

CAMBRIDGE NATIONALS

Examiners' report

ENGINEERING DESIGN



J831, J841

R105 January 2019 series

Version 1

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper R105 series overview

R105/01 is the examined unit for Cambridge National Award and Certificate in Engineering Design and contributes 25% towards the final qualification. The papers and associated specification provide theoretical underpinnings to the internally assessed units of the qualification.

This was the ninth series of the R105: *Assessing client briefs, specifications and user requirements* examination paper. In recent series, the maturity of the specification has demonstrated that centres are preparing candidates for the paper more effectively. This results in candidates being able to access the paper and gain marks on the vast majority of topics covered in the specification.

In reports to centres for previous series it was mentioned that centres should cover the entirety of the content set out in the specification. Once content has been covered it is advised that centres spend some time preparing candidates for the examination. This can be done using past examination papers on the OCR website. This should allow candidates to answer the whole paper with sufficient understanding and depth. There are key areas of the specification where candidates' understanding is not as fully developed, limiting access to some questions. There are particular examples of this in this paper that are explained in detail throughout this report.

Centres and candidates are reminded to address the command verbs in the questions. At times it is clear that candidates are not always answering questions in the style expected. For example; when a question command verb is 'Explain' or 'Describe' candidates are often answering with one-sentence answers. This limits their ability to access the full marks available for the question.

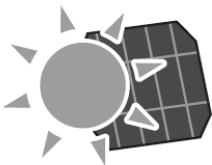





Question 1(a)(i)

1 (a) The use of sustainable resources is critical to sustainable design.

(i) The table below shows a range of resources.

Complete the table by placing a tick (✓) in the correct column to indicate if the resources are sustainable or non-sustainable.

One of each has been done for you.

	Resource	Resource	Sustainable	Non-sustainable
1		Solar		
2		Oil extracted from underground		✓
3		Natural gas		
4		Coal		
5		Wind	✓	
6		Hydroelectric		

[4]

This question required candidate to identify which resources in the table were either 'sustainable' or 'not sustainable' from a range of examples. On the whole candidates were able to identify at least two or three of the resources with many candidates gaining maximum marks. Where candidates did not gain maximum mark, they selected 'natural gas' as a sustainable resource. Overall, the question provided a positive opening to the paper.

Question 1(a)(ii)

- (ii) Give **two** ways the resources listed within the table for part (a) can contribute to sustainable design.

1

.....

2

.....

[2]

This question required candidates to give two ways in which resources listed in 1(a)(i) could contribute to sustainable design. A majority of candidates were able to access marks from this question with responses that demonstrated understanding of the 'renewable' nature of the sustainable resources detailed in the table. Where candidates did not gain credit, responses were generally too vague and, in many cases, repeated the stem of the question. This would include repeating the word sustainable but without exemplification so not demonstrate understanding.

Question 1(b)

- (b) Name **one** stage of a product life cycle.

.....

..... [1]

This question required candidates to name one stage of a product lifecycle. The majority of candidates were able to gain credit for a valid response. Where candidates did not gain credit, responses were focused on the 'design cycle' rather than the 'product life cycle'. This resulted in responses related to activities undertaken during the development of a new product rather than related to the stages of the life cycle. Additionally, some candidates focused on the product life cycle from a marketing perspective. Candidates and centres are reminded that this is not the focus of the product life cycle within the specification and subsequently cannot be given credit in responses.

Question 1(c)

- (c) Explain what is meant by the term Life Cycle Analysis (LCA).

.....

.....

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.....

..... [3]

Overall, candidates were able to gain some credit for responses to this question and demonstrated some understanding of 'Life Cycle Analysis.' Particularly, candidates who had knowledge of 'Life Cycle Analysis' were able to detail the particular stages that a designer would investigate as part of the analysis they were undertaking. Where candidates did not gain full credit, responses did not 'explain' the process and instead listed stages or, as highlighted in question 1(b) detailed the product life cycle from a marketing perspective relating to sales, product maturity and decline. This is not the focus of 'Life Cycle Analysis' in this specification. Candidates who gained maximum credit, explained the term and alongside the stages highlighted how the aim of the analysis was to improve the environmental impact of the product where possible.

Question 2(a)

- 2 The development of a design brief is the first stage of the development of a new product.

- (a) Give **two** requirements a client may provide as part of an initial design brief.

1

.....

2

.....

[2]

This question required candidates to give two requirements that a client may provide as part of an initial design brief. The majority of candidates were able to gain some credit with valid responses that were relevant to the creation of an initial brief. Where candidates did not gain credit, responses were vague and therefore understanding was not evident. These stated details of the product development process much further along the cycle or listed activities designers would undertake rather than requirements.

Question 2(b)

- (b) Explain why the client and designer may create a 'final' brief before creating a design specification.

.....

.....

.....

.....

.....

..... [3]

Responses to this question were generally awarded credit even if candidates did not gain the maximum 3 marks available. Candidates were able to explain why a 'final' design brief would be created between the client and the designer before a design specification was created. The majority of candidates recognised the importance of ensuring a mutual understanding and acceptance of a definitive brief between client and designer based on initial research or investigation before pursuing more detailed work. Where credit was not awarded, candidates gave responses that assumed a product had already been developed and were not focused at the early stages of the product development process. Candidates are advised to read the question in detail to ensure they fully understand the context of the question before providing responses.

Exemplar 1

- (b) Explain why the client and designer may create a 'final' brief before creating a design specification.

A 'final brief' allows the client and the designer to be completely sure that they are happy with the design brief. It will remove any chance of uncertainty in the product and will decrease the chance of error. It allows the designer to fully understand what the client wants from the product which will allow them to create an accurate design specification. [3]

This exemplar illustrates a good written explanation to gain maximum marks that clearly explains why a 'final' brief may be advantageous before pursuing the next stages of development.

Question 2(c)

- (c) Give **two** reasons why a client may be advised to reduce the number of features of a new product.

1

.....

2

.....

[2]

This question required candidates to give two reasons why a client may be advised to reduce the number of features of a new product. The majority of candidates were able to gain some credit by identifying that an increased number of features would likely result in higher costs that may not be within budget. In some cases, candidates were able to give wider examples relating to the target market. e.g. a product might be too complex for the end user. Furthermore, some candidates acknowledged the development of products that specifically had less features to ensure built in obsolescence that would allow 'updated' versions to be released in the future, increasing sales.

Question 2(d)

- (d) Explain why a designer would develop manufacturing plans during the design phase of the design cycle.

.....

.....

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.....

.....

..... [3]

This question required candidates to explain why a designer would develop manufacturing plans during the design phase of the design cycle. A variety of responses were given gaining a range of credit. The majority of those gaining credit provided responses that related to cost and the fact that manufacturing plans allowed for the consideration of production process and time and therefore costs can be subsequently calculated. More sophisticated responses identified how the chosen manufacturing process could have a direct impact on the geometry of the components or the possible scale of production. Therefore designers needed to develop the manufacturing plans early on to ensure the product or component they were designing could be manufactured. Centres are encouraged to develop candidates' deeper understanding of such areas to expand their knowledge, particularly if this can be reinforced with practical application in the internally assessed units of the qualification.

Exemplar 2

- (d) Explain why a designer would develop manufacturing plans during the design phase of the design cycle.

A designer would develop manufacturing plans so that the cost and quantity of the products can be understood. This could be as a mass produced product would have a low tooling cost ^{therefore} and lower purchase cost and a one off produced product will have a high cost. This will also influence the materials used for the product as they may be required for certain manufacturing techniques, such as plastic for injection moulding. [3]

This exemplar provides a strong written explanation. This response gained maximum credit by stating multiple reasons why manufacturing plans would be developed during the design phase. The response provides a coherent explanation even though the candidate could have been more succinct with their answer.

Question 3(a)

- 3 (a) The table shows a comparison of 6 materials.

Material	Factors to consider				
	Ease of storage	Easy to process	Lightweight	Strength	Cost
A	3	3	5	7	2
B	7	2	1	1	4
C	2	8	7	3	8
D	4	4	2	7	4
E	6	4	9	8	4
F	2	2	6	6	6

Suitability: 10 = excellent and 1 = very poor

Give **two** reasons why material C would be suitable for the production of a prototype.

- 1
-
- 2
-

[2]

This question required candidates to analyse a table of information containing various ratings for six material characteristics. Candidates were required to select why material C would be suitable for the production of a prototype. The vast majority of candidates were able to identify that material C was low in cost and easy to process meaning that it could be utilised to generate a series of prototypes easily without excessive material costs. Additionally, some candidates identified that the material was also lightweight which could be an advantage if the prototype was an initial design and required transportation to show to customers. Where candidates did not gain credit their responses tended to select random criteria from the table or in a small number of cases candidates did not reference the table and instead gave generic responses related to prototyping which were not worthy of credit.

Question 3(b)

- (b) Give **one** example of a product and a new and emerging technology used in that product.

Product

.....

New and emerging technology

.....

..... [2]

Question 3(b) generated a wide variety of responses from candidates. In many cases, some credit could be awarded for a product and technology when the two parts of the response were valid. In some cases, candidates could not gain credit because the product was too generic without a specific new and emerging technology or the two parts of the response had no correlation to one another. Centres are reminded to ensure that throughout the teaching of the specification, candidates are exposed to specific examples that contextualise their learning and give them opportunities to explore these examples within their responses.

Question 3(c)

- (c) State **two** activities carried out by designers when developing a design concept for a new product.

1

.....

2

.....

[2]

This question required candidates to state two activities carried out by designers when developing a design concept for a new product. The vast majority of candidates were able to provide valid responses worthy of credit that focused on the concept development stage of a new product. Where responses did not gain credit, candidates were stating activities that occurred much later in the design cycle when a product design may be production ready. Candidates are reminded to read the question carefully, use specific terminology and ensure responses relate directly to the question.

Question 3(d)

- (d) State what is meant by the term 'aesthetics'.

.....
..... [1]

Question 3(d) required candidates to state what is meant by the term 'aesthetics'. Overall this question was answered comprehensively by the majority of candidates who understood that aesthetics relates to the appearance or look of a product. In the few cases where credit could not be given, candidates gave responses related to 'ergonomics' or 'anthropometrics' where it appears they may have misunderstood the term given.

Question 3(e)

- (e) Designers often use virtual (on-screen) computer models when developing prototype products.

Explain why a designer might create a virtual prototype.

.....
.....
.....
.....
.....
..... [3]

Responses to this question were generally strong with the majority of candidates able to explain why 'virtual' prototypes were utilised in the development of new products. Most candidates could explain how a virtual prototype allowed designers to gain a detailed view of how a product will look without the complexity or cost of generating a physical prototype. They could also explain how a virtual prototype could be modified to rapidly generate multiple iterations, be subjected to 'real-world' simulations and be utilised as data for final prototype production. Where credit was not given, candidates did not explain or exemplify responses. For example, answers related to saving costs but without exemplification.

Question 4(a)(i)

4 (a) Fig. 1 shows two drinks bottles.

Bottle **A** is made from plastic. Bottle **B** is made from glass.



Fig. 1

(i) Give **two** benefits of Bottle **B** compared to Bottle **A**.

1

.....

2

.....

[2]

This question presented candidates with two different bottles. One made of glass and one made of plastic. Candidates were asked to give two benefits of the glass bottle compared to the plastic one. A majority of candidate's were able to gain credit here by demonstrating an understanding of how glass can be less damaging to the environment if not disposed of correctly and the fact that the glass bottle can be more easily reused. Where credit was not given candidates gave responses that could be applied to both bottles, for example, it can be easily recycled which could be true in both instances. In addition, some candidate focused on the aesthetics or shapes of the bottles which although different was not the aim of the question. Overall, candidates were able to demonstrate a good knowledge of the sustainability and environmental issues associated with the excessive use of plastic.

Question 4(a)(ii)

- (ii) Give **one** reason why a manufacturer may choose Bottle **A** over Bottle **B**.

.....

.....

[1]

Question 4(a)(ii) required candidates to build on their answer from 4(a)(i) by asking them to consider why manufacturers may still use a plastic bottle. This question was generally answered well by candidates who acknowledge that despite the environmental benefits of glass, the use of plastic is more cost effective and simpler in production compared with the complexities of mass manufacturing for glass. Additionally, candidates also highlighted how plastic is more resilient if dropped or when transported than glass which could break. As per response in part (a)(i), where credit was not given, candidates gave response that could apply for both bottles e.g. recycling.

Question 4(b)

- (b) Fig. 2 shows a piston and connecting rod assembly. The connecting rod assembly is manufactured by casting, and the piston is precision machined.

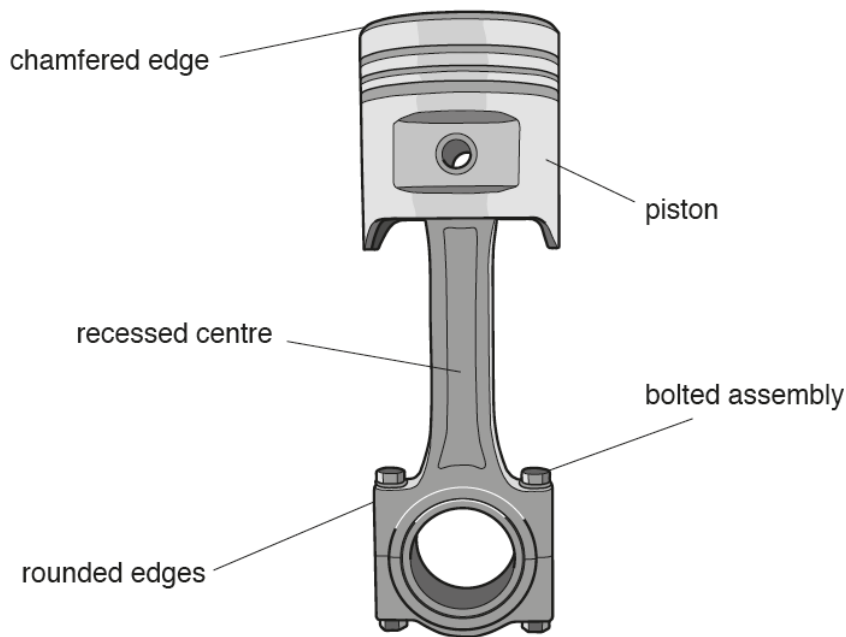


Fig. 2

Give **four** ways in which the piston and connecting rod assembly has been influenced by design for manufacture assembly (DFMA).

- 1
- 2
- 3
- 4

[4]

Question 4(b) saw candidates provide a wide variety of responses of varying quality. The majority of candidates were not able to gain maximum credit despite the wide variety of acceptable responses relating to the design of the piston and connecting rod assembly when considering its manufacture and assembly. Where credit was not given, candidates were generally repeating information given from the labels in the diagram and not highlighting how this information was related to the successful manufacture and assembly of the components and completed product assembly. For example, a large number of candidates provided responses that related to the rounded edges of the casting making it 'comfortable to hold' or the recessed centre of the connecting rod making it 'easier to grip'. Where credit was awarded, candidates gave responses that directly related to manufacturing considerations such as, the chamfered edge on the piston allowing for easy location when being assembled into the engine block, the recessed

centre maintaining constant wall thickness and reducing weight in the casting, the rounded edges allowing for improved material flow during the casting process and, the bolted assembly allowing for easier assembly of the connecting rod to the crank shaft. Centres are encouraged to ensure the content of the specification focuses on design in an engineering context where possible alongside more product-based design principles. Candidates should be exposed to real examples of design for manufacture, specifically how design geometry can be directly influenced by the manufacturing process.

Exemplar 3

Give **four** ways in which the piston and connecting rod assembly has been influenced by design for manufacture assembly (DFMA).

- 1 The connecting rod bolted assembly that houses the crankshaft and bearing is bolted together with standard ^{used} bolts which can be bought cheaply.
- 2 The connecting rod is cast rather than machined as the majority of it ~~is~~ has to be strong but not highly accurate
- 3 The recessed centre in the connecting rod reduces material used while keeping similar strength
- 4 The chamfered edge is designed so that when the piston is placed within the cylinder, it takes less time as it does not have to be lined up perfectly ^[4] to fit. This reduces time.

This exemplar provides four valid manufacturing and assembly considerations. This response gained maximum credit by stating four factors about the design that have been directly influenced by DFMA.

Question 4(c)

- (c) Explain why designers need to consider the manufacturing process when designing new products.

.....

.....

.....

..... [3]

Following question 4(b), candidate responses to question 4(c) demonstrated that the majority of candidates understand how the manufacturing process can have a direct impact on the design of a new product. A large number of candidates were able to gain credit for responses with a majority of answers relating to the impact of the manufacturing process on cost and budget. More developed responses were able to explain how the manufacturing process had a direct impact on the geometry being designed but as per the previous question, these responses were not as forthcoming. Centres are again reminded to ensure the content of the specification focuses on design in an engineering context to develop candidates' knowledge in such areas.

Question 5(a)(i)

- 5 (a) Fig. 3 shows a typical drawing title block with tolerance information.

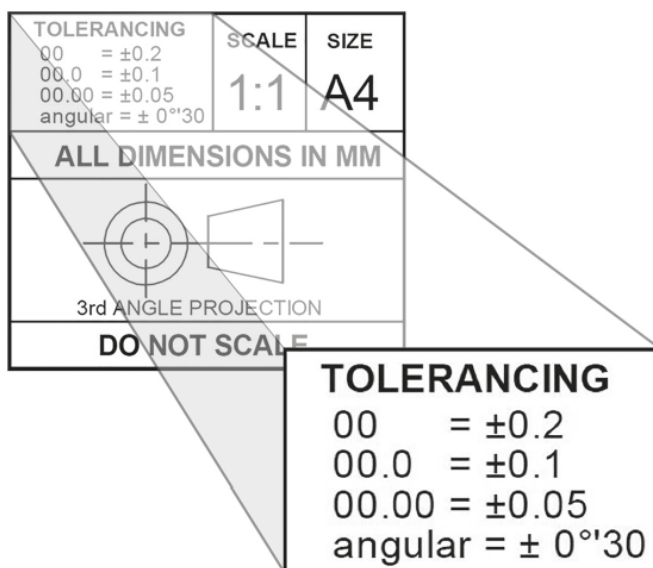


Fig. 3

- (i) Using the tolerancing information in Fig. 3, state the upper and lower limits for a dimension of 10.6 mm.

Upper

Lower

[2]

This question required candidates to state tolerancing information from a given drawing title block. Responses to this question varied. Responses demonstrated either clear understanding of tolerancing information, gaining maximum credit, or no knowledge of tolerance presentation and therefore answers appeared to be random. In a few cases, candidates had simply selected the wrong tolerance value for the precision given in the question and therefore could not gain credit for their responses.

Question 5(a)(ii)

- (ii) State what is meant by the angular tolerance in Fig. 3.

.....

..... [2]

Following question 5(a)(i), this question directed candidates to the angular tolerance given in the title block in Fig. 3. There were 2 marks available in this question and a large number of candidates were able to gain partial credit for correctly identifying that the angular tolerance gave the manufacturer the acceptable deviation from a given angle. However, very few candidates were able to gain maximum marks for correctly interpreting the actual value of the tolerance with a maximum plus or minus 30 minutes allowed from a given angle.

Question 5(b)

- (b) Give **one** impact of a batch of products being produced out of tolerance.

.....
..... [1]

This question required candidates to give one impact of a batch of products being out of tolerance. The majority of candidates were able to gain credit from this question by correctly identifying that a batch of products being produced out of tolerance would result in all of the products being scrapped, further products needing to be measured to verify their accuracy and subsequently loss of sales or delays to production. Where credit was not given for this question, candidates generally misunderstood the question and gave responses that related to products being produced within an acceptable tolerance and subsequently being fit for purpose.

Question 5(c)

- (c) Give **two** reasons why manufacturers may use pre-manufactured components in the production of new products.

1
.....
2
..... [2]

This question required candidates to give two reasons why manufacturers may use pre-manufactured components in the design of new products. Where candidates did not gain credit, their responses referred to the advantages or characteristics of standard rather than pre-manufactured components. The majority of candidates that gained credit from their responses understood that pre-manufactured components can speed up assembly, help to manage inventory or have guaranteed quality from specialist providers. In some cases, candidates referred to the saving of costs which could only gain credit if it was exemplified by the fact that costs could be saved if it meant manufacturers did not have to purchase specialist machinery, labour or materials to make the components on site.

Question 5(d)

- (d) Describe, using an example, how a cultural or fashion trend had an impact on the design of a new product.

.....

.....

.....

..... [3]

Question 5(d) required candidates to describe how a cultural or fashion trend had an impact on the design of a new product, using an example within their response. This question generated an extremely wide range of responses from candidates with many examples being utilised from their daily lives including clothing when utilising an example for 'fashion.' In some cases, these responses were justified with a valid product impact from the trend that gained credit. In other cases the responses were too vague and lacked specific design impact to justify credit. Centre's are reminded to consider specific trends that have directly impacted on the development of new products such as those detailed in the mark scheme. Candidates should study a selection of these so they have a deeper knowledge of the impact of cultural and fashion trends and can draw on this knowledge when answering extended questions.

Question 6(a)

- 6 (a) Regulations and safeguards are important considerations for designers.

Draw the 'British Standard' kitemark.

[1]

Question 6(a) required candidates to draw the 'British Standard' kitemark. A large number of candidates were able to gain credit here with many responses very close to the symbol. In a minor number of cases candidates drew the 'CE' symbol.

Question 6(b)

- (b) State the difference between durability and reliability.

.....

.....

..... [2]

This question required candidates to state the difference between durability and reliability. On the whole, this question generated good responses that were able to gain all or partial credit. Candidates were able to differentiate between the two and particularly understood that reliability relates to how a product works or functions every time over a sustained period. In many cases, candidates referred to the strength of a component or product when providing responses related to durability. Although partially true, this could only gain credit if it related to the products ability to withstand its operating conditions over time as per the definition in the mark scheme.

Question 6(c)

- (c) Give **one** way that designers can improve the reliability of a product.

.....

..... [1]

Question 6(c) developed on 6(b) by asking candidates to give one way they could improve the reliability of a product. The majority of candidates gave strong responses that gained credit as they understood that improving the strength or quality of materials and components or carrying out more sustained and rigorous testing of the product before sale would help to ensure improved reliability.

Question 6(d)*

- (d)* Discuss how copyright, patents, registered designs and trademarks influence the design of new products.

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..... [6]

Question 6d required candidates to show understanding of how copyright, patents, registered designs and trademarks influence the design of new products through a discussion that assesses their quality of written communication.

Candidate responses varied in quality but overall, candidates were able to demonstrate some understanding of how copyright, patents, registered designs and trademarks influence the design of new products. Some candidates were able to develop a discussion that focused on the differences between copyright, patents, registered designs and trademarks with embedded descriptions of how the different types of safeguards protected different elements of a business or product. Candidates were able to provide examples of each and how these can help companies profit from an original concept, design or technology.

Where candidates did not gain higher levels of credit in their responses, they focused on how the safeguards prevent companies copying ideas or designs but could not differentiate between the different safeguards listed. In some cases, the same points were repeated for each different safeguard rather than developed or differentiated.

Where candidates gained minimal credit they did not write in extended prose therefore failing to meet the requirement of the extended written response asked for in this type of question. Centres are reminded to ensure they cover the full scope of the specification in depth to ensure candidates achieve maximum marks. As previously, centres are reminded to develop candidates' ability to write extended responses. Some responses were written in bullet point format which, although some excellent points were made, candidates could not achieve higher marks as they are being assessed on their ability to write extended prose and not just their knowledge of the topic in the question.

Exemplar 4

- (d)* Discuss how copyright, patents, registered designs and trademarks influence the design of new products.

Copyright influences the design as it allows the designer to protect a certain literature or art piece used with the product (like a book - cover and story) / or limits them from using other peoples work. If they don't have the means to create. Patents influence the design of a product as they protect the invention / design / product from anyone else, so only they can decide it's manufacture, if it's bought and sold and who has the rights for it. This can be for up to 20 years so ~~keeps it~~ the only thing in the market prevents competition when it is newly released. Trade marks protect the logo or slogan used with the product, making it the only item holding these so it is unique and attracts more customers. Registered designs protect aesthetics (shape, colour, etc.) so the designer can create a product that is unique to attract more people as it can be more noticeable and more easily well-known.

This exemplar provides a coherent, well-structured written response that differentiates between the different safeguards, written in continuous prose. This response gained credit at Level 3 with a maximum 6 marks awarded.

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