GCE

Design and Technology

H404/02: Problem solving in Design Engineering

A Level

Mark Scheme for June 2025

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM 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 available in RM Assessor

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

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 RM Assessor 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, email or via the RM Assessor messaging system.

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 the annotation 'SEEN' to confirm that the work has been seen and mark any responses using the annotations in section 11.

7. There is a NR (**No Response**) option. Award NR (No Response):

- if there is nothing written at all in the answer space
- OR if there is a comment which does not in any way relate to the question (e.g., 'can't do', 'don't know')
- OR if there is a mark (e.g., a dash, a question mark) which is not an attempt at the question.

Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The RM Assessor **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.**

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:
    a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
    b. **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. Annotations

Annotation	Meaning
	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	Tick
	Benefit of doubt
	Error carried forward
	Noted but no credit given
	Level 1 response
	Level 2 response
	Level 3 response
	Level 4 response
	Highlighter for Level responses

12. Subject Specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

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

You should ensure that you have copies of these materials.

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.

Question			Answer	Mark	Guidance
1*			**Indicative content:** Within their answer candidates are expected to refer to both the technical challenges **and** ethical considerations that a designer would have to consider. Their answers could include but are not limited to: **Technical Challenges:** **Robustness and Reliability:** The vehicle must be designed to operate reliably in various environmental conditions and terrains, including extreme weather, rough terrain, and low visibility situations such as smoke-filled environments. **Sensors:** Integration of a variety of sensors to meet the requirements of the system. Could include, smoke, thermal imaging, infrared and high definition. **Navigation:** Developing algorithms and programs for efficient path planning and navigation, considering factors such as dynamic obstacles, changing terrain, and optimal routes to reach victims while ensuring safety for both the vehicle and the rescuers. **Communication and Connectivity:** Establishing reliable communication links between the vehicle, base station, and other rescue personnel is essential for coordinating rescue operations and providing real-time updates on the vehicle's status and location. **User and Robot Interaction:** Designing intuitive interfaces and control systems that allow rescuers to interact with the autonomous vehicle	**14** Answers that only cover one of the areas either technical challenges or ethical considerations can only be award a level 2. *Any lifted information can be used in support of the critical examination but no marks should be awarded simply for duplicating text.* *Credit should be given for responses which identify the information and examples in the supplied information and which are then analysed and evaluated in*	**Level 4 [12-14 marks]** A comprehensive discussion of the key technical challenges and ethical considerations a design engineer would face when developing an autonomous vehicle for use during disasters. Comprehensive understanding of the two elements specified in question. Information in RB is used effectively to fully exemplify the points being made. Well-constructed response in relation to question with a clear and developed narrative. Typically, candidates should discus two of each challenge. However, candidates that discuss a two, one split where the one challenge is discussed in exceptional detail can access Level 4. ***There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*** **Level 3 [9-11 marks]** A good discussion of the key technical challenges and ethical considerations a design engineer would face when developing an autonomous vehicle for use during disasters. Good understanding of typically both elements specified in question. Information in RB is used for the most part effectively to exemplify points being made although one or two opportunities are missed. Well-constructed response in relation to question although one or two opportunities missed to develop narrative. Candidate should have discussed both challenges with one of the challenges in good detail. ***There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.*** **Level 2 [5-8 marks]**

Question			Answer	Mark	Guidance
			effectively, especially in high-stress situations where quick decision-making is crucial. **Battery Life and Energy Efficiency:** Optimising energy consumption and battery life to ensure extended operation time, particularly in remote or disaster-stricken areas where recharging facilities may be limited. **Payload Capacity:** Designing the vehicle to accommodate various payloads and equipment required for different rescue scenarios, such as medical supplies, communication devices, and tools for extracting victims from hazardous environments. Any other valid suggestion. **Ethical Considerations:** **Safety:** Ensuring the safety of both victims and rescue personnel should be the primary concern. The vehicle must be designed to minimize the risk of accidents and injuries during rescue operations. **Autonomy and Accountability:** Determining the level of autonomy of the vehicle and establishing clear lines of accountability in case of errors or accidents, including mechanisms for human intervention and override. **Transparency and Trust of the Unit:** Building trust among stakeholders, including the public, government agencies, and emergency responders, through transparent communication about the capabilities, limitations, and ethical principles guiding the design and deployment of autonomous rescue vehicles. **Long-Term Impact:**	*terms of their significance.* *This is an extended response question. Candidates that produce bullet points or listed responses should not gain more than a level 2.*	A sufficient discussion of the key technical challenges and ethical considerations a design engineer would face when developing an autonomous vehicle for use during disasters. Sufficient understanding of typically at least one of the elements specified in question. Information in RB is used to exemplify some points being made although much more could have been done to exploit the stimulus material available. Reasonable response in relation to the question although narrative at times lacks depth and cohesion. ***The information has some relevance and is presented with limited structure. The information is supported by limited evidence.*** **Level 1 [1-4 marks]** A limited discussion of the key technical challenges and ethical considerations a design engineer would face when developing an autonomous vehicle for use during disasters. Limited understanding of typically one element specified in question. Use of information from the RB is used in a simplistic way and adds limited value to the points being made. Limited response in relation to question. Narrative is basic and unstructured. ***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.*** **0 marks =** No response or no response worthy of credit.

Question			Answer	Mark	Guidance
			Anticipating and mitigating potential long-term social, economic, and environmental impacts of autonomous rescue vehicles, such as changes in emergency response protocols, job displacement, and unintended consequences on local communities and ecosystems. Any other valid suggestion.		

Question			Answer	Mark	Guidance
2*			**Indicative content:** Within their response, candidates should refer to the various areas that an engineer could collaborate between the different engineering fields. Answer can include but not limited to: **The design phase of the product** **Diverse Expertise:** Complex systems often require expertise from multiple disciplines such as mechanical engineering, electrical engineering, software engineering, and more. Collaboration allows engineers with different specialties to contribute their unique skills and knowledge to address various aspects of the system design, ensuring a comprehensive and well-rounded approach. **Holistic Problem-solving:** Complex systems typically involve interconnected components and subsystems, each with its own requirements and constraints. Collaboration enables engineers to take a holistic approach to problem-solving, considering the interactions and dependencies between different parts of the system and finding solutions that optimize overall performance and reliability. **Innovation and Creativity:** Candidates should convey that collaboration fosters an environment where ideas can be shared, challenged, and refined collectively. By collaborating with peers, engineers can leverage each other's creativity and insights to explore new concepts, innovative design approaches, and novel solutions to complex engineering problems, leading to	**12** *Candidate should use the RB in their response. Information can be used from the RB however no credit should be given where text has been copied with no analysis.* *Candidates should be using examples in their response. Where they have not mentioned examples they should be limited to a level 2 response.* *Examples in the response does not have to relate to the fire-fighting robot. Any examples can be used which they may have looked*	**Level 4 [10-12 marks]** A comprehensive critical examination of the significance of collaboration amongst engineers in the design and development of complex systems. Comprehensive understanding of the three elements specified in the question. Information in RB is used effectively to fully exemplify the points being made and is strengthened by the use of examples drawn from own studies. Well-constructed response in relation to question with a clear and developed narrative. ***There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.*** **Level 3 [7-9 marks]** A good critical examination of the significance of collaboration amongst engineers in the design and development of complex systems. Good understanding of typically two elements specified in question. Information in RB is used for the most part effectively to exemplify points being made although one or two opportunities are missed, particularly in the use of examples drawn from own studies. Well-constructed response in relation to question although one or two opportunities missed to develop narrative. ***There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.*** **Level 2 [4-6 marks]** A sufficient critical examination of the significance of collaboration amongst engineers in the design and

Question			Answer	Mark	Guidance
			breakthrough innovations and advancements in technology. **Adaptability and Flexibility:** An acknowledgement that complex systems often evolve over time due to changing requirements, technological advancements, or external factors. Collaboration enables engineering teams to adapt and respond to these changes more effectively by fostering a culture of flexibility, open communication, and continuous learning, allowing the system to remain relevant and resilient in the face of evolving challenges. **User Need Assessment:** The collaboration between the designer and engineer begins during the user need assessment. With both parties consulting with medical professionals, users and other stakeholders, they are able to identify key requirements prior to the design process. **Concept Development and Technical Feasibility:** Designers are likely to generate initial concepts and prototypes based on the onformation gathered in the User Needs Assessment. Concurrently, engineers would have assessed the technical feasibility of the proposed designs considering factors such as materal selection, manufacturing processes and regulatory requirements. They will also be needed to ensure that the product meets the necessary performance standards while remaining practical for it's intended purpose. **Prototying and testing** **Testing:** During this phase the designers and engineers would have created the protoype scoop together, testing each element and ensuring that the ergonomics and ease of use are upmost. Feedback from medical professionals with give	*at through their studies.*	development of complex systems. Sufficient understanding of typically at least one of the elements specified in question. Information in RB is used to exemplify some points being made although much more could have been done to exploit the stimulus material available as well as the use of examples drawn from own studies. Reasonable response in relation to the question although narrative at times lacks depth and cohesion. ***The information has some relevance and is presented with limited structure. The information is supported by limited evidence.*** **Level 1 [1-3 marks]** A limited critical examination of the significance of collaboration amongst engineers in the design and development of complex systems. Limited understanding of typically one element specified in question. Use of information from the RB is used in a simplistic way and adds limited value to the points being made. Next to no examples are drawn from own studies. Limited response in relation to question. Narrative is basic and unstructured. ***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.*** **0 marks =** No response or no response worthy of credit.

Question			Answer	Mark	Guidance
			informed decisions for the engineers and designers to produce new iterations. **Risk Mitigation:** Complex systems carry an inherent risk such as technical failure, safety hazards and costs. Candidate would have mentioned these risks and the fact that collaboration will reduce the risk by identifying issues early. **Quality Assurance:** An understanding that collaboration facilitates peer review and feedback, allowing engineers to validate their designs, identify potential flaws or deficiencies, and make necessary improvements before finalizing the system. This iterative process of review and refinement helps ensure that the system meets quality standards, regulatory requirements, and customer expectations. **Manufacturing and production** **Manufacturing Methods:** Once the design has been finalised the engineers would work closely with both the designering and the manufacturing engineers to oversee the production process. They would ensure that the manufacturing methods and quality control measures were in place to produce the Magirus Aircore TAF35. **Efficiency and Productivity:** Reference to the fact that through collaboration engineers are able to play to others strengths and resources more effectively. By dividing individual tasks and sharing workload engineers would be able to decrease timelines and reduce costs. **Regulatory Compliance:** Throughout the development process, designers and engineers would have collaborated to ensure that the Magirus Aircore TAF35 complies with the relevant standards and certifications.		

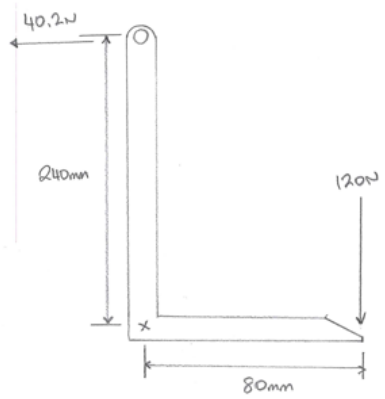
Question			Answer	Mark	Guidance
			Any other valid suggestion.		

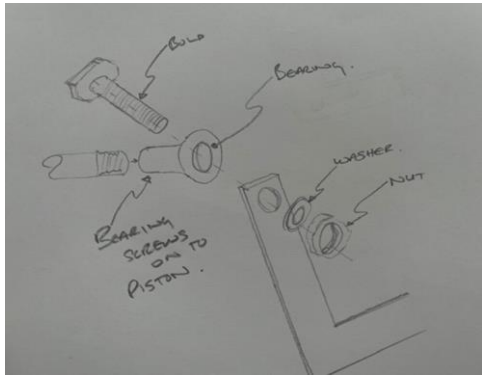
Question			Answer	Mark	Guidance
3	(a)	(i)	Find the length of the track required for one side of the vehicle. Find the circumference of the drive pulleys. $C = 2\pi r$ $C = 2 \times \pi \times 75$ = 471.238898mm (1) Track lengths between the centres of the pulleys: $(306 + 306)$ = 612mm (1) Total track length = 612 + 471.238898* = 1083mm (or equivalent – depending on value of π) (1)	3	Award three marks as follows: One mark for calculating circumference of drive pulleys. One mark for calculating the track lengths between the centre of the pulleys. One mark for calculating the length of rubber track that will be needed for one side of the robot. If correct answer is given without working out shown award full marks. Where an incorrect answer is given working out should be used to credit appropriate marks. Accept a range of 1083 – 1083.239 to allow for different values of π. *Allow error carried forward (ECF) where correct working out is shown.

Question			Answer	Mark	Guidance
		(ii)	Find the mass of both of the rubber tracks. First find the volume: $Volume = 0.0015\ x\ 1083$ * (from 3a(i)) $Volume = 0.0016245\ m^3$ (1) Calculate the mass: $mass = 1100\ x\ 0.0016245$ * $mass = 1.78695\ kg$ (1) Total mass = $1.78695 *\ x\ 2 = 3.5739 kg$ (1)	**3**	Award three marks as follows: One mark for calculating the volume of their track. Allow ECF from previous question. One mark for calculating the mass of one track. Allow ECF from previous part if method is correct. One mark for the total mass of two tracks. Allow answers to 1 decimal place. **NB:** If correct answer is given without working out shown award full marks. Where an incorrect answer is given working out should be used to credit appropriate marks. *Allow error carried forward (ECF) where correct working out is shown.

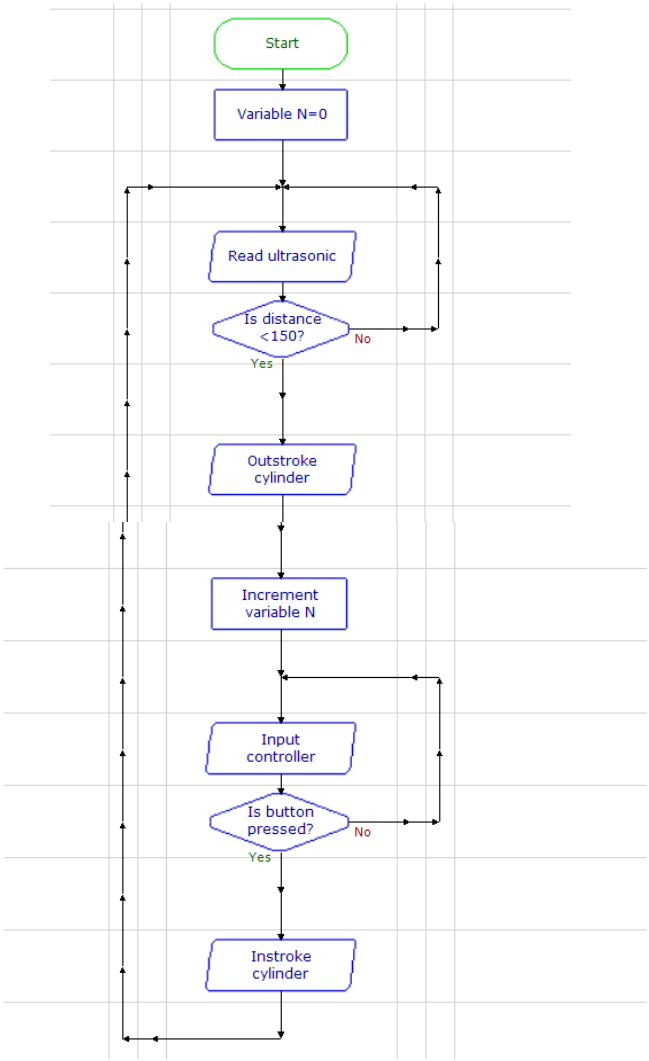
Question			Answer	Mark	Guidance
	(b)	**(i)**	Overall VR = (VR stage 1) x (VR stage 2) Using data from **Fig. 6**: Overall VR = $\frac{20}{1}$ x $\frac{24}{15}$ (1) = $32:1$ (1)	**2**	Award two marks as follows: One mark for taking the correct values from the RB. One mark for calculating the velocity ratio of the ZS-50 gear box. If correct answer is given without working out shown award full marks. Where an incorrect answer is given working out should be used to credit appropriate marks.

Question			Answer	Mark	Guidance
		(ii)	**Proof of speed requirements:** $output\ rotational\ speed = \frac{input\ rotational\ speed}{VR}$ GIVEN Use input rotational speed = 4000 rpm from Table (1) $output\ rotational\ speed = \frac{4000}{32*} = 125\ rpm$ (1) Covert rpm to km/h using the given equation: Speed of robot $= \frac{3}{25} \times \pi \times 0.075\ (1) \times 125 * = 3.53\ km/h$ (1)	**4**	Candidates must show their working to gain credit. Candidates may follow a different route through the calculations, but credit should be awarded for understanding shown as demonstrated through reasoning and calculations. The basic breakdown of marks is as follows: One mark for taking value of 4000 from RB. One mark for plugging numbers into given formula and calculating output rotational speed. One mark for converting radius from mm into m. One mark for plugging known values into given formula to show that the proposed motor gear box combination will produce an output speed of 3.53 km/h for the Scout robot. Watch out for ECF here – particularly when it comes to carrying forward answer from part (b)(i).

Question			Answer	Mark	Guidance
4	Issue 1 Issue 2		**Indicative content:** **Issue 1A** F = PA $Force = 200{,}000\ x\ 0.000201 = 40.2N$* (1) Calculate the length of the form parts. Input force from cylinder = 40.2N* Output force requirements =120N Mechanical Advantage required = 2.98:1 (3:1) (1) Candidate should give a 3:1 ration on the two parts of the folk. Like the example below. $40.2\ x\ X = Y\ x\ 120$ $X = 240\ (1)\quad Y = 80\ (1)$  **Issue 1B**	**16** **4 – Issue 1a** **4 – Issue 1b** **8 – Issue 2** *Allow ECF from the calculation of the force for the Mechanical Advantage.*	**Level 4 [13-16 marks] A comprehensive demonstration of technical solutions to overcome the two issues identified.** Comprehensive understanding of technical design and technology principles to overcome the two issues identified. Both solutions are well-developed. Information in RB is used effectively to fully exemplify the points being made. 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. Response for Issue 1a should include any calculations for the diameter of the piston and an appropriate mechanism to transmit the force by the appropriate factor. Response for Issue 2 should clearly show a flow chart using the correct symbols and identifying appropriate inputs and outputs. **Level 3 [9-12 marks] A good demonstration of technical solutions to overcome the two issues identified.** Good understanding of technical design and technology principles to overcome the two issues identified. Both solutions show development. Information in RB is used to fully exemplify the points being made. 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. Response for Issue 1a should include an attempt to show the calculations for the force of the piston but there may be some errors, and an appropriate mechanism to transmit the force. Response for Issue 2 should clearly show a flow chart using the correct symbols and identifying appropriate inputs and outputs but there may be some errors in either the symbols or/and input and outputs. **Level 2 [5-8 marks] A sufficient demonstration of technical solutions to overcome the two issues identified.** Sufficient understanding of technical design and

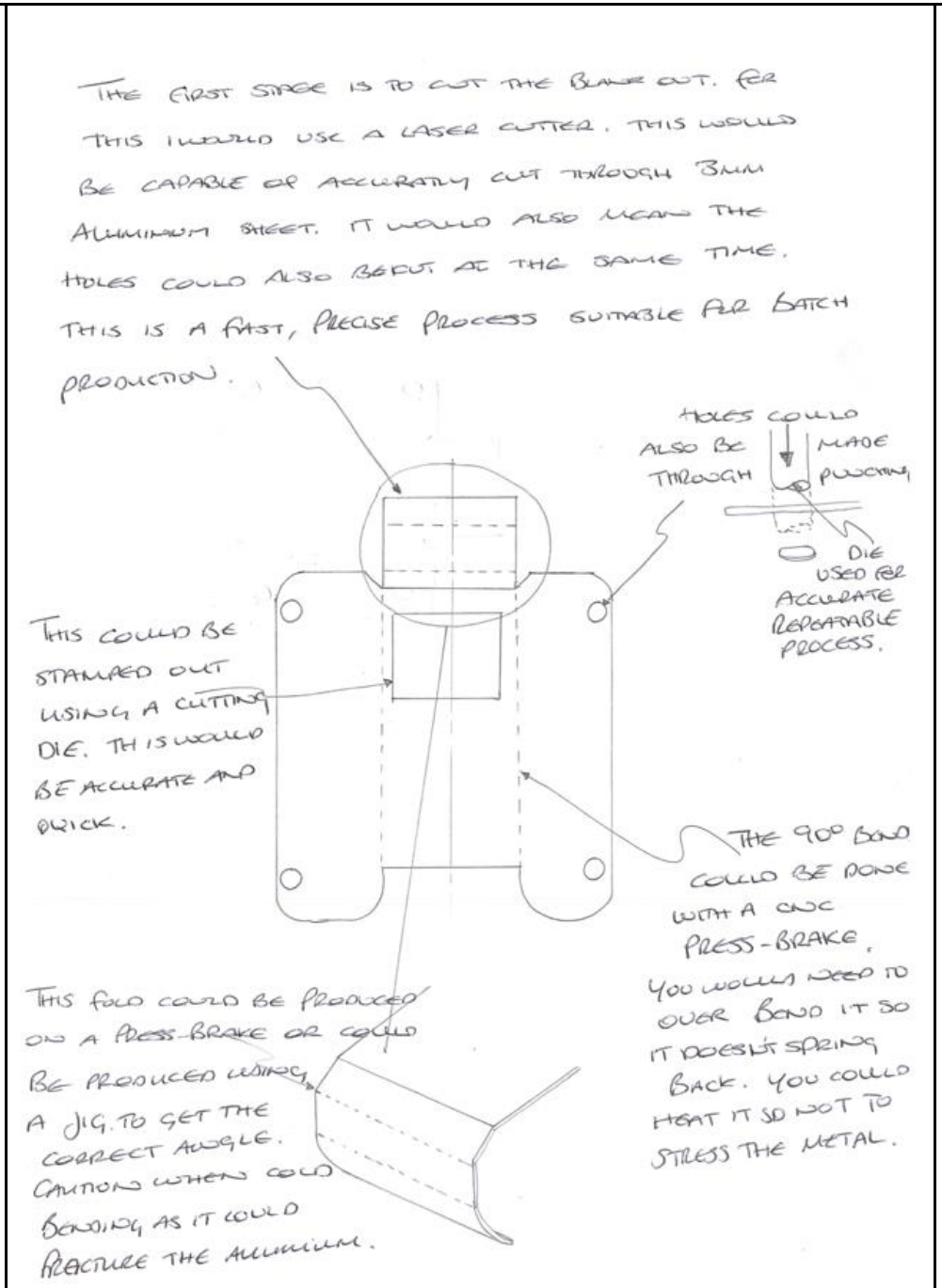
Question			Answer	Mark	Guidance
			Candidate should show how the piston is connected to the mechanism. They should have made reference to: • Method of attaching the piston to the fork mechanism (2) • the use of any bearings to aid efficiency of the system (1) • Acknowledgment of the joint being able to pivot when the mechanisms is being used. (1)  Candidate could show a mechanism that could be used to amplify the force of the piston by the correct factor required. Candidates could use a lever mechanism (class 1 or class 2) with the correct distances from the fulcrum to the load and effort. **Issue 2** Candidate will have produced a flow chart using the correct symbols.		technology principles to overcome the two issues identified. Both solutions show development but one may be more completed than the other. Information in the RB is used but not fully utilised. 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. Response for Issue 1a may not have any calculations for the force of the piston but will show an appropriate mechanism to transmit the force by the appropriate factor. Response for Issue 2 should show a flow chart using mostly the correct symbols and identifying appropriate inputs and outputs but there may be some errors in either the symbols or/and input and outputs. **Level 1 [1-4 marks] A limited demonstration of technical solutions to overcome one or two of the issues identified.** Limited understanding of technical design and technology principles to overcome one or two of the issues identified. One or both solutions show development but one may be more completed than the other. Information in the RB is used but not fully utilised. Sketches if used lack clarity and may or may not be supported with relevant notes. Response for Issue 1a may not have any calculations for the force of the piston but will show an attempt to produce an appropriate mechanism to transmit the force. Response for Issue 2 should show a flow chart using mostly the correct symbols, but may lack the appropriate inputs and outputs but there may multiple errors in either the symbols or/and input and outputs. **0 marks =** No response or no response worthy of credit.

Question			Answer	Mark	Guidance
			Candidate will have taken into consideration the following: • Input from the ultrasonic sensor (1) • Decision if the signal is less than 150mm (1) • Output to the pneumatic cylinder to outstroke (1) • Decision if the controller button has been pressed (1) • Output to the pneumatic cylinder to instroke (1) • Method of storing number of times the forks have been activated: (1) • Correct use of feedback loops (1) • Correct use of flow chart symbols (1)		

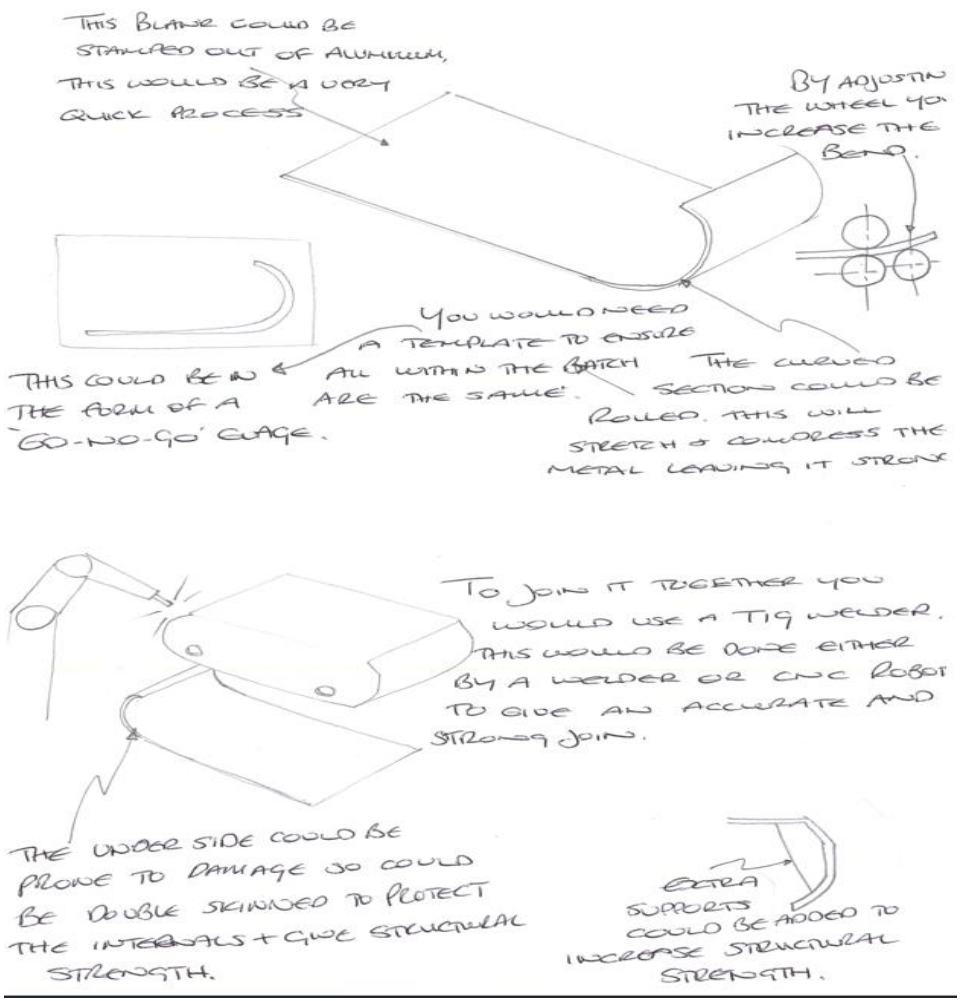
Question			Answer	Mark	Guidance
					

Question			Answer	Mark	Guidance
5			**Indicative content:** Candidate should have referred to the three bullet points in the question. **A detailed description of the cutting and shaping processes** Process should be appropriate for the process – Material is 3mm Aluminium therefore sheet metal. • Cutting: Piercing, Blanking, Notching, Cropping • Use of CNC, Laser cutter, Plasma, Water jet etc. • Bending: around former, cold bending problems, hot bending to reduce stresses, bending jig, overbending, radiused bending • Forming can be used with detailed descriptions and diagrams to support. • Rolling to produce curved section. **Details of any dies, formers or jigs** Details of the die used to pierce the holes with the design. Reference to shearing the metal should be used as opposed to cutting. Forming die is detailed showing the outer shape of the pressing, may have incorporated the access hole in the initial forming. **Methods of joining the parts to ensure structural integrity of the completed chassis.** Reference to any fabrication processes that would be needed, specifically to join the two parts of the chassis together. Candidate could have mentioned and described either of these processes: Welding (TIG) (Allow MIG and Brazing, they can be used in specialised forms) Riveting (would need reference to extra brackets being produced). Also reference to using Aluminium rivets to reduce the reaction of the metals. Relief in the larger sheet surface area to reduce bending and to increase the strength. Extra reinforcements in the bends to give strength. Consideration of the thickness of the material in areas, by doubling up.	**16**	Answers can be produced using notes and diagrams to explain the processes. To access Level 4, candidate should have mentioned all three areas. To access Level 3, candidate should have mentioned at least two of areas. To access Level 2, candidate should have mentioned at least one of areas. To access Level 1, candidate's response typically expected to be of limited understanding and not really covering any area specified. Where candidates mention processes not applicable for aluminium they should only be awarded a level 1 depending on the quality of the description. **Level 4 [13-16 marks]** A comprehensive demonstration of an appropriate method of batch manufacture for the robot chassis. Comprehensive understanding of the three elements specified in question. Information in RB is used effectively to fully exemplify the points being made. Well-constructed response in relation to question with a clear and developed narrative. The methods will be technically accurate and clear in the way they are explained. **Level 3 [9-12 marks]** A good demonstration of an appropriate method of batch manufacture for the robot chassis.

Question			Answer	Mark	Guidance
			Reference to the material changing mechanical properties when cold worked. **Other points** Accuracy of the process could be mentioned Efficiency of a cold process Speed of process Any other valid suggestion.		Good understanding of typically at least two elements specified in question. Information in RB is used for the most part effectively to exemplify points being made although one or two opportunities are missed. Sketches will for the most part be clear and supported with relevant notes. The methods will be technically accurate and for the most part be clear in the way they are explained. **Level 2 [5-8 marks]** A sufficient demonstration of an appropriate method of batch manufacture for the robot chassis. Sufficient understanding of typically one of the elements specified in question. Information in RB is used to exemplify some points being made although much more could have been done to exploit the stimulus material available. Sketches will be adequate and supported with notes. The methods will not always be technically accurate with some knowledge gaps evident. **Level 1 [1-4 marks]** A limited demonstration of an appropriate method of batch manufacture for the robot chassis. Limited understanding of question. Use of information from the RB is used in a simplistic way and adds limited value to the points being made . Sketches if used will be unclear with only basic notes to accompany them. The methods may lack technical detail and be basic in nature.



0 marks = 0 marks = No response or no response worthy of credit.

Question			Answer	Mark	Guidance
					

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