechanism requires assembly increasing tooling and labour costs over the polymer variety • due to the refillable nature of the design, the stainless steel pen is produced in smaller numbers and is seen as a premium product. Material Suitability Do not accept generic references to recycling of the materials, unless it is a comparison of sustainability and/or product lifecycle. Figure 1: • HIPS is a brittle thermoplastic used purely due to the limited life expectancy of the product • the PP lid (accept LDPE and HDPE) is flexible allowing the user to clip the pen in a pocket without breaking the lid • the PP lid and bung are easily coloured with pigments during the moulding process • the clear HIPS component allows the user to see the ink colour and how much remains. Figure 2: • stainless steel is a malleable material ideal for forming through deep drawing or spinning • the hardwearing nature of stainless steel increases its longevity without reducing its aesthetic appearance • as stainless steel does not require an applied finish there is no chance of chipping the surface when kept in a pocket with coins, keys etc. This list is not exhaustive. Accept any other valid responses.		
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Qu	Part	Marking Guidance	Total marks	AO										
02		Explain how testing would be used by a manufacturer to ensure all pens meet quality control requirements. <table><tr><th>Marks</th><th>Description</th></tr><tr><td>5–6 marks</td><td>The response provides detailed explanation of how testing would be used by a manufacturer to ensure all pens meet QC expectations. The response recognises the need for testing of specific aspects of each pen and refers to relevant testing methods for multiple aspects.</td></tr><tr><td>3–4 marks</td><td>The response provides a good explanation of how testing would be used by a manufacturer to ensure pens meet QC expectations. The response may refer to specific aspects of the pen that would be tested.</td></tr><tr><td>1–2 marks</td><td>The response gives a basic explanation of how pens could be tested within production to check they meet basic QC expectations, such as dimensional accuracy, however there will be limited reference to testing beyond this aspect.</td></tr><tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr></table> Indicative content: Expect either specific tests or general areas. Higher level responses may give specific aspects to be tested. • The use of visual inspection to check the quality of the product, this may be done by human or camera. • The use of random sampling from the production line allows a sample of pens to be tested to destruction, this checking force resistance against set standards. • Through random sampling dimensional accuracy can be checked using vernier callipers, micrometers and laser probes to give accurate readings to check mould and tooling wear and tear. • Using production line mounted go no-go gauges dimensional tolerances can be checked on critical dimensions, such as the fit of lids and bungs. • Once complete samples of pens are checked for the flow of ink, thus checking the tolerance of the ball point mechanism/applicator. • Dye penetrant check for material defects. This list is not exhaustive. Accept any other valid responses.	Marks	Description	5–6 marks	The response provides detailed explanation of how testing would be used by a manufacturer to ensure all pens meet QC expectations. The response recognises the need for testing of specific aspects of each pen and refers to relevant testing methods for multiple aspects.	3–4 marks	The response provides a good explanation of how testing would be used by a manufacturer to ensure pens meet QC expectations. The response may refer to specific aspects of the pen that would be tested.	1–2 marks	The response gives a basic explanation of how pens could be tested within production to check they meet basic QC expectations, such as dimensional accuracy, however there will be limited reference to testing beyond this aspect.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 2c
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Qu	Part	Marking Guidance	Total marks	AO
03		State two sustainability issues resulting from the use of oil-based inks. One mark for each correct answer up to a maximum of two marks. Indicative content: • As oil is a finite non-renewable resource the use of oil-based inks is using up valuable resources. • Oil-based inks will reduce the recyclability/bio-degradability of the substrate (paper) that has been written on • Production of oil-based inks is man-made causing chemical by-products that are toxic or harmful to the environment This list is not exhaustive. Accept any other valid responses.	2 marks	AO4 2b

Qu	Part	Marking Guidance	Total marks	AO																		
04		The spherical ball in a ball point pen has a volume of 7.24 mm³ The ball is held in a circular hole with a radius 0.1 mm smaller than that of the ball. Calculate the diameter of the hole. Give your answer to the nearest 0.1 mm Show your working out. <i>Volume of a sphere = $\frac{4}{3} \pi r^3$</i> <table><tr><td>Re arrange the formula for the volume of a sphere to calculate r³</td><td>$\frac{4}{3} \times \pi r^3 = \text{Volume}$ $r^3 = (3V/4\pi)$ or $(7.24 \times 3) / (4\pi)$ or 1.728</td><td>1 mark</td></tr><tr><td>Calculation of r</td><td>$\sqrt[3]{}$ (their 1.728) or 1.2</td><td>1 mark</td></tr><tr><td>Calculation of correct value of r with 0.1 mm smaller radius</td><td>their 1.2 - 0.1 or 1.1</td><td>1 mark</td></tr><tr><td>Calculation of the correct value of the diameter</td><td>Diameter = 2.2 mm</td><td>1 mark</td></tr><tr><td>Calculation of the correct diameter where no working out has been shown but the final answer is accurate</td><td>Diameter = 2.2 mm</td><td>4 marks</td></tr><tr><td>Special case</td><td>A final answer of 1.1 mm (where the radius has been calculated)</td><td>3 marks</td></tr></table>	Re arrange the formula for the volume of a sphere to calculate r ³	$\frac{4}{3} \times \pi r^3 = \text{Volume}$ $r^3 = (3V/4\pi)$ or $(7.24 \times 3) / (4\pi)$ or 1.728	1 mark	Calculation of r	$\sqrt[3]{}$ (their 1.728) or 1.2	1 mark	Calculation of correct value of r with 0.1 mm smaller radius	their 1.2 - 0.1 or 1.1	1 mark	Calculation of the correct value of the diameter	Diameter = 2.2 mm	1 mark	Calculation of the correct diameter where no working out has been shown but the final answer is accurate	Diameter = 2.2 mm	4 marks	Special case	A final answer of 1.1 mm (where the radius has been calculated)	3 marks	4 marks	AO4 2c
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Qu	Part	Marking Guidance	Total marks	AO										
05		Disposable pens are manufactured in and shipped to different parts of the world. Explain how the concept of a ‘circular economy’ applies to disposable pens. <table><tr><th>Marks</th><th>Description</th></tr><tr><td>5–6 marks</td><td>The response shows a detailed understanding of the circular economy using technically accurate vocabulary to explain how this applies to the disposable pen context.</td></tr><tr><td>3–4 marks</td><td>The response shows a good understanding of the circular economy and relates points made to the disposable pen context.</td></tr><tr><td>1–2 marks</td><td>The response shows a basic understanding of the circular economy with limited to no specific reference to the disposable pen context.</td></tr><tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr></table> Indicative content • The transportation of disposable pens should minimise energy used through shipping in bulk. • Any transported goods should use minimal packaging reducing product weight and improving tessellation within transport. • All materials used should be able to be separated into biological and technical nutrients, for end-of-life disposal. • Materials should be kept pure to improve efficiency during disassembly. • The location of production plants should be considered to minimise product miles throughout the life of the pen. • Production plants should utilise renewable energy sources wherever possible. • Delivery vehicles should use renewable power sources. • Ideally disposable pens should be refillable to reduce waste materials. This list is not exhaustive. Accept any other valid responses.	Marks	Description	5–6 marks	The response shows a detailed understanding of the circular economy using technically accurate vocabulary to explain how this applies to the disposable pen context.	3–4 marks	The response shows a good understanding of the circular economy and relates points made to the disposable pen context.	1–2 marks	The response shows a basic understanding of the circular economy with limited to no specific reference to the disposable pen context.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 2b
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Qu	Part	Marking Guidance	Total marks	AO
06		Identify two health and safety hazards and appropriate control measures when using machinery within a school workshop. Only accept one reference to each of the following. E.g. PPE cannot be rewarded twice. One mark for the hazard Second mark for the control measure. Indicative content Hazard and control measure • Missing PPE: <i>Effective user training/instruction.</i> • Entanglement: Effective prevention of entanglement with instruction and training. • Inhalation of fumes/gasses: Correct ventilation/extraction use of specific PPE • Lack of Safety Zones: Appropriate floor marked and taped off areas. • Chemicals left out in the workshop: <i>Supply of lockable COSHH cupboard.</i> • Trailing wires: <i>Use of cordless tools, hanging power supplies or cable covers.</i> • Slippages: <i>Effective training and signage.</i> • Moving parts: <i>Effective guarding.</i> • Ejected swarf: <i>Training and PPE.</i> This list is not exhaustive. Accept any other valid responses.	4 marks	AO4 2a

Qu	Part	Marking Guidance	Total marks	AO										
07		Figures 3 and 4 show lights designed by Marianne Brandt. Outline how the lights conform to the principles of the modernist design movement. <table><tr><th>Marks</th><th>Description</th></tr><tr><td>5–6 marks</td><td>The response shows a detailed understanding of how both lights link to the work of the Bauhaus design school or modernism with specific, clear characteristics that highlight key features of both lights. There may be some minor irrelevant points or lack of clarity in some areas, but this will not detract from the overall quality of the response.</td></tr><tr><td>3–4 marks</td><td>The response shows a good understanding of the major aspects of modernist design showing clear links between the lights and the work of modernist designers.</td></tr><tr><td>1–2 marks</td><td>The response gives a basic explanation of modernist design characteristics with limited reference to the two lights.</td></tr><tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr></table> Indicative content - Both lights use simple geometric forms, which conforms with the key characteristics of Bauhaus and Art Deco. - The simple geometric forms used in both lights assists with the production processes used. - The base of Figure 4 has large radii and smooth flat surfaces to aid removal from the mould. - The spherical lamp shade seen in Figure 3 follows the idea of Form follows function creating the maximum surface for lighting the room. - The directional shade in figure 4 has reflective interior to increase the efficiency of the light. Figure 3 has clearly visible construction techniques/screws and fittings on the lower chromed steel section. This embraces the machine aesthetic associated with Bauhaus. Figure 3 uses chrome plated steel and glass, material and colour combinations associated with modernism and specifically Bauhaus. - The simple designs of Figures 3 and 4 embrace a minimalist approach which means they remain relevant within modern homes nearly 100 years after their original design. This list is not exhaustive. Accept any other valid responses.	Marks	Description	5–6 marks	The response shows a detailed understanding of how both lights link to the work of the Bauhaus design school or modernism with specific, clear characteristics that highlight key features of both lights. There may be some minor irrelevant points or lack of clarity in some areas, but this will not detract from the overall quality of the response.	3–4 marks	The response shows a good understanding of the major aspects of modernist design showing clear links between the lights and the work of modernist designers.	1–2 marks	The response gives a basic explanation of modernist design characteristics with limited reference to the two lights.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 2b
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08		Explain how designers use specific types of labelling to encourage effective recycling of products. <table><tr><th>Marks</th><th>Description</th></tr><tr><td>3 marks</td><td>The response gives a detailed explanation of how specific labels are used to encourage effective recycling of products.</td></tr><tr><td>2 marks</td><td>The response gives a clear explanation of generic or unspecified labels associated with product recycling.</td></tr><tr><td>1 mark</td><td>The response gives a basic explanation of labels which may be linked to recycling.</td></tr><tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr></table> Indicative content: • The inclusion of standardised recycling symbols on products breaks language barriers and links directly to government regulations. • The use of the Mobius loop and recognised SPI codes that cross reference with recycling bins supplied by councils aids the recycling of different polymer resins. • By applying labelling to polymers in the mould materials are kept pure and suitable for recycling. • The inclusion of WEEE and RoHS symbols encourage responsible recycling of ‘technical nutrients’ and use of specific waste management systems. This list is not exhaustive. Accept any other valid responses.	Marks	Description	3 marks	The response gives a detailed explanation of how specific labels are used to encourage effective recycling of products.	2 marks	The response gives a clear explanation of generic or unspecified labels associated with product recycling.	1 mark	The response gives a basic explanation of labels which may be linked to recycling.	0 marks	No response or nothing worthy of credit.	3 marks	AO4 2b
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Qu	Part	Marking Guidance	Total marks	AO										
09		Figure 5 shows a car dashboard display. Analyse and evaluate how the dashboard display has been designed for ease of use. <table><tr><th>Marks</th><th>Description</th></tr><tr><td>5–6 marks</td><td>The response gives a detailed analysis and evaluation of how the dashboard display has been designed for ease of use. The response refers to specific aspects of the display, covering ergonomic interactions with the driver’s senses that allow efficient driving without distraction.</td></tr><tr><td>3–4 marks</td><td>The response gives a good analysis and evaluation of how the display has been designed for ease of use. The response refers to aspects of effective display design.</td></tr><tr><td>1–2 marks</td><td>The response gives a basic analysis of how the display has been designed for ease of use.</td></tr><tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr></table> Indicative content: Positives • The use of standardised symbols is essential to allow the driver to seamlessly transfer between cars without having to learn a new set of symbols. • The use of symbols makes interpretation more rapid than text, which would distract attention whilst driving. • Symbols are of different sizes indicating importance and increasing ease of reading/interpretation. • Combined with standardised symbols the highlighting colours indicate the type of symbol, with orange or red used for warnings. • The contrast of the black background with the coloured symbols increases ease of reading/interpretation. • Display is backlit for ease of use in dark conditions. Negatives • The large number of symbols can be confusing when looking at the dashboard. • The use of red and green can cause issues for users who are colourblind. • On example given, km/h could be seen as a negative in non-EU countries. This list is not exhaustive. Accept any other valid responses.	Marks	Description	5–6 marks	The response gives a detailed analysis and evaluation of how the dashboard display has been designed for ease of use. The response refers to specific aspects of the display, covering ergonomic interactions with the driver’s senses that allow efficient driving without distraction.	3–4 marks	The response gives a good analysis and evaluation of how the display has been designed for ease of use. The response refers to aspects of effective display design.	1–2 marks	The response gives a basic analysis of how the display has been designed for ease of use.	0 marks	No response or nothing worthy of credit.	6 marks	AO3 1a AO3 1b
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Qu	Part	Marking Guidance	Total marks	AO
10		Define the purpose of ‘Six Sigma’. One mark for a basic definition. Two marks for clear definition referring to identification and measuring of error rates. Typical 1-mark responses may include: • to improve processes by reducing defects and errors • to minimise variation in manufacturing • to increase quality and efficiency when manufacturing • sets an ideal target (of 0.00034% = 3.4 errors per million units). Typical 2-mark response must include: • a method of identifying and measuring error rates in manufacturing.	2 marks	AO4 1a

Qu	Part	Marking Guidance		Total marks	AO																														
11		An injection moulding cavity has a volume of 36 mm^3 The cavity is filled using an injector with a circular cross section. The diameter of the circular cross section is 0.5 mm and the injector has a feed rate of 250 mm per second. Calculate the time taken to fill the cavity. Give your answer to two decimal places. Show your working out. <table><tr><td>Calculate the area of circular cross section</td><td>$0.25^2 \times \pi$ or 0.19635</td><td>1 mark</td></tr><tr><td>Calculation of the volume extrusion per second</td><td>$250 \times \text{their } 0.196$ or 49.087</td><td>1 mark</td></tr><tr><td>Calculation of the time taken to fill the cavity</td><td>$36 \div \text{their } 49.087$</td><td>1 mark</td></tr><tr><td>Accurate time recorded to 2 decimal places</td><td>= 0.73 seconds</td><td>1 mark</td></tr><tr><td>Calculation of time taken to fill the cavity where no working has been shown but the final answer is accurate to 2dp</td><td>0.73 seconds</td><td>4 marks</td></tr><tr><td>Special Case 1 Calculation of time taken to fill the cavity where no working has been shown but the final answer is accurate (not to 2dp)</td><td>[0.733, 0.7333] seconds</td><td>3 marks</td></tr><tr><td>Special Case 2 Candidate has used the diameter rather than radius in their calculation</td><td>answer = 0.18 seconds</td><td>3 marks</td></tr><tr><td>Calculate the area of circular cross section</td><td>$0.25^2 \times \pi$ or 0.19635</td><td>1 mark</td></tr><tr><td>Calculate cavity volume divided by the injector cross section</td><td>$36 / \text{their } 0.19365$ or 183.346</td><td>1 mark</td></tr><tr><td>Calculation of the time taken to fill the cavity</td><td>Their $183.346 / 250$ or [0.733, 0.7333]</td><td>1 mark</td></tr></table>		Calculate the area of circular cross section	$0.25^2 \times \pi$ or 0.19635	1 mark	Calculation of the volume extrusion per second	$250 \times \text{their } 0.196$ or 49.087	1 mark	Calculation of the time taken to fill the cavity	$36 \div \text{their } 49.087$	1 mark	Accurate time recorded to 2 decimal places	= 0.73 seconds	1 mark	Calculation of time taken to fill the cavity where no working has been shown but the final answer is accurate to 2dp	0.73 seconds	4 marks	Special Case 1 Calculation of time taken to fill the cavity where no working has been shown but the final answer is accurate (not to 2dp)	[0.733, 0.7333] seconds	3 marks	Special Case 2 Candidate has used the diameter rather than radius in their calculation	answer = 0.18 seconds	3 marks	Calculate the area of circular cross section	$0.25^2 \times \pi$ or 0.19635	1 mark	Calculate cavity volume divided by the injector cross section	$36 / \text{their } 0.19365$ or 183.346	1 mark	Calculation of the time taken to fill the cavity	Their $183.346 / 250$ or [0.733, 0.7333]	1 mark	4 marks	AO4 2c
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Special Case 2 Candidate has used the diameter rather than radius in their calculation	answer = 0.18 seconds	3 marks																																	
Calculate the area of circular cross section	$0.25^2 \times \pi$ or 0.19635	1 mark																																	
Calculate cavity volume divided by the injector cross section	$36 / \text{their } 0.19365$ or 183.346	1 mark																																	
Calculation of the time taken to fill the cavity	Their $183.346 / 250$ or [0.733, 0.7333]	1 mark																																	

		Accurate time recorded to 2 decimal places	= 0.73 seconds	1 mark		
		Calculation of time taken to fill the cavity where no working has been shown but the final answer is accurate to 2dp	0.73 seconds	4 marks		
		Special Case 1 Calculation of time taken to fill the cavity where no working has been shown but the final answer is accurate (not to 2dp)	[0.733, 0.7333] seconds	3 marks		
		Special Case 2 Candidate has used the diameter rather than radius in their calculation	answer = 0.18 seconds	3 marks		

Qu	Part	Marking Guidance	Total marks	AO										
12		Outline how designers may refine or redevelop electronic products to reduce a decline in sales and encourage consumers to upgrade. <table><tr><th>Marks</th><th>Description</th></tr><tr><td>5–6 marks</td><td>The response gives some varied details of how electronic products are refined and redeveloped to encourage users to purchase newer models. The response deals with a range of issues which could include software and hardware.</td></tr><tr><td>3–4 marks</td><td>The response gives some limited information about how electronic product development encourages users to purchase newer models.</td></tr><tr><td>1–2 marks</td><td>The response gives basic information of how designers encourage users to purchase newer products.</td></tr><tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr></table> Indicative content: • Introduction of cheaper versions using same moulds, but with less memory. • Introduction of package deals with associated peripherals. • Incremental hardware updates giving greater functionality. • Planned or built in obsolescence, battery technology limits life so upgrading becomes necessary. • Software updates that are not supported on older models to encourage upgrading. • Software upgrades that may affect operating speeds of older models encouraging upgrading. • Introduction of new functionality, such as wireless charging not supported on older models. • Introduction of new connectivity, such as changing of charging ports reducing the availability of older peripherals. This list is not exhaustive. Accept any other valid responses.	Marks	Description	5–6 marks	The response gives some varied details of how electronic products are refined and redeveloped to encourage users to purchase newer models. The response deals with a range of issues which could include software and hardware.	3–4 marks	The response gives some limited information about how electronic product development encourages users to purchase newer models.	1–2 marks	The response gives basic information of how designers encourage users to purchase newer products.	0 marks	No response or nothing worthy of credit.	6 marks	AO4 2b
Marks	Description													
5–6 marks	The response gives some varied details of how electronic products are refined and redeveloped to encourage users to purchase newer models. The response deals with a range of issues which could include software and hardware.													
3–4 marks	The response gives some limited information about how electronic product development encourages users to purchase newer models.													
1–2 marks	The response gives basic information of how designers encourage users to purchase newer products.													
0 marks	No response or nothing worthy of credit.													

Qu	Part	Marking Guidance	Total marks	AO										
13		Figures 6 and 7 show two room fans. Discuss the developments that have enabled the product evolution from the 1930s fan to the 2020s fan. In your answer you should refer to: • technological developments including, microelectronics, miniaturisation, ICs and components. • improvements in product development techniques. • developments in materials and manufacturing processes. <table><tr><th>Marks</th><th>Description</th></tr><tr><td>9–12 marks</td><td>The response provides a detailed discussion of reference points that have led to the evolution of Figure 7. This will expand on the majority of the information provided showing mostly technical knowledge and understanding. There may be greater emphasis on one of points. This should not detract from the overall quality of the answer.</td></tr><tr><td>5–8 marks</td><td>The response provides a good discussion of the bullet points that have led to the evolution of Figure 7. The response uses most of the information provided, expanding on some aspects with technical knowledge and understanding.</td></tr><tr><td>1–4 marks</td><td>The response provides a basic discussion of developments in technology and/or materials that have helped in the evolution of Figure 7. Some of the information provided has been referenced with limited to no expansion to demonstrate technical knowledge and understanding.</td></tr><tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr></table>	Marks	Description	9–12 marks	The response provides a detailed discussion of reference points that have led to the evolution of Figure 7 . This will expand on the majority of the information provided showing mostly technical knowledge and understanding. There may be greater emphasis on one of points. This should not detract from the overall quality of the answer.	5–8 marks	The response provides a good discussion of the bullet points that have led to the evolution of Figure 7 . The response uses most of the information provided, expanding on some aspects with technical knowledge and understanding.	1–4 marks	The response provides a basic discussion of developments in technology and/or materials that have helped in the evolution of Figure 7 . Some of the information provided has been referenced with limited to no expansion to demonstrate technical knowledge and understanding.	0 marks	No response or nothing worthy of credit.	12 marks	AO3 2a AO3 2b
Marks	Description													
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0 marks	No response or nothing worthy of credit.													

		Indicative content: Technological developments • Rapid prototyping development has allowed design iteration to be realised physically and adjusted with less financial investment. • Developments in microelectronics allow products to sense environmental conditions and automatically adjust to surroundings, thus improving efficiency. Improvements in product development techniques • The development of CAD modelling has allowed virtual prototypes of products to be developed and refined prior to final production. • CNC machining allows complex 3D moulds to be produced that may not be possible with manual techniques. • Development of CFD (Computational Fluid Dynamics) has allowed simulation testing of air flow prior to physical product production. • Development of FEA (Finite Element Analysis) has allowed the testing of components under load to maximise efficiency within material usage. Developments in materials and manufacturing processes • The development of injection moulding allowed the formation of complex 3D polymer components necessary for the fan body seen in Figure 7. • The development of thermoplastics has allowed the creation of complex 3D components using thermal and electrical insulators, essential for modern electronic products such as the fan in Figure 7. • Due to the self-finishing nature of thermoplastics Figure 7 is available in a wide range of colours, increasing the market for Figure 7. • CNC machining allows complex 3D moulds to be produced that may not be possible with manual techniques. This list is not exhaustive. Accept any other valid responses.		
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Qu	Part	Marking Guidance	Total marks	AO																														
14		Figure 8 shows six identical holes, with centre points evenly spaced around a large circle. The centre of hole A is (0,0) Calculate the co-ordinates of the centre of hole C Show your working out. <table><tr><td>Calculation of x co-ordinate</td><td>x co-ordinate = r + r/2 x = 50+25 = 75</td><td>1 mark</td></tr><tr><td>Use of Pythagoras to calculate y co-ordinate</td><td>y co-ordinate $25^2 + y^2 = AB^2$</td><td>1 mark</td></tr><tr><td>Calculation of y co-ordinate</td><td>$Y^2 = AB^2 - 25^2$ $Y^2 = 50^2 - 25^2$ $Y^2 = 2500 - 625$ $Y^2 = 1875$ Y = 43. (30127.....)</td><td>1 mark</td></tr><tr><td>Final co-ordinate</td><td>(75, [43,43.301])</td><td>1 mark</td></tr><tr><td>Calculation of the final co-ordinates where no working has been shown, but the final answer is accurate. Final answer should be in the format (x, y)</td><td>(75, [43,43.301])</td><td>4 marks</td></tr></table> or <table><tr><td>Calculation of x co-ordinate</td><td>cos60 = x/50 or 50cos60 or 50sin30</td><td>1 mark</td></tr><tr><td>Calculation of y co-ordinate</td><td>sin60 = y/50 or 50sin60 or 50cos30</td><td>1 mark</td></tr><tr><td>Calculation of first co-ordinate (x or y)</td><td>(75 or [43,43.301])</td><td>1 mark</td></tr><tr><td>Final co-ordinate</td><td>(75, [43, 43.301])</td><td>1 mark</td></tr><tr><td>Calculation of the final co-ordinates where no working has been shown, but the final answer is accurate. Final answer should be in the format (x, y)</td><td>(75, [43,43.301])</td><td>4 marks</td></tr></table>	Calculation of x co-ordinate	x co-ordinate = r + r/2 x = 50+25 = 75	1 mark	Use of Pythagoras to calculate y co-ordinate	y co-ordinate $25^2 + y^2 = AB^2$	1 mark	Calculation of y co-ordinate	$Y^2 = AB^2 - 25^2$ $Y^2 = 50^2 - 25^2$ $Y^2 = 2500 - 625$ $Y^2 = 1875$ Y = 43. (30127.....)	1 mark	Final co-ordinate	(75, [43,43.301])	1 mark	Calculation of the final co-ordinates where no working has been shown, but the final answer is accurate. Final answer should be in the format (x, y)	(75, [43,43.301])	4 marks	Calculation of x co-ordinate	cos60 = x/50 or 50cos60 or 50sin30	1 mark	Calculation of y co-ordinate	sin60 = y/50 or 50sin60 or 50cos30	1 mark	Calculation of first co-ordinate (x or y)	(75 or [43,43.301])	1 mark	Final co-ordinate	(75, [43, 43.301])	1 mark	Calculation of the final co-ordinates where no working has been shown, but the final answer is accurate. Final answer should be in the format (x, y)	(75, [43,43.301])	4 marks	4 marks	AO4 2c
Calculation of x co-ordinate	x co-ordinate = r + r/2 x = 50+25 = 75	1 mark																																
Use of Pythagoras to calculate y co-ordinate	y co-ordinate $25^2 + y^2 = AB^2$	1 mark																																
Calculation of y co-ordinate	$Y^2 = AB^2 - 25^2$ $Y^2 = 50^2 - 25^2$ $Y^2 = 2500 - 625$ $Y^2 = 1875$ Y = 43. (30127.....)	1 mark																																
Final co-ordinate	(75, [43,43.301])	1 mark																																
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Qu	Part	Marking Guidance	Total marks	AO										
15		Outline how Fairtrade is improving the ethical extraction of gold. <table><tr><th>Marks</th><th>Description</th></tr><tr><td>3 marks</td><td>The response gives a detailed outline of the impact of Fairtrade on the ethical extraction of gold.</td></tr><tr><td>2 marks</td><td>The response gives an outline of how Fairtrade is applied to gold. Some limited reference specific to gold extraction, linked to the indicative content.</td></tr><tr><td>1 mark</td><td>The response gives a generic Fairtrade outline with no specific reference to gold.</td></tr><tr><td>0 marks</td><td>No response or nothing worthy of credit.</td></tr></table> Indicative content: • Fairtrade work to reduce chemicals needed in gold extraction, increase awareness of health and safety risks and ensure proper health and safety policies are in place to protect the work force. • The Fairtrade premium received is used by mining co-operatives to invest as they see fit, improving extraction methods such as safety and reducing environmental impact. • Fairtrade gold certification bans the use of conflict minerals. • Fairtrade certification sets a minimum price for the gold mined. This list is not exhaustive. Accept any other valid responses.	Marks	Description	3 marks	The response gives a detailed outline of the impact of Fairtrade on the ethical extraction of gold.	2 marks	The response gives an outline of how Fairtrade is applied to gold. Some limited reference specific to gold extraction, linked to the indicative content.	1 mark	The response gives a generic Fairtrade outline with no specific reference to gold.	0 marks	No response or nothing worthy of credit.	3 marks	AO4 2b
Marks	Description													
3 marks	The response gives a detailed outline of the impact of Fairtrade on the ethical extraction of gold.													
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