



Pearson
Edexcel

Mark Scheme (Results)

October 2020

Pearson Edexcel GCE
In Design and Technology: Product
Design
9DTo/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 characteristics of polyester:</p> <ol style="list-style-type: none"> 1. High tensile strength / tear resistance (1) 2. Extremely low water absorbency (1) 3. Resistant to pollutants (1) 4. Resistant to mould / mildew (1) 5. Provides UV protection / opaque (1) 6. Available in a range of colours (1) 7. Resistant to stretching (1) 8. Resistant to shrinking (1) 9. Does not degrade under UV light/retains colour(1) 10. Flexible (1) 11. Easy to clean (1) <p>Do not accept durable, lightweight or waterproof as these are examples given in the question.</p>	(2)

Question number	Answer	Mark
1(b)	<p>Two valid explanations with linked justification:</p> <ol style="list-style-type: none"> 1. Good tensile strength / tensile strength to weight ratio (1) allowing a relatively small diameter / lightweight cord / will not snap (1) 2. Elastic / good shock absorber / tough (1) will be able to withstand live loads eg the tug of a wind gust (1) 3. Good resistance to the elements (1) so will not degrade in UV sunlight/water/mould/pollutants/low temperatures (1) 4. Good abrasion resistance (1) so will retain its integrity at points of connection eg eyelets (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. Lightweight compared to solid oak (1) therefore easy to handle / carry (1) facilitates easy erection / transportation (1) 2. Durable compared to solid oak (1) aluminium is more resistant to damp / wet conditions (1) so will not [rot / decay / split] / does not require a [finish / treatment] (1) 3. Unlike solid oak the tubular shape provides good strength to weight ratio (1) so will resist bending / buckling (1) whilst remaining light and easy to handle (1) 4. Aluminium has uniform strength (1) due to the lack of [grain / natural defects] (1) so will not split / break at weak points (1) 	(3)

Question number	Answer	Mark
2(a)	<p>Two valid working properties:</p> <ol style="list-style-type: none"> 1. Foil provides a barrier against moisture / moisture resistant (1) 2. Good printing surface (1) 3. Inert material that does not contaminate / taint the contents (1) 4. Prevents passage of contaminants (1) 5. Can be bent/creased without compromising the integrity of the foil/card (1) <p>Do not accept good insulator as the foil is internal and not used to reflect heat in this context.</p> <p>Do not accept responses relating to strength as this was an example given in the question.</p>	(2)

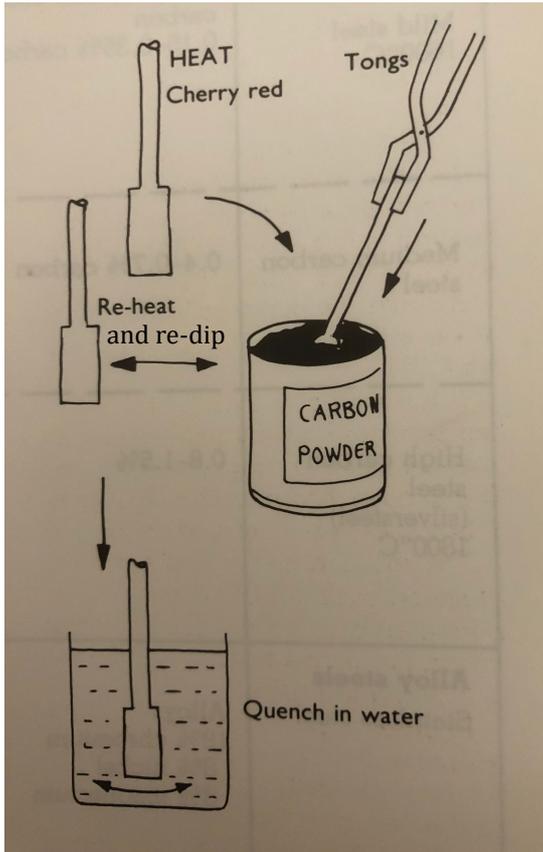
Question number	Answer	Additional Guidance	Mark
2(b)	<p>In order for the candidates to solve the problem, they will need to recognise that each of the following stages are required.</p> $V = \frac{1}{3}\pi h(R^2 + Rr + r^2)$ $h = V \times 3 / \pi(R^2 + Rr + r^2)$ <p>M1 – for transposing the formula</p> $h = 500 \times 3 / 3.142 \times (4^2 + (4 \times 2.5) + 2.5^2)$ <p>M1 - for correct substituti</p> <p>$h = 1500 / 101.3294$ A1</p> <p>$h = 14.8032$ A1</p> <p>14.8 cm A1 for 3SF</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>	(5)

Question number	Answer	Mark
3(a)	<p>A valid explanation with linked justification:</p> <ol style="list-style-type: none"> 1. Thermo-chromic materials change colour as the temperature changes (1) giving an indication of unsafe temperatures/which stops people handling items that are hot / avoiding burns/injury (1) 2. Colour changing children's bath toys (1) to give an indication of safe water temperature (1) 3. Colour changing kettle (1) indicates when the kettle contains boiling water (1) 4. Colour changing mugs (1) indicate when the liquid is too hot to drink (1) 5. Colour changing stickers on food packaging (1) to indicate the correct storage temperature (1) 6. Colour changing forehead thermometers (1) safer than glass thermometers that could break/cut the user (1) 	(2)

Question number	Answer	Additional guidance	Mark
3(b)	<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. Superelasticity / SMAs are extremely flexible (1) allows them to spring back to their original shape / providing a close and comfortable fit (1) making them suitable for a range of head shapes / sizes (1) 2. If bent or kinked (1) they can return to their original shape (1) by application of heat to the transition temperature / submersion in hot water (1) 3. Thin / discreet sections can be used / good strength to weight ratio (1) reducing the weight of the spectacle frame (1) so very comfortable to wear (1) 4. Good mechanical properties (1) so resistant to typical spectacle damage (1) therefore durable and long lasting (1) <p>Accept any other appropriate answer</p>	Do not accept repeated justification.	(6)

Question number	Answer	Mark
4(a)	<p>Three valid appropriate jointing methods:</p> <ol style="list-style-type: none"> 1. Welded (1) 2. Bolted/machine screwed (1) 3. Self-tapping screwed (1) 4. Bonded (adhesive) (1) 5. Lapped seam (1) 6. Riveted (1) 	(3)

Question number	Answer	Additional guidance	Mark
4(b)	An outline covering six of the following stages <ol style="list-style-type: none">1. Steel is straightened (1)2. Steel is cut to required blank size (1)3. Blank passes through an automated feeder (1)4. Blank loaded into press/former/die (1)5. Press is activated (1)6. High pressure forces sheet steel to take the shape of the former (1)7. Die cuts/stamps out any apertures / openings / holes / outline shape (1)8. Finished pressing is removed from the machine (1)		(6)

Question number	Answer	Additional Guidance	Mark
4(c)	 <p>Annotations to include (1)</p> <ol style="list-style-type: none"> 1. Tongs / PPE are used for health and safety / to prevent burns (1) 2. Mild steel is rapidly heated to cherry red colour / 800 to 900°C (1) 3. Hot steel is dipped into carbon powder (1) 4. Allowed to soak/cool to absorb carbon powder (1) 5. Process is repeated two or three times (1) 6. Steel is reheated to cherry red colour (1) 7. Steel is quenched in water to cause rapid cooling (1) <p>No marks to be awarded if a different process is described</p>	<p>Maximum of 5 marks if step 4 is not included in the response.</p> <p>Maximum of 3 marks if no sketches are provided.</p> <p>Maximum of 3 marks if no annotations are provided.</p>	(6)

Question number	Indicative Content	Mark
5(b)	<p>This question asks candidates to evaluate the impact of built in obsolescence with a specific focus of the impact on manufacturers.</p> <p>Candidates should analyse the situation and consider the potential advantages and disadvantages of built in obsolescence on manufacturers</p> <p>Candidates might refer to the following in their responses:</p> <ol style="list-style-type: none"> 1. New/updated/better products 2. Safety 3. New technology 4. Market share 5. Trends / fashions 6. Brand perceptions / impacts / reputation 7. Environmental reputation / green credentials 8. Quick response 9. Delayed release 10. Plagiarism 11. Upgrading of production lines 12. R&D/development budget 13. Size of manufacturers 14. Pace of development 15. Costs 16. Consumer confidence 17. Product lifespan 18. Perceived quality 19. Impact on sales 20. Impact on profits 	(9)

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 syntheses of understanding. • Judgements are tentatively supported by evidence.
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.
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.

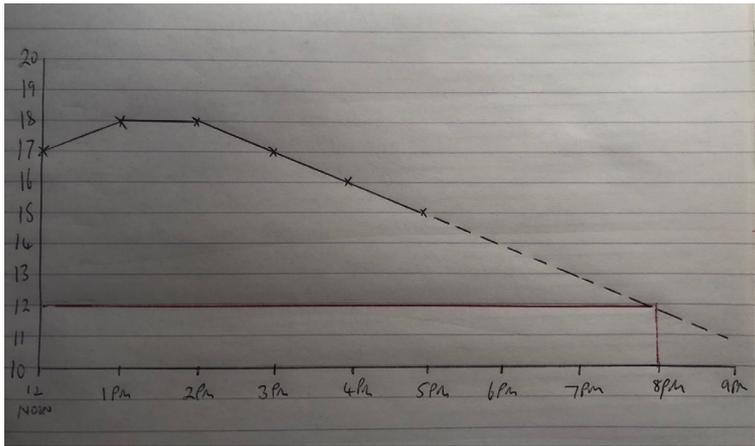
Question Number	Answer	Mark
6(a)	<p>Any two disadvantages</p> <ol style="list-style-type: none"> 1. Designs become publicly available / secrecy is lost (1) 2. Time consuming / 3 to 4 years to obtain a patent (1) 3. Speed of technological development may mean that the invention is out of date by the time the patent is granted (1) 4. Cost of registering the patent / annual fees for maintaining the permit (1) 5. May need to be prepared to defend your patent (1) 6. Often the patent is not that effective as many patents can be 'copied' by clever changes to the design / legal loopholes / minor changes (1) 7. Limits development / design improvements by other companies / discourages the sharing of new design ideas (1) 8. Patents are time limited / can only be renewed for a 20 year period / require renewal every 4 years (1) 9. Monopoly situations arise when only one manufacturer is allowed to produce a product (1) 10. Patents may not be valid internationally (1) 	(2)

Question number	Answer	Mark
6(b)	<p>Any two explanation that includes identification of a way Six Sigma can improve a manufacturing process (1) and linked justifications of the improvements/impact of/on the process (1) + (1).</p> <ol style="list-style-type: none"> 1. Six Sigma improves quality of products by focusing on quality control (1) aimed at reducing the number of defects (1) from the 1st Sigma at 30% defects to the 6th Sigma at less than 0.001% defects (1) 2. Six Sigma reduces the process cycle time (1) by removing errors / unnecessary stages in production (1) for example reducing the number of products that need to be reworked or replaced / inefficient layout of production lines / paperwork being completed that is not needed (1) 3. Six Sigma reduces pollution resulting from the process (1) by reducing transportation and travel (1) and reducing production of waste due to product faults / utilising more energy efficient processes (1) 4. Six Sigma reduces costs (1) by simplifying processes and steps needed / by using common manufacturing processes for different products (1) therefore reducing setting up time / reducing the amount of capital investment needed (1) 5. Six Sigma makes processes as consistent as possible (1) by streamlining processes (1) which reduces the possibilities for defects (1) 6. Six sigma improves efficiency / productivity (1) by using DMAIC (Define, Measure, Analyse, Improve, Control) (1) resulting in improved / streamlined use of resources (1) 7. Six Sigma is a management tool / methodology (1) where employees become involved in the implementation of quality improvement (1) helps with defect reduction as employees understand the processes involved in the manufacturing of the product (1) 	(6)

Question number	Indicative Content	Mark
6(c)	<p>This question is about the sale of goods act and the consumer rights act and asks candidates to discuss how this legislation provides protection for consumers. 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> <ol style="list-style-type: none"> 1. Consumer rights act 2. Sale of goods act 3. Goods should be fit for purpose including any specific purpose made known to the retailer at the time of purchase 4. Goods should be what a reasonable person would consider to be satisfactory quality for the goods in question ie higher expectations of luxury/high end products 5. Goods should be as described or any samples shown at the time of purchase 6. Does not apply if the buyer was aware of the defects at the time of purchase 7. Consumer has rights / can claim against the retailer 8. Remedies under the act include return and refund, repair, and replacement 9. Defects assumed to be present at the time of purchase if notified within 6 months 10. Right to reject goods for a refund within 30 days if criteria is not met 11. After 30 days retailer has the choice of repair or refund 12. Defects assumed to be present at the time of purchase if notified within 6 months unless proved otherwise by the retailer 13. After 6 months the purchaser needs to prove that the defect was present at the time of sale 14. Can make a claim within the first six years 15. Special rules apply to digital content 16. Also covers delivery rights, services and unfair contract terms 	(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.
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.
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.

Question Number	Answer	Mark
6(d)	<p>Any two ways of sustainable disposal</p> <ol style="list-style-type: none"> 1. Separation for recycling (1) 2. Segregation of waste (1) 3. Reclamation / re-use of materials (1) 4. Use of licenced disposal contractors / licenced tipping facilities (1) 5. Repurposing / upcycling of the product (1) 6. Identification of biodegradable parts (1) 	(2)

Question number	Answer	Additional Guidance	Mark
6(e)	<p>Candidates will be required to produce a graph to answer the question</p>  <p>M1 for drawing / plotting graph</p> <p>M1 for extrapolation of graph (ecf)</p> <p>A1 for correct answer 8pm (ecf)</p>	<p>Only award one mark for correct answer only as the question requires a graph to be produced.</p>	(3)

Question number	Answer	Additional Guidance	Mark
7	<p>Area of main rectangle: $(700 + 300) \times (400 + 300)$ 1000×700 $= 700,000\text{mm}^2$ (M1)</p> <p>Area of rectangular cut out: 300×300 $= 90,000\text{mm}^2$ (M1)</p> <p>Area of triangular cut out: $0.5 \times 300 \times 300$ $= 45,000\text{mm}^2$ (M1)</p> <p>Area of component: $700,000 - 90,000 - 45,000$ $= 565,000\text{mm}^2$ or 0.565m^2 (M1)</p> <p>Weight of component: $0.565 \times 47.1 =$ $26.6(115)\text{kg}$ (A1)</p> <p>Award up to 4 marks for alternative calculation of area by totalling a number of regular shapes plus a further mark for calculation of component weight (5th stage as above)</p>	<p>Accept alternative methods of correct working out.</p> <p>Error carried forward should be applied.</p> <p>Unit conversion can be carried out at any point and is embedded in the method marks</p>	(5)

Question number	Indicative Content	Mark
8	<p>This question is about how the designer of the Office building was influenced by Art Deco 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 building, showing understanding of the influence of Art Deco philosophy.</p> <p>Candidates might refer to the following in their responses:</p> <ol style="list-style-type: none"> 1. Art Deco emerged from France in the 1920s 2. Eclectic yet elegant style that drew on tradition yet simultaneously celebrated the mechanised modern world 3. Opulent style a reaction to the forced austerity of the First World War 4. Often referred to as 'Hollywood' style 5. Ocean liner aesthetics 6. Use of geometric forms and patterns 7. Vertical lines, symmetry and repetition 8. Expensive materials eg polished stone 9. Use of bright and pastel colours for features, window and door frames 10. Use of white / cream / pale colours for the 'exterior envelope' of the building 11. Use of geometric fan motifs / sunburst motifs 12. Simplified sculptural forms of African, Egyptian and Aztec art and architecture 13. Influences from Tutankhamun's tomb 14. Explicit use of man-made materials 15. Architecture that celebrated man's technological achievements in building skyscrapers and ocean liners <p>Note the response should relate to architecture and influences on the given office building and not general consumer products</p>	(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.
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.
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.

Question number	Indicative Content	Mark
9(a)	<p>This question is about considerations relating to the use of computer-aided testing within quality control systems for a high volume manufacturer. 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> <ol style="list-style-type: none"> 1. Allows for sampling 2. Utilises coordinate measuring machines (CMM) 3. Incorporates optical character recognition and barcode readers 4. Can incorporate ultrasound scanning 5. Use of measuring probes 6. Can give immediate feedback on errors 7. Efficiency of checking process 8. Levels of accuracy 9. Cost efficient method of quality control in mass production 10. Automated production of QC records / QC data can be stored and reviewed 11. Allows computerised adjustments to be made 12. Uses feedback systems 13. Removes human error 14. Can operate in hazardous environments / improves safety 15. Can continuously check quality without rest breaks / can run 24/7 16. Can check several aspects simultaneously 17. Can include failure mode and effects analysis (FMEA) 18. Links to statistical process control (SPC) 19. Laser scanning system can build 3D image to compare with ideal CAD model 20. Unable to cope with unexpected issues / problem solving so human intervention is often necessary 21. Set-up costs 22. Staff require training 23. Machines need to be maintained / calibrated 24. Impacts on production flow 25. Impacts on employment 26. Destructive and non-destructive testing 	(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.
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.
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.

Question number	Answer	Mark
9(b)	<p>The three further stages of lean manufacturing identified (1) and linked explanations of the methodology of the stages (1) + (1).</p> <ol style="list-style-type: none"> 1. Flow (1) design of processes that result in uninterrupted flow from raw materials to delivery of the finished product (1) including the use of JIT (1) 2. Pull (Kanban) (1) design of manufacturing systems for 'pull' of the product through the process (1) as a response to demand (1) 3. Perfection (Kaizen) (1) adopting an approach that continually improves working processes (1) resulting in getting it right first time (1) <p>Note – there are five definitive principles, two are excluded via the question stem so only three answers available</p>	(9)

Question number	Answer	Mark
10	<p>This question asks candidates to evaluate the functionality of the suitcase. Candidates should analyse the design and specification and link this to ease of use and fitness for purpose and give reasoned justification to qualify their judgements and conclusion.</p> <p>Points of analysis:</p> <ol style="list-style-type: none"> 1. Size, proportions and shape 2. Capacity 3. Method of closure 4. Locking method 5. Materials and properties 6. Weight 7. Methods of carrying 8. Wheels 9. User requirements <p>Points of evaluation:</p> <ol style="list-style-type: none"> 10. Stackability 11. Ergonomics of use 12. Ergonomics at a micro level 13. Range of human movement 14. Use of anthropometrics 15. Airline costs 16. Airport/Seaport convenience 17. Safety 18. Comfort 19. Wheelability 20. Fitness for purpose 21. Types of use 22. Baggage handling / potential for damage 23. 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.
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.
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.
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.