



Mark Scheme (Results)

Summer 2019

Pearson Edexcel GCE

In Design and Technology: Product Design

9DT0/01

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question number	Answer	Mark
1(a)	<p>Two valid material checks:</p> <ol style="list-style-type: none"> 1. Check for correct colour/graphics (1) 2. Check type of material is correct/meets specification (1) 3. Check for defects/damage/creases or smooth (1) 4. Check quantity/size of material (1) <p>Check thickness of material (1)</p>	(2)

Question number	Answer	Mark
1(b)	<p>Two valid explanations with linked justification:</p> <ol style="list-style-type: none"> 1. Lightweight/ excellent strength to weight ratio (1) allowing a design that is comfortable to wear/use (1) 2. Can be engineered to be anisotropic (1) allowing additional strength to be provided at different points in the design (1) 3. Can be formed into complex one-piece structures (1) facilitating a time efficient production process (1) 4. Allows an aerodynamic/vented helmet to be produced (1) allowing an aerodynamic/vented helmet to be produced without loss of structural integrity (1) 5. Provides good impact resistance/ tough/ shatter-proof (1) to prevent day to day damage/ protects the head (1) 6. Can be moulded to another product (1) to provide excellent shock absorption / work as a composite safety material (1) 7. Hard/ hard-wearing material (1) meaning that the outer skin is difficult to crack/ penetrate/ scratch/ indent (1) 8. Water resistant (1) does not deteriorate/ degrade over time/ protects the absorbent material/ can be used in inclement weather (1) 	(4)

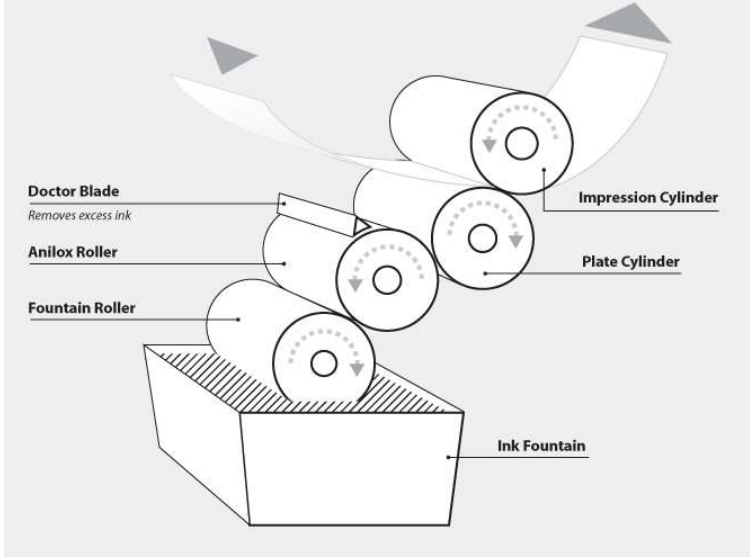
Question number	Answer Additional guidance	Mark
1(c)	<p>Any explanation that includes the identification of an advantage (1) and linked justifications of that advantage (1+1):</p> <ol style="list-style-type: none"> 1. Carbon fibre has higher strength than PVC (1) providing better protection for the wearer of the helmet (1) reducing the chance of serious injury or fatality (1) 2. Carbon fibre is tougher/harder/more impact resistant than PVC (1) which increases the durability/life of the helmet (1) providing long term economies (1) 3. Carbon fibre provides a marketing opportunity (1) because users may perceive the helmet as high-tech/ cutting edge/ trendy product (1) increasing sales of the helmet/ providing higher profit opportunities (1) 4. Woven structure of the fibres (1) provides strength in all directions (1) providing excellent protection for the wearer (1) 5. Carbon fibre does not degrade when exposed to sunlight/ UV light (1) providing longer lasting functional protection/ durability (1) making the product cost-effective for the user (1) 6. Carbon fibre has a unique and distinct appearance (1) that is difficult to replicate (1) giving the perception of a high quality desirable product/ providing increased profit opportunities for the manufacturer (1) 	(3)

Question number	Answer	Mark
2(a)	<p>Two valid material properties:</p> <ol style="list-style-type: none"> 1. Good tensile/ compressive strength/ strength to weight ratio (1) 2. Weather/ moisture/ rot resistant (1) 3. Resists insect infestation (1) 4. Stable material/ limited distortion/ warping (1) 5. Straight grained/ long lengths available (1) 	(2)

Question number	Answer	Additional Guidance	Mark
2(b)	<p>In order for the candidates to solve the problem, they will need to recognise that each of the following stages are required.</p> <p>Stage 1:</p> <p>Use of Pythagoras theorem</p> $h^2 = a^2 + o^2 \quad (1)$ <p>Stage 2:</p> $h^2 = 2.31^2 + 4.00^2$ $h^2 = 5.3361 + 16.000$ $h^2 = 21.3361 \quad (1)$ $h = \sqrt{21.3361} \quad (1)$ $h = 4.6195 \quad (1)$ <p>Stage 3:</p> <p>Correct rounding to 2dp</p> $4.62\text{m} \quad (1)$ <p>Alternative methods for question 2b</p> <p>Alternative Method 1 - using sine</p> <p>Stage 1</p> $\tan\theta = 2.31/4 \quad (1)$ $\theta = \tan^{-1}(2.31/4)$ $\theta = 30.006 \quad (1)$ <p>Stage 2</p> $H = 2.31/\sin 30.006 \quad (1)$ $H = 4.6188 \quad (1)$	<p>Accept alternative methods of correct working out.</p> <p>Error carried forward should be applied.</p> <p>Award full marks for correct answer only.</p>	(5)

	<p>Stage 3</p> <p>$H = 4.62$ (1)</p> <p>Alternative Method 2 - using cosine</p> <p>Stage 1</p> <p>$\tan\theta = 2.31/4$ (1)</p> <p>$\theta = \tan^{-1}(2.31/4)$</p> <p>$\theta = 30.006$ (1)</p> <p>Stage 2</p> <p>$H = 4/\cos 30.006$ (1)</p> <p>$H = 4.6188$ (1)</p> <p>Stage 3</p> <p>$H = 4.62$ (1)</p> <p>Alternative Method 3 - using the Sine Rule</p> <p>Stage 1</p> <p>$\tan\theta = 2.31/4$ (1)</p> <p>$\theta = \tan^{-1}(2.31/4)$</p> <p>$\theta = 30.006$ (1)</p> <p>Stage 2</p> <p>$H/\sin 90 = 2.31/\sin 30.006$</p> <p>$H = (2.31 \times \sin 90)/\sin 30.006 = (2.31 \times 1)/\sin 30.006$ (1)</p> <p>$H = 4.6188$ (1)</p> <p>Stage 3</p> <p>$H = 4.62$ (1)</p>		
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Question number	Answer	Mark
3(a)	<p>A valid explanation with linked justification:</p> <ol style="list-style-type: none"> 1. Easily scored / bent / creased (1) without splitting / tearing / making it easier to form the box (1) 2. Good/ smooth printing surface (1) allows the application of high quality graphics/ allows for a more visually appealing package (1) 3. Rigid stiff board (1) will protect contents from damage/ help to retain its shape (1) <p>Do not accept references to folding as it is in the question</p>	(2)

Question number	Answer	Mark
3(b)	<p>Award marks as follows (maximum 4 marks):</p> <ol style="list-style-type: none"> 1. Diagram showing 4 rollers with media in the correct position (1) 2. Correctly labelling all 4 cylinders in the correct order (1) 3. Ink pan/fountain sources ink for fountain roller/cylinder (1) 4. Ink transferred to the plate cylinder using rollers (1) 5. Doctor blade removes excessive ink (1) 6. Ink is transferred to the media by pressure applied by the impression cylinder/roller (1)  <p>The diagram illustrates the lithographic printing process. It shows an ink fountain at the bottom left, which feeds ink into a fountain roller. This roller is in contact with an anilox roller, which is in turn in contact with a doctor blade. The doctor blade is positioned to remove excess ink from the anilox roller. The anilox roller is in contact with a plate cylinder, which is in contact with an impression cylinder. The impression cylinder is in contact with a sheet of paper that is being fed into the machine from the top right. The paper is shown being printed with a pattern. Labels with arrows point to the Doctor Blade, Anilox Roller, Fountain Roller, Ink Fountain, Plate Cylinder, and Impression Cylinder. A note below the diagram states: 'If no sketch, or a sketch without labels, award a maximum of 2 marks.'</p>	(4)

Question number	Answer	Additional guidance	Mark
3(c)	<p>Any two explanations that include identification of an advantage (1) and linked justifications of that advantage (1) + (1).</p> <ol style="list-style-type: none"> 1. Printing plates can be made from solid or liquid photopolymer (1) whereas gravure needs an engraved copper plate (1) this means that flexography has lower start-up costs/ overall is a quicker start-up (1) 2. Flexography prints onto sheet material (1) whereas gravure is fed from material on a roll (1) making flexography more versatile for printing on different media/mountable on uneven surfaces (1) 3. Flexography can be used on shorter print runs (1) as it is able to respond to changes in demand / has shorter lead times (1) enabling greater flexibility and varied use of the process (1) 	Do not accept repeated justification.	(6)

Question number	Answer	Mark
4(a)	<p>Three valid appropriate joints:</p> <ol style="list-style-type: none"> 1. Mortise and tenon (1) 2. Dowel (1) 3. Mechanical (screw) fixing (1) 4. KD fixings/ cross dowels/ barrel nuts (1) 5. Halving joint (1) 6. Dovetail halving joint (1) 	(3)

Question number	Answer	Additional guidance	Mark
4(b)	<p>An outline covering six of the following stages</p> <ol style="list-style-type: none"> 1. Construct former (1) 2. Apply release agent to former (1) 3. Steam/ soak pre-cut timber sections in water (1) 4. Apply adhesive to individual sections (1) 5. Assemble timber sections and place in former/ jig/ bag press (1) 6. Close the former applying even pressure by incrementally tightening all clamps/ vacuum/ use of wedges (1) 7. Remove surplus adhesive before it cures (1) 8. Leave in former until adhesive has sufficiently cured to allow removal of the rocker (1) 9. Release the rocker from the former (1) 	<p>Note the question stem relates to a bespoke one-off product so the response must relate to the production of a one-off rather than mass production.</p> <p>Maximum 5 marks if stages are not in the correct order.</p>	(6)

Question number	Answer	Additional Guidance	Mark
4(c)	<p>In order for the candidates to solve the problem, they will need to recognise that each of the following stages are required.</p> <p>Area of one side</p> <p>Rectangular section: $20 \times 380 = 7600 \text{ mm}^2$ Quadrant of circle: $0.25 \times (\pi \times 20^2) = 314 \text{ mm}^2$ Area of one side = $7600 + 314 = 7914 \text{ mm}^2$ (1)</p> <p>Area of two sides plus end = $15828 + (35 \times 20) = 16528 \text{ mm}^2$ (1)</p> <p>Area of base: $35 \times 400 = 14000 \text{ mm}^2$ (1) Area of top: $35 \times 380 = 13300 \text{ mm}^2$ (1) Area of curved face: $35 \times (2\pi \times 20)/4 = 1099.7 \text{ mm}^2$ (1)</p> <p>Total surface area = $16528 + 14000 + 13300 + 1099.7 = 44927.7 \text{ mm}^2$ (1)</p> <p>Area of 2400 pieces:</p> <p>$107826480 \text{ mm}^2 = 107.82 \text{ m}^2$ (1)</p> <p>Volume of varnish needed $107.82/11 = 9.8 \text{ litres}$ (1)</p> <p>Alternative</p> <p>Stage 1:</p> <p>Calculate perimeter of side</p> <p>Straight edges</p> <p>$0.4 + (0.4 - 0.02) + 0.02$ (1)</p> <p>Curved edge</p> <p>$(2 \times 3.142 \times 0.02)/4$ (1)</p> <p>Straight edge + curved edge</p> <p>$= 0.83142 \text{ m}$ (1)</p>	<p>Accept alternative methods of correct working out.</p> <p>Error carried forward should be applied.</p> <p>Award full marks for correct answer only.</p>	(8)

	<p>Stage 2:</p> <p>Calculate area of 35mm wide surface for 2400 pieces</p> $0.83142 \times 0.035 \times 2400$ $= 69.83928 \text{ m}^2 (1)$ <p>Stage 3:</p> <p>Calculate area of 20mm wide sides for 2400 pieces</p> $[(2 \times (0.4 - 0.02) \times 0.02) + (2 \times 3.142 \times 0.02^2/4)] \times 2400 (1)$ $= 0.0158284 \times 2400$ $= 37.98816 \text{ m}^2 (1)$ <p>Stage 4</p> <p>Total area to be varnished</p> $69.83928 + 37.98816$ $= 107.82 \text{ m}^2 (1)$ <p>Stage 5</p> <p>Calculate volume of varnish required</p> $(107.82/11)$ $= 9.8 \text{ litres (1)}$ <p>Accept answers that round to 9.8</p>		
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Question number	Answer	Mark
4(d)	<p data-bbox="391 271 1058 340">Two valid appropriate ways copyright will protect the company's images:</p> <ol data-bbox="438 383 1137 869" style="list-style-type: none"><li data-bbox="438 383 1137 452">1. Prevents the distribution/renting/lending/selling of copies by others (1)<li data-bbox="438 465 1137 535">2. Prevents others from showing/using the images in public (1)<li data-bbox="438 548 1137 618">3. Prevents others from putting the images on the internet (1)<li data-bbox="438 631 1137 701">4. Prevents others from making an adaptation of the company's images (1)<li data-bbox="438 714 1137 784">5. Potential court action for the breach of copyright by others will act as a disincentive to copy images (1)<li data-bbox="438 797 1137 869">6. Prevents others from claiming ownership of the image (1)	(2)

Question number	Answer	Mark
4(e)	<p>This question asks candidates to evaluate the use of the circular economy with reference to suppliers and consumers. Candidates should analyse the system in order to weigh up the potential advantages and disadvantages of the circular economy for suppliers and consumers.</p> <p>Candidates might refer to the following in their responses:</p> <ul style="list-style-type: none"> • Design out/Minimisation of waste, and energy leakage • Decoupling economic activity from the consumption of finite resources • Keeps products/materials in use • A shift from fossil fuels to renewable energies • Emphasises 'cradle to cradle' approach • Slowing, closing and narrowing material and energy loops • Contrast to a linear economy which is a 'take, make, dispose' model of production • Optimisation of systems • Circular framework • Approach taken to deal with the end of the cheap oil and fossil fuels era • Transition to a low carbon economy • Prioritisation of regenerative resources • Use waste as a resource • Designing for a lifetime and extended future use • Preserving and extending what is already made • Collaboration to create joint value • Incorporation of digital technologies to track and optimise resource use • Circular business models <p>Expansion that can be used to justify judgments relating to positive or negative points:</p> <ul style="list-style-type: none"> • Company image and sales • Consumers need to support and 'buy-in' to the circular economy as they can 'break the chain' • Classic less fashion approach to products to maintain appeal (slow fashion) • Costs associated with circular economy implementation and alternative energy • Sustainability benefits and 'green credentials' • Consumer support feeling that they are 'doing their bit for the environment' • Increase in recycling, associated costs and benefits • Requirement for recycling infrastructure • Negative pressure from oil companies and oil producing countries 	(9)

	<ul style="list-style-type: none"> • Positive support from governments and environmental pressure groups • Investment in waste recovery systems • Increased use of repair and upgrade programmes including buyback programmes and supporting logistics • Prices reflecting real cost 	
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Level	Mark	Descriptor
	0	No rewardable content
Level 1	1 – 3	<ul style="list-style-type: none"> • Applies a basic understanding to deconstruct information, making limited connections between concepts. • Incomplete evaluation with unresolved conclusion that demonstrates limited syntheses of understanding. • Judgements are tentatively supported by evidence. • The candidate demonstrates a limited understanding of the circular economy concept
Level 2	4 – 6	<ul style="list-style-type: none"> • Applies a competent understanding to deconstruct information and provide some clear connections between concepts. • Imbalanced evaluation that synthesises some relevant understanding into a generally coherent conclusion. • Judgements are occasionally supported by relevant evidence. • The candidate demonstrates a good understanding of the circular economy concept
Level 3	7 - 9	<ul style="list-style-type: none"> • Applies a thorough understanding to deconstruct information and provides logical connections between concepts throughout. • Balanced evaluation that synthesises relevant understanding into a well-developed conclusion. • Judgements are supported by relevant evidence throughout. • The candidate demonstrates a developed understanding of the circular economy concept

Question Number	Answer	Mark
5(a)	<p>Any two named sources</p> <ol style="list-style-type: none"> 1. British Standards Institute (BSI) (1) 2. Department of Business Innovation and Skills (BIS) also accept former name Department for Trade and Industry (DTI) (1) 3. Compendium of essential design and technology standards for schools and colleges (1) 4. European (anthropometric) database (1) 5. European sizing survey (1) 6. International Standards Organisation (ISO) (1) 7. World Health Organisation (WHO) (1) 	(2)

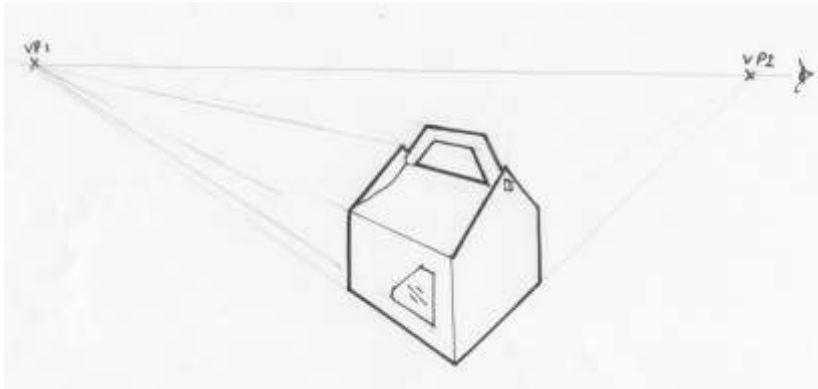
Question number	Answer	Mark
5(b)	<p>Any one explanation that includes identification of a performance characteristic (1) and linked justifications of the suitability of the performance characteristic (1) + (1).</p> <ol style="list-style-type: none"> 1. ABS is a hard material (1) is therefore resistant to surface scratching (1) which will maintain the appearance / aesthetics of the product/ provide durability (1) 2. ABS is a tough material/ impact resistant (1) will therefore withstand knocks/ drops (1) that are associated with their use (1) 3. Available in a range of colours (1) provides good appearance/aesthetics (1) which will attract buyers/ increase sales (1) 4. Good fluidity helps to provide high quality finish (1) can therefore be injection moulded (1) allowing mass production of the games controller (1) 5. Rigid material (1) so does not flex/deform in use (1) allowing precision control (1) 6. Electrical insulator (1) prevents potential earth leakage (1) preventing damage to the electronics (1) 7. Water/chemical resistant (1) as hands become sweaty/ spilled liquids etc (1) the sweat/ liquids will not damage the games controller/ can be cleaned (1) 	(6)

Question number	Answer	Mark
5(c)	<p>This question is about form versus function and asks candidates to discuss this in the context of the games controller. Creditworthy responses will make connections which show understanding of factors that need to be considered, going beyond general knowledge.</p> <p>Candidates might refer to the following in their responses:</p> <ul style="list-style-type: none"> • Form follows function • Function follows form • Shape/form • Key functions • Ergonomics and anthropometrics • Demographics of the user group • Proximity of key controls to fingers and thumbs • Range of hand movement • Shape of handles • Comfort in use • Ease of use • Aesthetics 	(6)

Level	Mark	Descriptor
	0	No rewardable materials
Level 1	1 - 2	<ul style="list-style-type: none"> • Superficial discussion that considers a narrow range of factors, demonstrating limited understanding. • Partial application of understanding to the context of the question. • The candidate demonstrates a limited understanding of the conflicting needs of form and function
Level 2	3 - 4	<ul style="list-style-type: none"> • Coherent discussion that makes some relevant links between a sufficient range of factors, demonstrating competent understanding. • Generally sound application of understanding to the context of the question. • The candidate demonstrates a good understanding of the conflicting needs of form and function
Level 3	5 - 6	<ul style="list-style-type: none"> • Comprehensive discussion that makes effective links between a wide range of factors, demonstrating thorough understanding. • Considered and effective application of understanding to the context of the question. • The candidate demonstrates a developed understanding of the conflicting needs of form and function

Question number	Answer	Mark
5(d)	<p>Any two valid materials handling systems:</p> <ol style="list-style-type: none"> 1. Automated (storage) and retrieval systems (ASRS/ARS) (1) 2. Automated guided vehicles (AGVs) (1) 3. Automated warehouse system (AWS) (1) 4. Automated racking system (1) 5. Robotic Fork Lift (1) 6. Programmable Drones (1) 7. Automated Conveyor System (1) 8. Automated Pallet Trucks (1) 	(2)

Question number	Answer	Additional Guidance	Mark
5(e)	<p>In order for the candidates to solve the problem, they will need to recognise that each of the following stages are required.</p> <p>Stage 1:</p> <p>Calculate area of board in one pack</p> $50 \times 0.42 \times 0.594 = 12.474 \text{ m}^2 \text{ (1)}$ <p>Stage 2:</p> <p>Calculate the number of packs required</p> $310 / 12.474 = 24.85 \text{ packs}$ <p>Therefore 25 packs (1)</p> <p>Stage 3:</p> <p>Calculate the cost of 25 packs</p> $25 \times \text{£}36.88 = \text{£}922.00 \text{ (1)}$	<p>Accept alternative methods of correct working out.</p> <p>Error carried forward should be applied.</p> <p>Award full marks for correct answer only.</p>	(3)

Question number	Answer	Mark															
5(f)	<p data-bbox="368 271 1050 304">A two point perspective drawing of the assembled net.</p>  <table border="1" data-bbox="368 797 1190 1856"> <thead> <tr> <th>Level</th> <th>Mark</th> <th>Descriptor</th> </tr> </thead> <tbody> <tr> <td></td> <td>0</td> <td>No rewardable materials</td> </tr> <tr> <td>Level 1</td> <td>1 - 2</td> <td> <ul style="list-style-type: none"> • Drawing is produced with limited attention to detail and lacks accuracy and precision. • Limited use of vanishing points/line convergence • Some features of the drawing may be included but lack detail and may be inappropriately positioned. • Line style is inconsistent and inappropriate throughout. </td> </tr> <tr> <td>Level 2</td> <td>3 - 4</td> <td> <ul style="list-style-type: none"> • Drawing is produced with some precision and accuracy. • Appropriate use of vanishing points/ line convergence • Most drawing features are detailed with correct positioning and appropriate proportions. • Line style is broadly consistent and appropriate throughout. </td> </tr> <tr> <td>Level 3</td> <td>5 - 6</td> <td> <ul style="list-style-type: none"> • Drawing is produced with precision and accuracy. • Accurate use of vanishing points/line convergence • Drawing features are fully and correctly detailed with correct positioning and proportions. • Line style is consistent and appropriate throughout. </td> </tr> </tbody> </table> <p data-bbox="368 1899 1129 2000">Note vanishing points may not be shown on the drawing and professional judgement will need to be used on the use of vanishing points / line convergence.</p>	Level	Mark	Descriptor		0	No rewardable materials	Level 1	1 - 2	<ul style="list-style-type: none"> • Drawing is produced with limited attention to detail and lacks accuracy and precision. • Limited use of vanishing points/line convergence • Some features of the drawing may be included but lack detail and may be inappropriately positioned. • Line style is inconsistent and inappropriate throughout. 	Level 2	3 - 4	<ul style="list-style-type: none"> • Drawing is produced with some precision and accuracy. • Appropriate use of vanishing points/ line convergence • Most drawing features are detailed with correct positioning and appropriate proportions. • Line style is broadly consistent and appropriate throughout. 	Level 3	5 - 6	<ul style="list-style-type: none"> • Drawing is produced with precision and accuracy. • Accurate use of vanishing points/line convergence • Drawing features are fully and correctly detailed with correct positioning and proportions. • Line style is consistent and appropriate throughout. 	(6)
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Question number	Answer	Mark
6	<p>This question is about how the designer of the Paris Metro Station entrances was influenced by Art Nouveau philosophies. Creditworthy responses will make connections, which show understanding of factors that need to be considered, going beyond general observation of the image provided. Candidates should consider the design of the entrance, showing understanding of the influence of Art Nouveau philosophy. Candidates might refer to the following in their responses:</p> <ol style="list-style-type: none"> 1. Unity and harmony across the various fine arts and crafts 2. Establishment of 'modern' urban life 3. Designers appreciated the benefits of mass production 4. Embraced technological advances of the time 5. Embraced the aesthetic possibilities of new materials including glass and stained glass 6. High standards of craftsmanship and design to everyday objects 7. The form of an object should be expressed through its function and function should be expressed through decorative forms 8. Influenced by natural forms 9. Elongated curvy 'whiplash' lines 10. Stylised flowers/leaves/roots/buds/seedpods 11. Exotic insects and peacock feathers 12. Use of the female form/languid female figures/long flowing hair 13. Influenced by the arts and artefacts of Japan 14. Vertical lines and height 15. Celtic/Arabian/Ancient Greek patterns provided inspiration for intertwined ribbon patterns 	(9)

Level	Mark	Descriptor
	0	No rewardable materials
Level 1	1 – 3	<ul style="list-style-type: none"> • Superficial discussion that considers a narrow range of factors, demonstrating limited understanding. • Partial application of understanding to the context of the question. • The candidate demonstrates a limited understanding of Art Nouveau design and philosophies of the movement.
Level 2	4 – 6	<ul style="list-style-type: none"> • Coherent discussion that makes some relevant links between a sufficient range of factors, demonstrating competent understanding. • Generally sound application of understanding to the context of the question. • The candidate demonstrates a good understanding of Art Nouveau design and philosophies of the movement.
Level 3	7 - 9	<ul style="list-style-type: none"> • Comprehensive discussion that makes effective links between a wide range of factors, demonstrating thorough understanding. • Considered and effective application of understanding to the context of the question. • The candidate demonstrates a developed understanding of Art Nouveau design and philosophies of the movement.

Question number	Answer	Mark
7(a)	<p>This question is about considerations relating to the location of a new vehicle production facility and asks candidates to discuss this in the context of UK mainland or offshore in a developing country. Creditworthy responses will make connections, which show understanding of factors that need to be considered, going beyond general knowledge.</p> <p>Candidates might refer to the following in their responses:</p> <ul style="list-style-type: none"> • Available infrastructure • Transportation costs/distance to market • Availability of skilled workforce • Workforce training • Engineering expertise local/imported • Cost benefits including low labour costs • Public perception including ethics and exploitation • Government incentives in host country • Availability and price of development land • Language barriers • Exposure to volatile exchange rates • Political stability of host nation • Loss of UK jobs/skills • Issues surrounding technical robotics expertise • Labour relations issues in UK/host country • Trade agreements and tariffs • Availability/location of raw materials and components • Benefits to the host nation • Environmental considerations and regional legislation • Health and Safety legislation and employment law • Just-in-time and issues surrounding border controls 	(9)

Level	Mark	Descriptor
	0	No rewardable materials
Level 1	1 – 3	<ul style="list-style-type: none"> • Superficial discussion that considers a narrow range of factors, demonstrating limited understanding. • Partial application of understanding to the context of the question. • The candidate demonstrates a limited understanding of factors that influence the location of the manufacturing facility.
Level 2	4 – 6	<ul style="list-style-type: none"> • Coherent discussion that makes some relevant links between a sufficient range of factors, demonstrating competent understanding. • Generally sound application of understanding to the context of the question. • The candidate demonstrates a good understanding of factors that influence the location of the manufacturing facility.
Level 3	7 - 9	<ul style="list-style-type: none"> • Comprehensive discussion that makes effective links between a wide range of factors, demonstrating thorough understanding. • Considered and effective application of understanding to the context of the question. • The candidate demonstrates a developed understanding of factors that influence the location of the manufacturing facility.

Question number	Indicative Content	Mark
7(b)	<p>Any three explanations that include identification of a way computers have enabled/enhanced the use of robotics (1) and linked justifications of the benefit of the identified way (1) + (1).</p> <ol style="list-style-type: none"> 1. Advances in computer processing speed/ technology (1) allows accurate and fine motor control/co-ordination (1) at a fast speed to increase production rates in the car plant (1) 2. Integration of feedback systems / loops (1) allows self-diagnosis of errors/ production problems in the car plant (1) providing automated shutdown to prevent repeat errors / reduce warranty claims (1) 3. Links to sensors (1) have allowed for computer monitoring of quality/tolerances within the car assembly (1) reducing the number of faulty or imperfect products (1) 4. Computer integration/ sharing of data with other company systems (1) allow JIT supply systems to link with production output (1) maintaining appropriate supply levels when required / allowing customers to personalise their car(1) 5. Use of GPS and computer mapping (1) allows robots to link with ASRS (1) facilitating the automated deployment of materials/multiple products on one production line (1) 6. Links from design (CAD) (1) to manufacturing (CAM) (1) allowing automated machine setup (1) 7. Sophisticated programming/ AI (1) allows/ adapts automated control of manufacturing systems (1) improving efficiency/ accuracy/ speed of production (1) 	(9)

Question number	Answer	Mark
8	<p>This question asks candidates to evaluate the decision to use driving ergonomics as a key priority when designing the interior of the car shown in the image. Candidates should analyse the car cockpit in terms of ergonomic design and ease of use and give reasoned justification to qualify their judgements and conclusion.</p> <p>Points of analysis:</p> <ul style="list-style-type: none"> • Orientation of dashboard towards the driver • Position, size and level of satnav / infotainment screen • Instrument binnacle relative to steering wheel position and shape • Height of dashboard • Shape, size, rim thickness and ergonomic design of steering wheel • Steering wheel based/positioned controls • Position and shape of other controls and minor switchgear • Position and shape of ventilation inlets/controls • Position, shape and presentation of door handle/grab • Position and shape of arm rests • Aesthetic points related to the above <p>Points of evaluation:</p> <ul style="list-style-type: none"> • Driver focused environment • Holistic ergonomics of the whole cockpit / driving environment • Ergonomics at a micro level • Range of human movement • Use of anthropometrics • Safety • Comfort • Access • Aesthetic evaluation • Appropriate conclusion 	(12)

Level	Mark	Descriptor
	0	No rewardable materials
Level 1	1 - 3	<ul style="list-style-type: none"> • Applies a basic understanding to deconstruct information, making limited connections between concepts. • Incomplete evaluation with unresolved conclusion that demonstrates limited synthesis of understanding. • Judgements are tentatively supported by evidence. • The candidate demonstrates a limited understanding of ergonomic design within the context of the question
Level 2	4 - 6	<ul style="list-style-type: none"> • Applies a generally sound understanding to deconstruct information and provide some clear connections between concepts. • Imbalanced evaluation that synthesises some relevant understanding into a generally coherent conclusion. • Judgements are occasionally supported by relevant evidence. • The candidate demonstrates a basic understanding of ergonomic design within the context of the question
Level 3	7 - 9	<ul style="list-style-type: none"> • Applies an effective understanding to deconstruct information and provide logical connections between concepts. • Balanced evaluation that synthesises relevant understanding into a considered conclusion. • Judgements are mostly supported by relevant evidence. • The candidate demonstrates a good understanding of ergonomic design within the context of the question
Level 4	10 - 12	<ul style="list-style-type: none"> • Applies a comprehensive understanding to deconstruct information and provides insightful connections between concepts throughout. • Thorough and balanced evaluation that synthesises relevant understanding into a well-developed conclusion. • Judgements are supported by pertinent evidence throughout. • The candidate demonstrates a developed understanding of ergonomic design within the context of the question

