



Oxford Cambridge and RSA

Practice Paper December 2018
A Level in Design and Technology: Product Design
H406/02 Problem Solving in Product Design

MARK SCHEME

Duration: 1 hour **45** minutes

MAXIMUM MARK **70**

Last updated: 09/01/2019

This document consists of 28 pages

MARKING INSTRUCTIONS**PREPARATION FOR MARKING
SCORIS**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to scoris and mark the **required number** of practice responses (“scripts”) and the **number of required** standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the scoris messaging system, or by email.
5. **Crossed Out Responses**
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. Award No Response (NR) if:
 - there is nothing written in the answer space

Award Zero '0' if:













- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The scoris **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your team leader, use the phone, the scoris messaging system, or e-mail.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.
10. For answers marked by levels of response: Not applicable in F501
- To determine the level** – start at the highest level and work down until you reach the level that matches the answer
 - To determine the mark within the level**, consider the following:

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

11. These are the annotations, (including abbreviations), used in RM Assessor, which are used when marking:

Symbol	Description	Comment
	Tick	worthy of credit
	?	unclear
	S	error of spelling
	E	error of grammar, punctuation or expression
	F	error of fact
	^	omission
	H Line	to draw an attention to an error
	H Wavy Line	to draw attention to something
.....	Highlight	as directed by PE
	REL	irrelevant point
	REP	conspicuous repetition
	L	illegible word or phrase
	BP	Blank Page – this annotation must be used on all blank pages within an answer booklet and on each page of an additional object where there is no candidate response.

SUBJECT–SPECIFIC MARKING INSTRUCTIONS

Introduction

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. You should ensure that you have copies of these materials:

- the specification, especially the assessment objectives
- the question paper and its rubrics
- the mark scheme.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**. Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Information and instructions for examiners

The co-ordination scripts provide you with *examples* of the standard of each band. The marks awarded for these scripts will have been agreed by the Team Leaders and will be discussed fully at the Examiners' Co-ordination Meeting.

The specific task-related indicative content for each question will help you to understand how the band descriptors may be applied. However, this indicative content **does not** constitute the mark scheme: it is material that candidates **might** use, grouped according to each assessment objective tested by the question. It is hoped that candidates will respond to questions in a variety of ways. Rigid demands for 'what must be a good answer' would lead to a distorted assessment. Candidates' answers must be relevant to the question. Beware of prepared answers that do not show the candidate's thought and which have not been adapted to the thrust of the question. Beware also of answers where candidates attempt to reproduce interpretations and concepts that they have been taught but have only partially understood.

Using the Mark Scheme

Please study this Mark Scheme carefully. The Mark Scheme is an integral part of the process that begins with the setting of the question paper and ends with the awarding of grades. Question papers and Mark Schemes are developed in association with each other so that issues of differentiation and positive achievement can be addressed from the very start.

This Mark Scheme is a working document; it is not exhaustive; it does not provide 'correct' answers. The Mark Scheme can only provide 'best guesses' about how the question will work out, and it is subject to revision after we have looked at a wide range of scripts.

The Examiners' Standardisation Meeting will ensure that the Mark Scheme covers the range of candidates' responses to the questions, and that all Examiners understand and apply the Mark Scheme in the same way. The Mark Scheme will be discussed and amended at the meeting, and administrative procedures will be confirmed. Co-ordination scripts will be issued at the meeting to exemplify aspects of candidates' responses and achievements; the co-ordination scripts then become part of this Mark Scheme.

Before the Standardisation Meeting, you should read and mark in pencil a number of scripts, in order to gain an impression of the range of responses and achievement that may be expected.

Please read carefully all the scripts in your allocation and make every effort to look positively for achievement throughout the ability range. Always be prepared to use the full range of marks.

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The specific task-related indicative content for each question will help you to understand how the band descriptors may be applied. However, this indicative content **does not** constitute the mark scheme: it is material that candidates **might** use, grouped according to each assessment objective tested by the question. It is hoped that candidates will respond to questions in a variety of ways. Rigid demands for 'what must be a good answer' would lead to a distorted assessment. Candidates' answers must be relevant to the question. Beware of prepared answers that do not show the candidate's thought and which have not been adapted to the thrust of the question. Beware also of answers where candidates attempt to reproduce interpretations and concepts that they have been taught but have only partially understood.

Marking Scripts

Answers must be marked using the level descriptors in the marking grids and a mark awarded for each Assessment Objective. The points in the mark scheme are **indicative content only** and offer some question specific guidance. Credit should be given for other points and different views, if they seem possible and are well argued or supported by good evidence.

You must avoid negative marking - don't deduct marks for individual errors. All marks should be allocated by reference to the assessment grid.

Any queries on unexpected answers please consult your Principal Examiner.

Using annotations

- Take great care to place a tick (see below) against any valid points that lead you to think at all favourably of the answer.
- **Do not leave any page unmarked** (as a last resort tick the very bottom of a page to indicate that you have read it - otherwise Team Leaders/Principal Examiners cannot tell whether account has been taken of that page).
- Underline errors and place the appropriate symbol in the margin.
- Indicate that you have looked at every page of the answer booklet by placing the **BP** symbol at the top and bottom of any blank pages.

Ticks: these are the simplest, quickest and most efficient means for examiners to convey approval to Senior Examiners, and they should be inserted where they can be most effective. If the point you wish to highlight is in the middle of a paragraph, then put the tick in the middle of a line in the middle of a paragraph. Overuse of the tick tends to devalue its effectiveness.

Do use ticks to draw attention to anything worthy of credit [even single words].

Do not use ticks as a substitute for marking/assessment; marks for questions must be determined by reference to the assessment grid, **NOT** by mechanical addition of ticks.

Highlighting: use highlighting as directed by your Principal Examiner.

Question	Answer	Mark	Guidance
<p>The indicative content in this mark scheme provides suitable explanation of the key lines of enquiry that would be worthy of credit. In an examination series actual candidate responses will be reviewed to supplement this mark scheme with additional exemplification to ensure all key lines of enquiry are covered.</p>			
			<p style="text-align: center;">Content</p> <p style="text-align: center;">Levels of Response</p>
1*	<p>Indicative content:</p> <ul style="list-style-type: none"> • Discussion of the differing standpoints of stakeholders in the new transportation product and that this can present the Council with complex problems to solve. The Council needs to involve stakeholders as early as possible in the design process of the scheme to ensure all views are considered and incorporated as far as possible. • Recognition of primary stakeholders who have direct influence or are directly affected, and secondary stakeholders who have indirect influence or are indirectly affected. Primary are essential to the Scheme, and secondary are not. For the snow clearing scheme, primary stakeholders include residents with a wide range of ability and mobility. Secondary stakeholders would include council workers. <p>Stakeholders for the snow clearing scheme would include the following, with their potential interest: (Candidates would be expected to contrast and compare some of these in their critical examination)</p> <ul style="list-style-type: none"> • Council marketing/advertising/publicity – the style and image of the Scheme, scope for advertising space, private company sponsorship, promoting the idea to residents. • Council finance department – understanding the financial implications, business modelling, whether to use council workers for deliveries and additional hire vehicles, depreciation of unused stock if purchased, storage of products between 	12	<p><i>If a candidate demonstrates generic knowledge about stakeholder/user considerations without utilising the contextual information given in the Resource Booklet, candidates should be awarded 0 marks.</i></p> <p><i>Any lifted information can be used in support of the critical examination but no marks should be awarded simply for duplicating text.</i></p> <p><i>Credit should be given for responses which identify issues evident in the supplied information and which are then critically analysed and evaluated in terms of their significance to the given scenario and relating to design and technical principles.</i></p> <p>Level 4 (10-12 marks) The candidate demonstrates a comprehensive understanding of challenges that would be faced in providing a scheme of this nature. The candidate effectively uses both the information in the Resource Booklet and applies their own design and technology understanding to build a well-constructed argument in relation to the question being asked with a clear and concise narrative.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 3 (7-9 marks) The candidate demonstrates a good understanding of challenges that would be faced when providing a scheme of this nature. The candidate for the most part uses the information in the Resource Booklet and applies their own design and technology understanding to build a well-constructed argument in relation to the question being asked although one or two opportunities are missed to develop the narrative.</p>

		<p>deliveries, transportation, stacking to save space...</p> <ul style="list-style-type: none"> • Insurance advisers - reducing risk by clear instructions with the products for users, higher risk equals higher insurance costs. Possible excess payments by users if damage. Cost of the administration of extra payments. • Local neighbours – in the event that residents are not in when deliveries are made, products may have to be left with neighbours. • Residents – storage and security – preventing the products from being removed from outside houses. • Residents – elderly or with mobility issues – may not be able to use the products provided and/or have storage for them. • Council health and safety officers and policy-makers, first aid staff – input on safety aspects of the products and risk assessments for manual handling heavy bags of salt. • Council clearance operatives/waste collection after winter – empty plastic salt bags and discarded snow shovels will need to be collected and cleared. • Wildlife – empty plastic salt bags can blow away and pose a danger to wildlife. • Manufacturer – supply to the demand of a large batch size. <p>Potential conflicts between stakeholders that could be mentioned:</p> <ul style="list-style-type: none"> • Storage and/or missed delivery costs for undelivered seasonal products would be high. • The design for the wheels of the product, for use over muddy ground, may be less useful in other applications. These are the sorts of challenges that the designer will face. • The primary users of the products, the residents 			<p><i>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</i></p> <p>Level 2 (4-6 marks) The candidate demonstrates a sufficient understanding of challenges that would be faced when providing a scheme of this nature. The candidate adequately uses the information in the Resource Booklet and applies their own design and technology understanding to build a reasonable argument in relation to the question being asked although one or two inaccuracies exist into the narrative put forward.</p> <p><i>The information has some relevance and is presented with limited structure. The information is supported by limited evidence.</i></p> <p>Level 1 (1-3 marks) There is no analysis or evaluation of the Scheme. The candidate demonstrates a limited knowledge of challenges that would be faced. The information in the Resource Booklet is used in a simplistic way and only limited knowledge is applied to the question being asked.</p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i></p>
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		<p>are key stakeholders and products that meet their needs efficiently and safely should be the focus of the Scheme designers. Users will include individuals, families with young children, teenagers, students, elderly and residents with mobility issues. These different users will interact with the products in different ways bringing challenges to the Scheme designer e.g. an elderly resident will struggle with the shovel and weight of the snow, a group would more easily 'move' a mobile product than an individual. Children like to 'help' and could push such items.</p> <ul style="list-style-type: none">• A user-centred approach to designing the snow clearing Scheme will put the users at the heart of the designing - it focuses on the user interface, how the user interacts with and relates to the product which will provide products with a high level of usability. The end result will be products that give a more efficient, satisfying, and user-friendly experience which will translate into increased numbers of residents clearing snow and ice and improved safety to drivers and pedestrians.• Any other valid suggestion.		<p>0 marks No response or no response worthy of credit.</p>
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Question		Answer	Mark	Guidance	
2		<p>Indicative content:</p> <ul style="list-style-type: none"> • Although both shovels have polypropylene scoops, the wheeled snow shovel has the additional reinforcement of the two mild steel handle location tubes which spread the load across the scoop. • The untreated ash shaft will absorb water if left out in the snow, whereas the powder coated mild steel tubes are likely to rust if the coating is compromised. It is also possible that the mild steel tubular handle could rust from the inside. • The PP snow shovel handle is likelier to feel warmer to the touch than the powder coated surface of the mild steel, due to the conductive properties of mild steel. • The snow shovel is designed for users to relocate shovelled snow through lifting and tipping, whereas the wheeled snow shovel is not designed to be lifted. With this shovel snow is tipped to a new location which could be difficult if there is not already an existing clear area. • The snow shovel can be used in any location where snow is covering the ground, whereas the wheeled snow shovel is designed to run under the snow and thus needs to access the snow from the side. Wheels are likely to clog if used on snow. 	12	<p><i>All responses should be in relation to the existing product information provided in Fig. 1.</i></p> <p><i>Any lifted information can be used in support of the critical examination but no marks should be awarded simply for duplicating text.</i></p> <p><i>Credit should be given for responses which identify issues evident in the supplied information and which are then critically analysed and evaluated in terms of their significance to the given scenario and relating to design and technical principles.</i></p>	<p>Level 4 (10-12 marks)</p> <p>The candidate demonstrates a comprehensive analysis of the two products in Fig. 1 to determine the extent of their functional suitability for undertaking the task of clearing snow. All three bullet points are considered in detail. The candidate effectively uses both the information in the Resource Booklet and applies their own design and technology understanding to build a well-constructed argument in relation to the question being asked with a clear and concise narrative.</p> <p>Level 3 (7-9 marks)</p> <p>The candidate demonstrates a good analysis of the two products in Fig. 1 to determine the extent of their functional suitability for undertaking the task of clearing snow. At least two of the bullet points are covered in detail. The candidate for the most part uses the information in the Resource Booklet and applies their own design and technology understanding to build a well-constructed argument in relation to the question being asked although one or two opportunities are</p>

		<ul style="list-style-type: none"> • The standard snow shovel has a riveted reinforcing strip as opposed to the bonded strip on the wheeled snow shovel. This is likely to be a more secure method of retaining the strip as adhesive can become brittle and fracture. However, the rivets are likely to prevent the underside of the standard shovel scoop from cleanly removing snow from the surface beneath. • In addition, the rivets may scrape against road and path surfaces and the resulting abrasion eventually cause the rivets to lose integrity, fracture, loosen and fall-out. • Any other valid suggestion. 			<p>missed to develop the narrative.</p> <p>Level 2 (4-6 marks) The candidate demonstrates a sufficient analysis of the hats in Fig. 1 to determine the extent of their functional suitability for undertaking the task of clearing snow. At least one of the bullet points is covered. The candidate adequately uses the information in the Resource Booklet and applies their own design and technology understanding to build a reasonable argument in relation to the question being asked although one or two inaccuracies exist in the narrative put forward.</p> <p>Level 1 (1-3 marks) There is no analysis or evaluation of the information in Fig. 1. The candidate demonstrates a limited knowledge of the existing products and there is only limited evidence against the bullet points provided. The information in the Resource Booklet is used in a simplistic way and only limited knowledge is applied to the question being asked.</p> <p>0 marks No response or no response</p>
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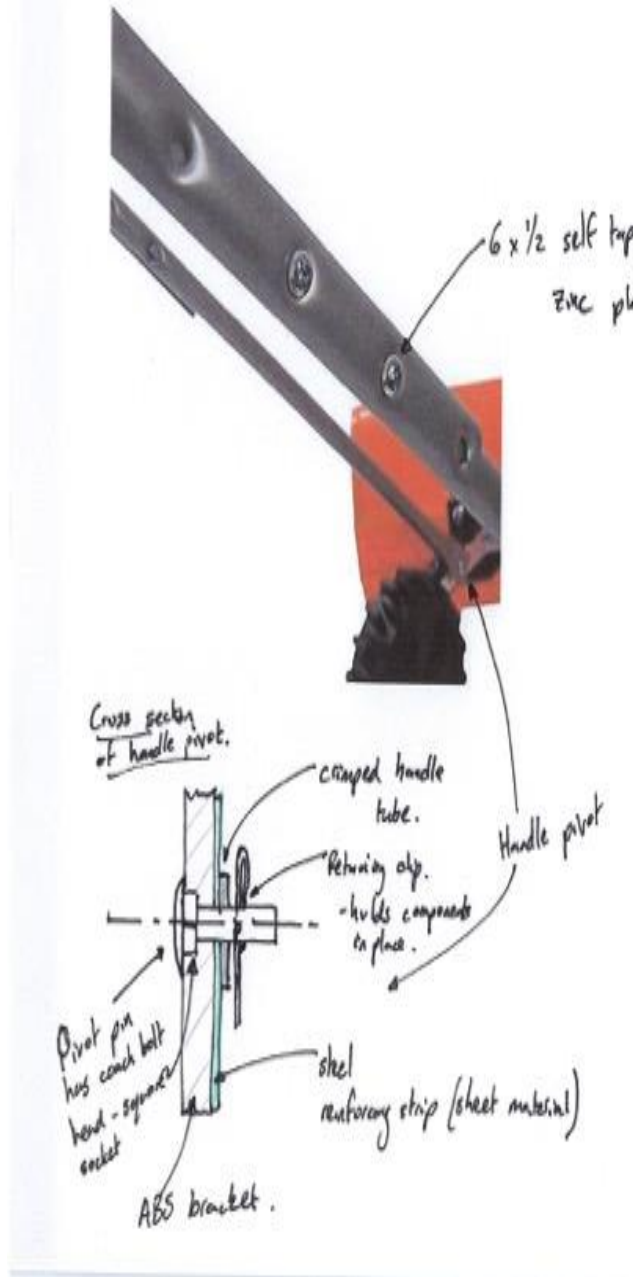
3	<p>Snow Shovel $650/50 = 13$ per carton (1)</p> <p>Wheeled Snow Shovel $400/75 = 5$ per carton (1)</p> <p>Van load $2670/650 = 4.1$ $1870/400 = 4.7$ $4 \times 4 = 16$ (1)</p> <p>Number of different shovels required to supply 1000 homes 20% of 1000 = 200 wheeled snow shovels Therefore 800 standard shovels (1)</p> <p>Number of loads required Snow Shovel – $800^*/13^* = 61.54 = 62$ Wheeled Snow Shovel – $200^*/5^* = 40$ $62^*+40^* = 102$ $102^*/16^* = 6.38 = 7$ (1)</p> <p>Total cost $7^* \times 300 = \text{£}2100$ (1)</p>	6	<p>One mark for calculating the number of snow shovels per carton</p> <p>One mark for calculating the number of wheeled snow shovels per carton</p> <p>One mark for calculating the number of cartons per van load</p> <p>One mark for calculating the number of different shovels required to supply 1000 homes.</p> <p>One mark for calculating the number of loads to supply 1000 homes</p> <p>One mark for calculating the cost of delivering all loads</p> <p>Where an incorrect answer is given working out should be used to credit appropriate marks.</p> <p>*Allow error carried forward (ECF) where correct working out is shown.</p> <p>Award marks for any other correct method.</p>
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4*	Question	Answer	Mark	Guidance
		<p>Indicative content:</p> <p>Negatives:</p> <ul style="list-style-type: none"> • 620mm wide and 75mm deep, the wheeled snow shovel is quite cumbersome. When coupled with the weight of 4Kg, it could be awkward for a user with reduced mobility to transport it to and from starting shovel positions. • The 620mm wide scoop will need quite a bit of force which would be hard work for some elderly users. • On pushing the snow shovel through snow, it is likely that the movement is uneven as different densities of the snow pack is experienced. This could result in the user losing their balance and losing their footing. • The powder coated mild steel tube handle is of a small diameter and difficult for arthritic hands to grip. • In addition, the handle will be cold to the touch as mild steel is a good thermal conductor. Users will need to wear gloves and further lose dexterity. • The design relies on snow on the scoop being pushed out of the way either over existing snow, ploughing through it or reversing, turning, moving and tipping the load. This presents numerous slip hazards and difficulties for users with reduced mobility. • The user is required to hold the handle up at all times. When in use, the snow shovel provides very little stability. • The front lip of the shovel should be in contact with the ground in order to scoop 	16	<p><i>All responses should be in relation to the Wheeled Snow Shovel for marks to be awarded.</i></p> <p><i>Any lifted information can be used in support of the critical examination but no marks should be awarded simply for duplicating text.</i></p> <p><i>Credit should be given for responses which identify issues evident in the supplied information and which are then critically analysed and evaluated in terms of their significance to the given scenario and relating to design and technical principles.</i></p> <p>Level 4 (13-16 marks) The candidate demonstrates a comprehensive understanding of the suitability of the Wheeled Snow Shovel product for use by elderly users. The candidate effectively uses both the information in the Resource Booklet and applies their own product knowledge to build a well-constructed argument in relation to the question being asked with a clear and concise narrative.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p>Level 3 (9-12 marks) The candidate demonstrates a good understanding of the suitability of the Wheeled Snow Shovel product for use by elderly users. The candidate for the most part uses the information in the Resource Booklet and applies their own product knowledge to build a well-constructed argument in relation to the question being asked although one or two opportunities are missed to</p>

		<p>under the snow. However, the handle is not adjustable and may not suit the height of all users. It may cause discomfort for short or tall users to elevate the handle to the optimum angle for use.</p> <ul style="list-style-type: none"> Fitting and/or removing the handle to the scoop could be difficult for the user who may lack the necessary strength or dexterity to depress the sprung rivet while pushing components together or pulling them apart. <p>Positives:</p> <ul style="list-style-type: none"> The additional mass of the wheeled snow shovel will help the user to force the shovel through snow once inertia/friction is overcome. The user can wheel the snow shovel into position, rather than carry it. Snow is wheeled away rather than lifted. The increased capacity of the scoop will enable more snow to be relocated quicker, exposing elderly users to the cold for less time than a standard shovel. Any other valid suggestion. 			<p>develop the narrative.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i></p> <p>Level 2 (5-8 marks) The candidate demonstrates a sufficient understanding of the suitability of the Wheeled Snow Shovel product for use by elderly users. The candidate adequately uses either the information in the Resource Booklet or applies their own product knowledge to build a reasonable argument in relation to the question being asked although one or two inaccuracies exist in the narrative put forward.</p> <p><i>The information has some relevance and is presented with limited structure. The information is supported by limited evidence.</i></p> <p>Level 1 (1-4 marks) There is no analysis or evaluation of the suitability of the Wheeled Snow Shovel product for use by elderly users. The candidate demonstrates a limited</p>
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						<p>knowledge of this user group. The information in the Resource Booklet is used in a simplistic way and only limited product knowledge is applied to the question being asked.</p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i></p> <p>0 marks No response or no response worthy of credit.</p>
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Question	Answer	Mark	Guidance
5	<p>Indicative content:</p> <p>Countersunk self tapping screws - passes through mild steel plate. - bites into pilot holes on the polypropylene mouldings.</p> <p>Rebate on mouldings allow joining plate to lie flat - 3mm mild steel sheet - press formed. - countersunk $\phi 4$mm holes - drilled.</p> <p>M6/M5 Headed coach bolt, retained with M6 lock nut + washer.</p> <p>ABS injection moulded bracket, reinforced with sheet steel.</p> <p>End of ss. rod threaded to M10. M10 peany washer and nylon nut fasten rod in place at each end.</p> <p>$\phi 10$mm stainless steel rod - doesn't rust when exposed to environment.</p> <p>Mild Steel plate with chrome plating or zinc galvanneal. - Pressed sheet - Square holes retain threaded coach bolts.</p>	12	<p>Candidates can draw on practical experience of iterative designing and product analysis to support their response to this question.</p> <p>The question assesses applied knowledge of technical principles to the existing design, so responses that focus on redesigning the existing solution should not be rewarded.</p> <p>The candidate is expected to demonstrate their understanding of the process involved through a series of annotated sketches and/or notes. There may be variations to the process as indicated but to get into L3 candidates must demonstrate a clear understanding of the end to end process.</p> <p>Level 4 (10-12 marks) The candidate has produced an excellent account of the manufacturing and assembly process needed for the features of the design concept. All four bullet points in the question have been covered. Sketches if used will be clear and supported with relevant notes. The process will be end to end and clear in the way it is explained.</p> <p>Level 3 (7-9 marks) The candidate has produced a good account of the manufacturing and assembly process needed for the features of the design concept. At least three bullet points in the question have been covered. Sketches if used will for the most part be clear and supported with relevant notes although one or two opportunities for clarity may be missed. The process will be end</p>



to end and for the most part be clear in the way it is explained.

Level 2 (4-6 marks)

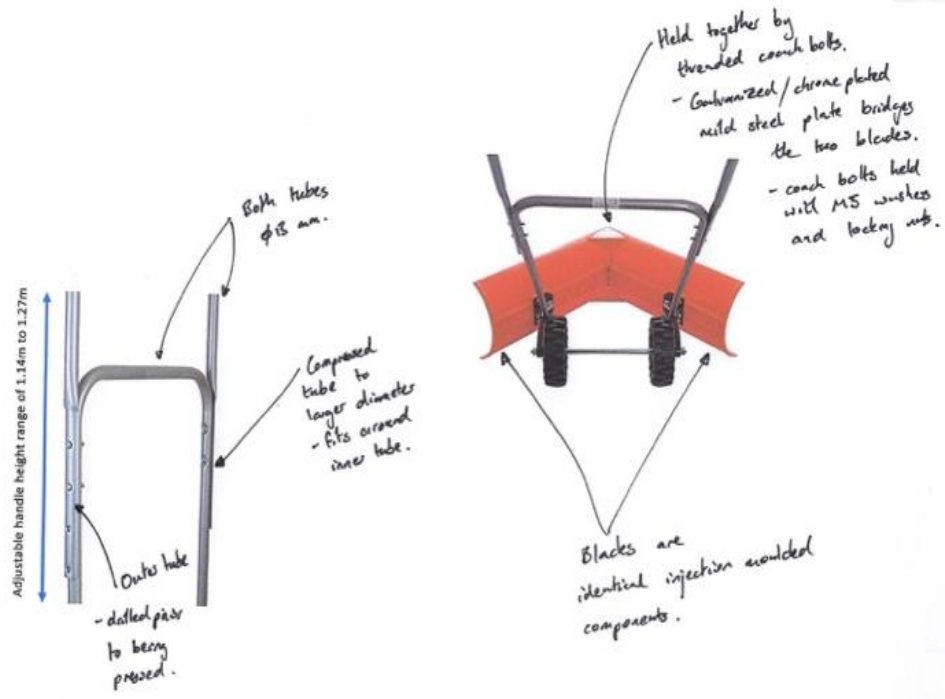
The candidate has produced a sufficient account of the manufacturing and/or assembly process needed for the features of the design concept. At least two bullet points in the question have been covered. Sketches if used will be adequate and supported with notes some of which will be relevant. The process may not necessarily be end to end with some knowledge gaps evident.

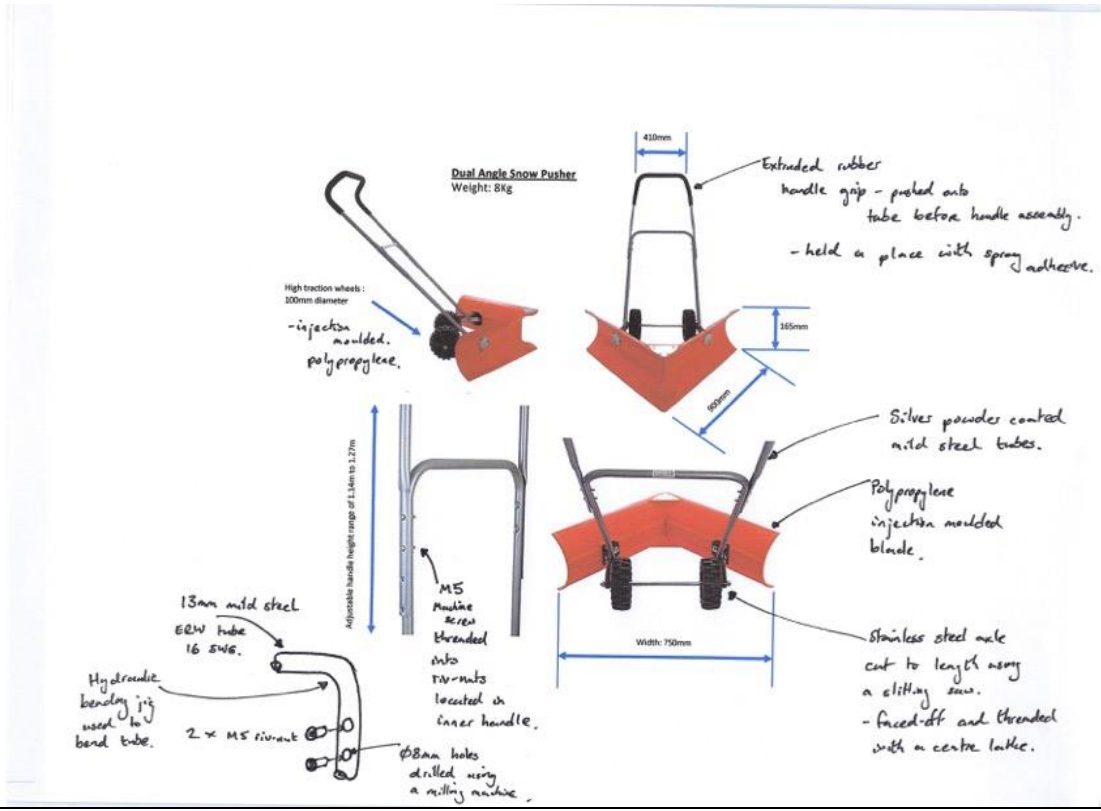
Level 1 (1-3 marks)

The candidate has produced a basic account of the manufacturing and/or assembly process needed for the features of the design concept. At least one bullet point in the question has been covered. Sketches if used will be unclear with only basic notes to accompany them. The end to end process may not exist and if anything is basic in nature.

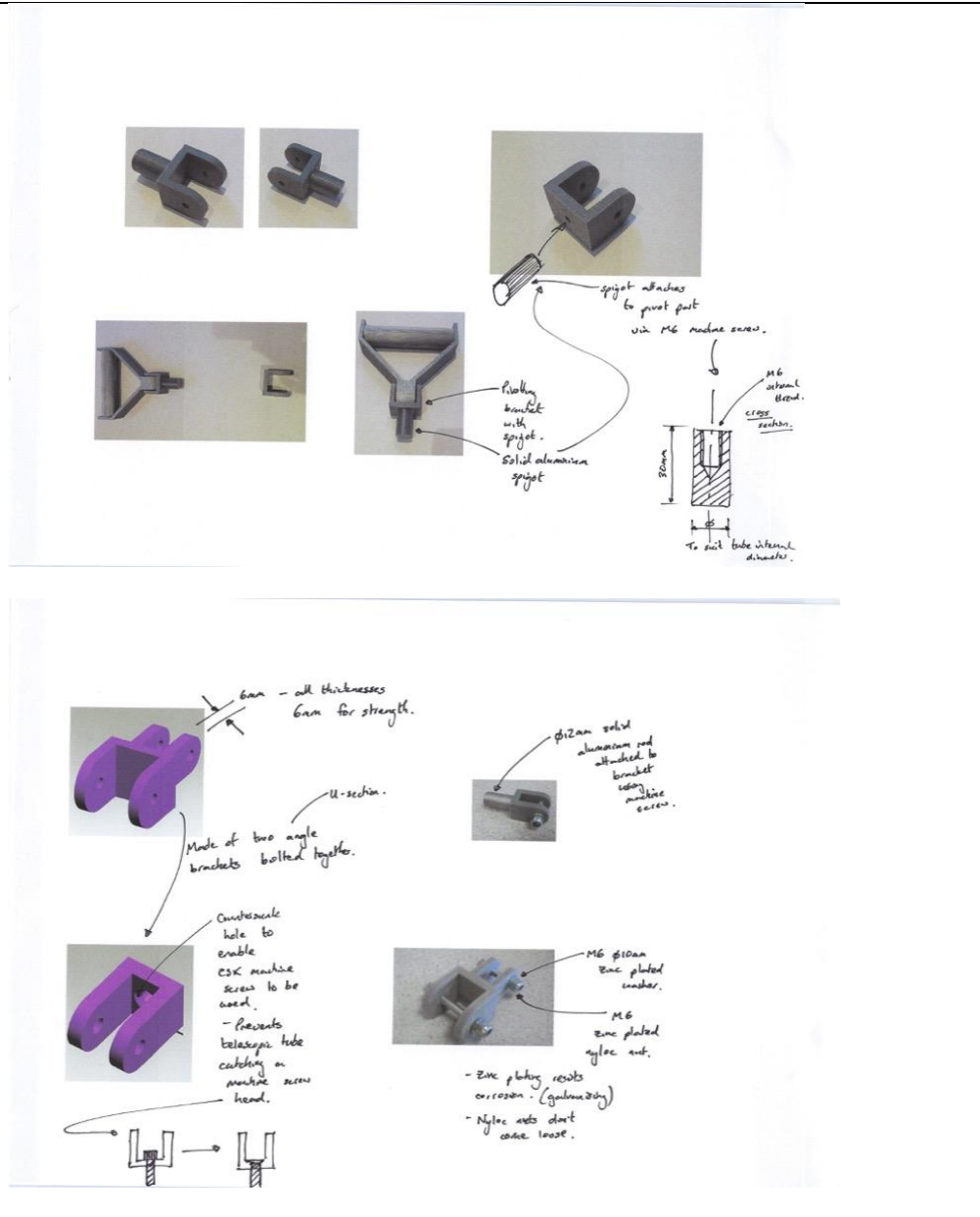
0 marks

No response or no response worthy of credit.





Question	Answer	Mark	Guidance
<p>6</p>	<p>Indicative content:</p>	<p>12</p>	<p>Candidates can draw on practical experience of iterative designing and product analysis to support their response to this question.</p> <p>The question assesses applied knowledge of technical principles to the existing design, so responses that focus on redesigning the existing solution should not be rewarded.</p> <hr/> <p>The candidate is expected to demonstrate their understanding of the process involved through a series of annotated sketches and/or notes. There may be variations to the process as indicated but to get into L3 candidates must demonstrate a clear understanding of the end to end process.</p> <p>Level 4 (10-12 marks) The candidate has produced an excellent account of the manufacturing process needed for the Ergo Kit. All three bullet points in the question have been covered. Sketches if used will be clear and supported with relevant notes. The process will be end to end and clear in the way it is explained.</p> <p>Level 3 (7-9 marks) The candidate has produced a good account of the manufacturing process needed for the Ergo Kit. At least two bullet points in the question have been covered. Sketches if used will for the most part be clear and supported with relevant notes although one or two opportunities for clarity may be missed. The process will be end to end and for the most</p>



part be clear in the way it is explained.

Level 2 (4-6 marks)

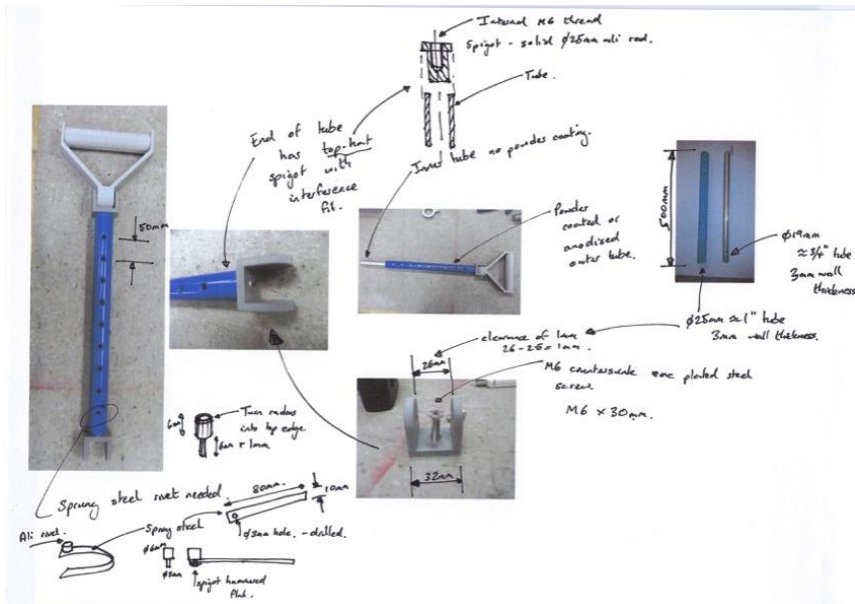
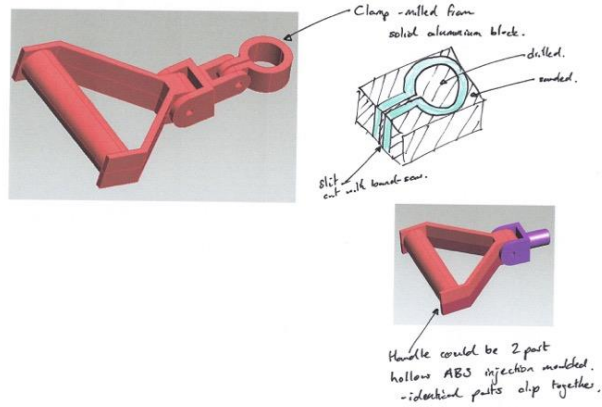
The candidate has produced a sufficient account of the manufacturing process needed for the Ergo Kit. At least two bullet points in the question have been covered. Sketches if used will be adequate and supported with notes some of which will be relevant. The process may not necessarily be end to end with some knowledge gaps evident.

Level 1 (1-3 marks)

The candidate has produced a basic account of the manufacturing process needed for the features of the Ergo Kit. At least one bullet point in the question has been covered. Sketches if used will be unclear with only basic notes to accompany them. The end to end process may not exist and if anything is basic in nature.

0 marks

No response or no response worthy of credit



		<p>Aluminium components:</p> <ul style="list-style-type: none"> • High strength to weight ratio suitable for elderly users. Strong to withstand forces when raking. • Low density components are important to ensure that the overall weight of the rake with handles is not too much greater than the rake alone and cause the elderly user increased fatigue in use. • High strength to toughness ratio – will withstand knocks in transit and in use. • Suitable for the pivoting components that attach to the handles as toughness will resist cracking. Pivoting parts will be subjected to high forces and torque during raking. • Negative: high cost of aluminium. • Aluminium forms an oxide layer that protects it from further corrosion. • Aluminium can be anodised in a range of colours making it suitable for aesthetic colours e.g. green and yellows associated with gardening products. • Aluminium – high recycle fraction. • Negative: aluminium (bauxite mining) extraction requires a lot of energy – environmental impact. <p>Aluminium connecting pivot U brackets:</p> <ul style="list-style-type: none"> • Milled from a block of aluminium – CNC milling machine. • Drilled using a pillar drill or CNC milling machine for accuracy. • Cheaply made from aluminium U section, or box section with one face milled away after holes are drilled. <p>Telescopic sections: Aluminium tube components:</p> <ul style="list-style-type: none"> • Telescopic sections: extruded tubes. Aluminium tubes are seamless and suitable for telescopic use. • Extrusion • Cut to length using repeat stops. Cut to length with chop saw/slitting saw. • Ends faced off using centre lathes. • Chamfers applied to ends to remove sharp edges – using centre lathe. • Push rivet holes machined (drilled and countersunk/chamfered) using a CNC milling machine where centre of tube and separation of holes can be accurately set with g-codes. • Inner tubes may need to be turned down to ensure a suitable sliding fit 		
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		<p>using a centre lathe.</p> <p>Sprung rivet:</p> <ul style="list-style-type: none"> • Sheet spring steel, drilled and cut with shears/guillotine. • Rivet – turned using centre lathe from stock stainless steel or aluminium rod. <p>ABS components:</p> <ul style="list-style-type: none"> • High strength to density ratio suitable for maintaining low weight of overall rake assembly. • Not as tough as aluminium. More suited to components such as the handle where the handle can bear inside an aluminium pivot bracket. • Low cost to strength ratio based on large scale batch production with injection moulding. Injection moulding has high setup costs though. • It is possible to have high quality ABS components 3D printed for the initial batch of 50. If the initial batch is successful, then use injection moulding for large batch sizes e.g. 500+ <p>Other considerations:</p> <ul style="list-style-type: none"> • The design does not have any spaces in which the user could easily get their fingers trapped. Furthermore, the design helps prevent repetitive strain injury to the user whilst raking as the user is more upright whilst utilising this product. • ABS/aluminium which has a high strength to weight ratio. • Aluminium/ABS is water resistant. • ABS can be made by quick/cheap manufacturing processes (injection moulding high set-up costs), whereas aluminium cannot (requires a lot of energy to manufacture parts made from aluminium). • ABS raw material is cheap (the aluminium is more expensive). • Powder coated aluminium/anodised aluminium and the aluminium itself are aesthetically pleasing and the ABS can be coloured to make it more aesthetically pleasing/fun. • It is possible to source the aluminium from recycled material (from recycled aluminium cans) appeals to many consumers. • Although aluminium does not have great flexibility, it has enough strength to withstand impacts and shocks during raking. ABS on the other hand also is strong enough to withstand shocks and forces but also has some degree of flexibility meaning it won't fracture as soon as 		
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			<p>shearing force is applied to it.</p> <ul style="list-style-type: none">• Retired elderly users may have budgetary constraints and parts which can be made cheaply (such as the ABS parts, made by injection moulding).• The attachable handle aids easy storage. The rake can be hung from one of the handles.• The telescopic tubing system allows a range of users to utilise the design (due to it's ability to be adjustable in size).• The clamps enable the handles to be set to the optimum separation for the user's comfort.		
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