Pearson Edexcel

Mark Scheme (Results)

November 2021

Pearson Edexcel GCE
In Design and Technology: Product Design (9DT0)
9DT0/01

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

November 2021
Publications Code 9DT0_01_2111_MS

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)	Two valid benefits of a virtual architectural model: 1. Provides a photorealistic view of the building. (1) 2. Architectural model can be placed in its proposed location. (1) 3. Allows experimentation with different external finishes. (1) 4. Allows redraws/amendments to be easily/quickly reflected in the architectural model. (1) 5. Can be shared electronically to be viewed in other locations. (1) 6. Both internal and external views can be seen. (1) 7. Can zoom it to look at specific details. (1) 8. Can be used to produce a walk through. (1)	**(2)**

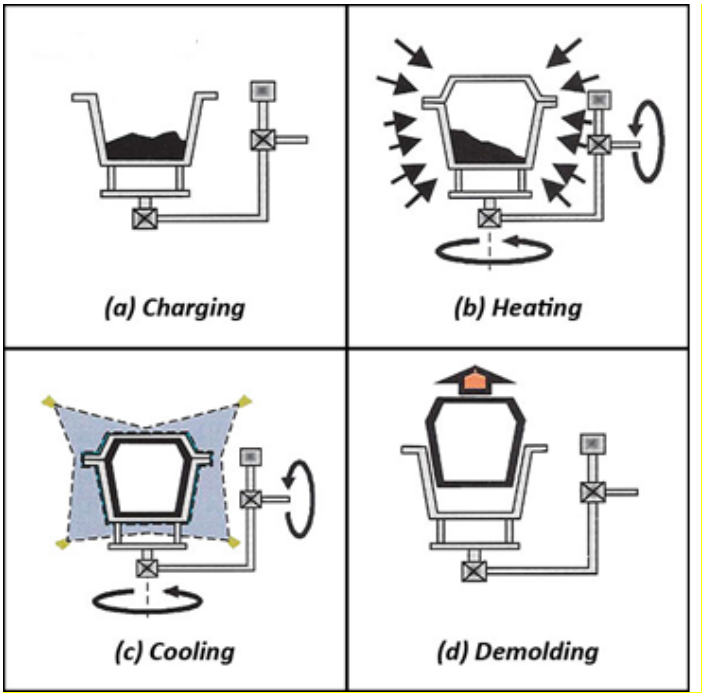
Question number	Answer	Mark
1(b)	Two valid explanations with linked justification: 1. Lightweight (1) allows easy transportation. (1) 2. Soft material (1) easy to work / cut. (1) 3. Straight grained (1) less likely to twist / pull / warp. (1) 4. Fine grain/texture/short fibres (1) allows a good finish to be achieved/takes paint easily. (1) 5. Absorbency (1) allows wood glue to provide an effective bond. (1)	**(4)**

Question number	Answer Additional guidance	Mark
1(c)	Any explanation that includes the identification of an reason (1) and linked justifications of that reason (1+1): 1. Available in large sheets (1) so not limiting the size of the model (1) allowing larger scale models when required. (1) 2. Smooth / flat / even surface (1) providing a stable / dense / supportive surface for the model (1) allowing a clean fixing between the model and the base with no gaps. (1) 3. Surface takes paint and other modelling features (1) allowing realistic surface features (1) and a high-quality finish. (1) 4. Less expensive than 'natural' timber (1) resulting in a cost-effective model (1) allowing money to be spent on visible features. (1) 5. No grain (1) therefore no tendency to distort / warp / cup (1) limiting potential splitting. (1)	**(3)**

Question number	Answer	Additional Guidance	Mark
2(a)	Two valid sustainable textiles: 1. Cotton (1) 2. Linen (1) 3. Wool (1) 4. Hemp (1) 5. Jute (1) 6. Recycled fibres (1)	Other answers may be acceptable, examiners should check with PE if unsure	**(2)**

Question number	Answer	Additional Guidance	Mark
2(b)	In order for the candidates to solve the problem, they will need to recognise that each of the following stages are required. **Stage 1** 650,100/300 = 2167 days (1) **Stage 2** 2167/7 = 309.5714285 weeks (1) **Stage 3** 309 x 7 = 2163 days (1) **Stage 4** 2167 – 2163 = 4 days (1) **Stage 5** Answer 309 weeks and 4 days (1)	Accept alternative methods of correct working out. Error carried forward should be applied. Award full marks for correct answer only.	**(5)**

Question number	Answer	Mark
3(a)	A valid explanation with linked justification: 1. Tough (1) so will withstand the rough and tumble of children's play. (1) 2. Stiff (1) so will not flex / distort in use. (1) 3. Relatively hard (1) so will restrict abrasive wear and tear during use. (1) 4. Weather / water / chemical resistant (1) so can be left outside. (1) 5. Good mechanical / tensile / compressive strength (1) so can appropriately support the weight of a small child. (1)	**(2)**

Question number	Answer	Mark
3(b)	Award marks as follows (maximum 4 marks): 1. Release agent is applied to the mould. (1) 2. Mould is charged / closed / plastic is placed into the mould. (1) 3. Heat is applied externally to the mould whilst rotating about two axes. (1) 4. Mould is cooled with air (or water). (1) 5. Mould is opened / completed moulding is removed. (1)  If no sketch, or a sketch without annotations, award a maximum of 3 marks.	**(4)**

Question number	Answer	Additional guidance	Mark
3(c)	Any two explanations that include identification of a benefit (1) and linked justifications of that advantage (1) + (1). 1. Can be used for the large parts of the toy car (1) because the moulding is hollow (1) resulting in a lightweight product / low mass to volume. (1) 2. The finished toy car has no seams (1) which improves the aesthetics / safety of the surface finish (1) and means that flash removal / secondary finishing is not required. (1) 3. The wall of the toy car has uniform thickness (1) resulting in less stress at the corners of the product (1) reducing the possibility of weak points. (1) 4. Metal inserts can be included in the moulding (1) allowing other components (e.g. the wheels) to be easily attached / connected via mechanical fixings (1) increasing the strength and versatility of joints. (1) 5. Rotational moulding produces uniform thickness throughout (1) which eliminates weak spots (1) producing a tougher / higher strength toy car. (1)	Do not accept repeated justification.	**(6)**

Question number	Answer	Mark
4(a)	Three valid appropriate properties: 1. Easy to pour with good flow rate / fluidity (1) 2. High strength to weight ratio (1) 3. Lightweight / low density (1) 4. Does not rust (1) 5. Relatively low melting point (1)	**(3)**

Question number	Answer	Additional guidance	Mark
4(b)	An outline covering six of the following stages 1. Parting powder / French chalk is sprinkled over the pattern. (1) 2. Sand is then packed around the first half of the pattern in the drag. (1) 3. The drag is turned over and the cope is placed on top. (1) 4. The second half of the pattern and the sprue pins are then positioned. (1) 5. The cope is then filled with sand. (1) 6. The mould is separated and the pattern and sprue pins are removed. (1) 7. Gates and channels are cut. (1) 8. The cope and drag are then reassembled in readiness for casting. (1)	Note the question stem relates to the clamping bracket so the response must relate to sand casting Maximum 5 marks if stages are not in the correct order.	**(6)**

Question number	Answer	Additional Guidance	Mark
4(c)	Cost of aluminium per m^3 1700 x 2.7 = £4950.00/m^3 (1) Volume of aluminium required in m^3 500/(100x100x100) = 0.0005 m^3 (1) Cost of aluminium for bracket £4950.00 x 0.0005= £2.30 (1) Addition of waste allowance £2.30 + 7.5% £2.30 x 1.075 = £2.47 (1) Cost of labour 2 hours x £18.25/hr = £36.50 (1) Net cost £2.47 + £75.00 + £36.50 = £113.97 (1) Profit £113.97 x 25% £113.97 x 25/100 £28.49 (1) Total cost £113.97 + £28.49 = £142.46 (1)	Accept alternative methods of correct working out. Error carried forward should be applied. Award full marks for correct answer only.	**(8)**

Question number	Answer	Additional Guidance	Mark
4(d)	**Two** appropriate control measures: 1. Use of localised ventilation extract / hood. (1) 2. Use of screens to separate user from molten metal. (1) 3. Sand floor to stop rapid spread of aluminium if spilled. (1) 4. Specialist tools to lift crucible and pour aluminium. (1)	The control measures must relate directly/only to the pouring stage	**(2)**

Question number	Answer	Mark
4(e)	This question asks candidates to evaluate the use of quick response manufacturing (QRM) with reference to the manufacturer of specialist commercial vehicles. Candidates should analyse the system in order to weigh up the potential advantages and disadvantages QRM for the manufacturer and their customers. Candidates might refer to the following in their responses: • Efficiency • Move from batch to flow production • Use of total quality management (TQM) • Just-in-time (JIT) • Flexibility of teams / manufacturing cells • Use of flexible manufacturing systems (FMS) • Production triggered by demand • Less storage needed • Less capital tied up in stock • Use of a pull process / kanban system • High automation including robotics and AGVs • Increased reliance on the supply chain. Expansion that can be used to justify judgments relating to positive or negative points: • Incorporation of customer options • More able to capitalise on changes in demand • Immediate shipping of goods • Minimisation of waste • Production teams take responsibility for quality • Improved job satisfaction • Attracts customers • Industrial action in supply chain causes disruption • Transport problems causes delays • Capacity to meet large changes in demand • Changes the roles and responsibilities of employees.	**(9)**

Level	Mark	Descriptor
	0	No rewardable materials
Level 1	1 – 3	• Applies a basic understanding to deconstruct information, making limited connections between concepts. • Incomplete evaluation with unresolved conclusion that demonstrates limited synthesises of understanding. • Judgements are tentatively supported by evidence.
Level 2	4 – 6	• 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	• 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
5(a)	Any two named benefits 1. Warns parents of high / low water temperature. (1) 2. Novelty effect provides entertainment for the child. (1) 3. Can incorporate a thermometer to indicate actual water temperature. (1)	**(2)**

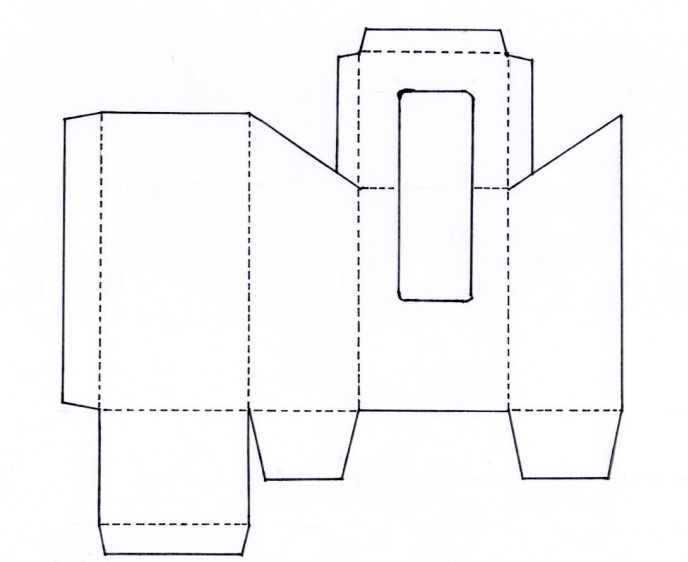
Question number	Answer	Mark
5(b)	Any **two** explanations that includes identification of a reason why high-volume manufacturing is used (1) and linked justifications of the suitability of the use of high-volume manufacturing (1) + (1). 1. Complex mould required (1) which is high cost (1) means that high production volumes are required to breakeven / recover costs / make a profit. (1) 2. Product appeals to all children (1) not limited by culture or language (1) therefore potential for a large market / high level of sales. (1) 3. Efficient method of production (1) therefore minimises unit costs (1) increasing potential profitability for the company. (1)	**(6)**

Question number	Answer	Mark
5(c)	This question is about the suitability of polymer-based materials for children's toys during play activities. Creditworthy responses will make connections which show understanding of factors that need to be considered, going beyond general knowledge. Candidates might refer to the following in their responses: • Use of colour • Ease of cleaning • Hygiene • Health concerns • Inert material • Cost • Realism / detail • Toughness • Durability • Strength • Weight • Age of user • Hand to mouth issues • Learning aids • Anthropometrics / ergonomics / surface textures / feel	**(6)**

Level	Mark	Descriptor
	0	No rewardable materials
Level 1	1 – 2	• 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	• 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	• 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
5(d)	Any **two** valid paper and board finishing processes that will enhance the aesthetics of the packaging: 1. Varnishing / spot varnishing. (1) 2. Hot foil blocking. (1) 3. Embossing. (1) 4. Debossing. (1) 5. Laminating. (1)	**(2)**

Question number	Answer	Additional Guidance	Mark
5(e)	Probability of failure for tolerance = 100 - 98.5 = 1.5/100 = 0.015 (1) Probability of failure for print = 100 - 98 = 2/100 = 0.02 (1) Probability of failing both = 0.015 x 0.02 = 0.0003 (1)	Accept alternative methods of correct working out and answer format (e.g. ratio, percentage, fraction) Error carried forward should be applied. Award full marks for correct answer only.	**(3)**

<table>
<tr><th>Question number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>5(f)</td><td>A net suitable for the proposed packaging.
 
<table>
<tr><th>Level</th><th>Mark</th><th>Descriptor</th></tr>
<tr><td></td><td>0</td><td>No rewardable materials</td></tr>
<tr><td>Level 1</td><td>1 – 2</td><td>• Net is produced with limited attention to detail and lacks accuracy and precision.
• Limited inclusion of fold lines
• Some features of the net may be included but lack detail and may be inappropriately positioned.
• The net will not assemble to correctly form the 3D packaging.
• Line style is inconsistent and inappropriate throughout.</td></tr>
<tr><td>Level 2</td><td>3 – 4</td><td>• Net is produced with some precision and accuracy.
• Appropriate inclusion of fold lines
• Most net features are detailed with correct positioning and appropriate proportions.
• The net will assemble to approximately form the 3D packaging.
• Line style is broadly consistent and appropriate throughout.</td></tr>
<tr><td>Level 3</td><td>5 - 6</td><td>• Net is produced with precision and accuracy.
• Accurate inclusion of fold lines
• Net features are fully and correctly detailed with correct positioning and proportions.</td></tr>
</table></td><td>(6)</td></tr>
</table>

			• The net will assemble to accurately form the 3D packaging. • Line style is consistent and appropriate throughout.	
	Note: Candidates providing alternative net layouts which can be assembled to create the 3D package should be credited.			

Question number	Answer	Mark
6	This question is about how the Memphis Design Movement has influenced consumer choice and expectations. 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 philosophies of the movement, showing understanding of the impact of designs on consumer choice and expectations. Candidates might refer to the following in their responses: • Founder member Ettore Sottsass • Originated in the Post-Modernist period • Also known as the 'New International Style' • Influential products in the 1980s • Challenged conventional shapes, colours, textures and patterns • Inspiration from Art Deco and Pop Art • Concepts in stark contrast to so called 'good design' • Products vibrant, eccentric and ornamental • Influences of Indian and Aztec art • Culture of rock music, travel and excess • Gave consumers alternative and exciting choices • Consumers needed to make brave bold purchase decisions • Made consumers think about design • May not attract consumers with traditional or conservative tastes • Influenced designers such as Philippe Starck who maintained some of the philosophies.	**(9)**

Level	Mark	Descriptor
	0	No rewardable materials
Level 1	1 – 3	• 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	• 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	• 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
7(a)	This question is about the use of user centred design to ensure that the chair is fit for purpose for use with the target market group. Creditworthy responses will make connections, which show understanding of factors that need to be considered, going beyond general knowledge. Candidates might refer to the following in their responses: • Focus on users and their needs • Framework process • Two users – the baby and the adult • Anthropometrics and ergonomics of both users • Use of investigative methods • Use of generative methods • Iterative process • User feedback throughout • Understanding the context of use • Specifying user requirements • Production of design solutions • Evaluation/testing against requirements • Use of consumer panels • Real life prototype testing • More likely to meet expectations and requirements • Helps designers understand the diversity of cultures • Key design features of the chair and how USD may have influenced these features.	**(9)**

Level	Mark	Descriptor
	0	No rewardable materials
Level 1	1 – 3	• 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	• 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	• 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
7(b)	Any **three** explanations that include identification of a consideration that a designer could implement to reduce the chair's lifetime impact on the environment (1) and linked justifications of the considerations of the identified way (1) + (1). 1. Consideration of materials selection (1) by use of green/sustainable materials that will reduce the use of finite resources (1) and use of recycled / recyclable materials. (1) 2. Consideration of manufacturing methods (1) designing for processes that minimise energy use (1) and achieve optimum use of materials / minimise waste. (1) 3. Consideration of distribution methods / packaging shape and size (1) by efficient use of vehicles (1) minimising journey length / use of renewable energy / alternative fuelled vehicles. (1) 4. Consideration of how the product is used (1) by designing for energy efficiency (1) and designing for repair rather than replacement. (1) 5. Consideration of ease of repair and maintenance (1) by standardisation / use of modular parts (1) and ease of access to components. (1) 6. Consideration of end of product life (1) by designing for disassembly / use of recoverable / recyclable materials (1) non-reusable parts suitable for landfill / biodegradable. (1)	**(9)**

Question number	Answer	Mark
8	This question asks candidates to evaluate the performance of a hill walkers' jacket with reference to inclement weather conditions. Candidates should analyse the jacket in terms of potential performance and ease of use and give reasoned justification to qualify their judgements and conclusion. Points of analysis: • Material performance in inclement weather • Breathability of the fabric • Zips • Cuffs • Seams • Shape and fit • Hood / peak • Position and shape of pockets • Ventilation • Aesthetic points related to the above. Points of evaluation: • Weather protection • Range of human movement • Activity type and levels • Use of anthropometrics • Safety • Comfort • Features of the coat • Aesthetic evaluation • Packability • Lining / layering potential • Appropriate conclusion.	**(12)**

Level	Mark	Descriptor
	0	No rewardable materials
Level 1	1 – 3	• 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	• 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	• 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	• 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.

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom