



ADVANCED
General Certificate of Education
2025

Technology and Design

Assessment Unit A2 1
assessing

Systems and Control or Product Design

[ATE11]

MONDAY 2 JUNE, MORNING

**MARK
SCHEME**

General Marking Instructions

Introduction

The main purpose of the mark scheme is to ensure that examinations are marked accurately, consistently and fairly. The mark scheme provides examiners with an indication of the nature and range of candidates' responses likely to be worthy of credit. It also sets out the criteria which they should apply in allocating marks to candidates' responses.

Assessment objectives

Below are the assessment objectives for GCE Technology and Design.

Candidates should be able to:

- AO1** Demonstrate specific knowledge and understanding, be able to apply that knowledge and understanding in combination with appropriate skills in their designing, communicate ideas and outcomes, and demonstrate strategies for evaluation.
- AO2** Apply skills, knowledge and understanding of relevant materials to produce suitable and appropriate outcomes; communicate ideas and outcomes, and demonstrate strategies for evaluation.

Quality of candidates' responses

In marking the examination papers, examiners should be looking for a quality of response reflecting the level of maturity which may reasonably be expected of a 17- or 18-year-old which is the age at which the majority of candidates sit their GCE examinations.

Flexibility in marking

Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive marking

Examiners are encouraged to be positive in their marking, giving appropriate credit for what candidates know, understand and can do rather than penalising candidates for errors or omissions. Examiners should make use of the whole of the available mark range for any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 17- or 18-year-old GCE candidate.

Awarding zero marks

Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Marking Calculations

In marking answers involving calculations, examiners should apply the 'own figure rule' so that candidates are not penalised more than once for a computational error. To avoid a candidate being penalised, marks can be awarded where correct conclusions or inferences are made from their incorrect calculations.

Types of mark schemes

Mark schemes for tasks or questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

Levels of response

In deciding which level of response to award, examiners should look for the 'best fit' bearing in mind that weakness in one area may be compensated for by strength in another. In deciding which mark within a particular level to award to any response, examiners are expected to use their professional judgement.

The following guidance is provided to assist examiners.

- **Threshold performance:** Response which just merits inclusion in the level and should be awarded a mark at or near the bottom of the range.
- **Intermediate performance:** Response which clearly merits inclusion in the level and should be awarded a mark at or near the middle of the range.
- **High performance:** Response which fully satisfies the level description and should be awarded a mark at or near the top of the range.

Quality of written communication

Quality of written communication is taken into account in assessing candidates' responses to all tasks and questions that require them to respond in written form. These tasks and questions are marked on the basis of levels of response. The description for each level of response includes reference to the quality of written communication.

For conciseness, quality of written communication is distinguished within levels of response as follows:

Level 1: Quality of written communication is basic.

Level 2: Quality of written communication is good.

Level 3: Quality of written communication is excellent.

In interpreting these level descriptions, examiners should refer to the more detailed guidance provided below:

Level 1 (Basic): The candidate makes only a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary. Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

Level 2 (Good): The candidate makes a reasonable selection and use of an appropriate form and style of writing. Relevant material is organised with some clarity and coherence. There is some use of appropriate specialist vocabulary. Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning clear.

Level 3 (Excellent): The candidate successfully selects and uses the most appropriate form and style of writing. Relevant material is organised with a high degree of clarity and coherence. There is widespread and accurate use of appropriate specialist vocabulary. Presentation, spelling, punctuation and grammar are of a sufficiently high standard to make meaning clear.

Section A

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MARKS

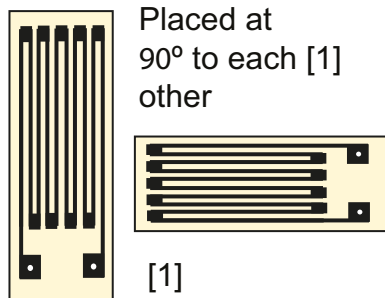
Electronic and Microelectronic Control Systems

1 (a) (i) Resistance changes as the gauge is deformed [1]

(ii) When the strain gauge is deformed there is little or no change to its resistance along the A axis [1] however there will be greater resistance change along the B axis [1] as it is the axis that detects deformation [1]

All relevant, valid responses will be given credit. [3]

(iii) sample answer



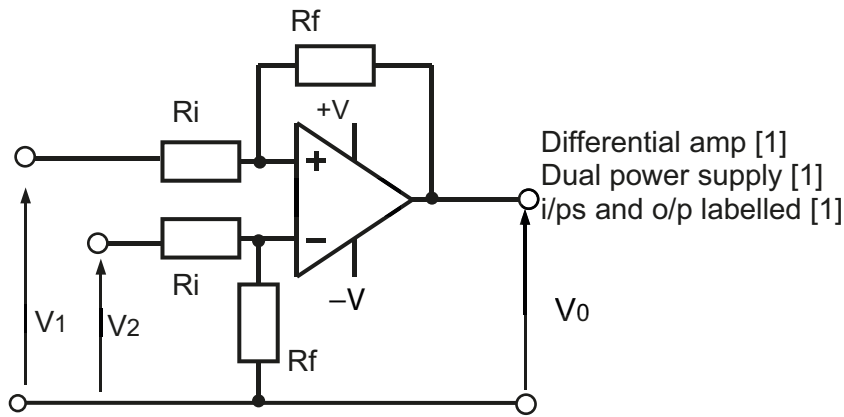
All relevant, valid responses will be given credit. [2]

(b) (i) The bridge circuit uses 2 voltage dividers [1] to provide a measurable proportional output voltage corresponding to the very small changes in gauge resistance [1]

All relevant, valid responses will be given credit. [2]

(ii) $V_1 = 5 \times (150.8 / 301)$ [1]
 $= 2.504 \text{ V}$ [1] [2]

(iii) Sample answer



All relevant, valid responses will be given credit. [3]

(iv) gain = V_o/V_{in}
 $V_{in} = 2.504 - 2.5 = 0.004$ [1]
gain = $4.5/0.004 = 1125$ [1] [2]

(c) Indicative content:

- LED displays are generally more robust making them an appropriate choice for environments where shock, vibration and temperature variations are present. In the case of beam testing, these environmental conditions are highly likely as the actuator display will be in physical contact with the actuator as the beam is loaded.
- LED displays have a wide viewing angle and have a generally higher contrast than non backlit LCD displays. This makes them easier to see from a range of angles even in bright conditions. The viewer of the actuator display can therefore keep a safe distance from the testing area.
- The actuator display requirement is to show a pressure reading which is likely to be numbers only. Therefore a relatively simple arrangement of 7 segment LED displays and appropriate hard wired drivers would be sufficient.
- One method of multiplexing that could be employed is to drive the LED displays one at a time but with high switching frequency between each display. The effect of persistence of vision can make the viewer believe the entire display is continuously active.
- Multiplexing allows for a number of displays, for example 3×7 segment displays with a total of 24 connection pins, to be driven with a much lower number of control pins. This can reduce the size and complexity of driver circuits. The resulting displays are also generally more efficient and cost effective to run as each display is not continuously illuminated.

All relevant, valid responses will be given credit.

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<p>Level 3 The candidate provides two excellent reasons for using an LED type display rather than an LCD type display for the beam testing application. The candidate then describes in detail one method of multiplexing that can be employed to drive an LED type display and provides an excellent explanation of the advantages of the chosen method of multiplexing. The written presentation is clear and precise and demonstrates very good knowledge of the subject. Appropriate specialist terms and technological vocabulary are used throughout. The candidate uses excellent spelling, punctuation and grammar, and the form and style are of a high standard.</p>	<p>[7]–[9]</p>
<p>Level 2 The candidate provides two good reasons for using an LED type display rather than an LCD type display for the beam testing application. The candidate then describes in some detail one method of multiplexing that can be employed to drive an LED type display and provides a good explanation of the advantages of the chosen method of multiplexing. The written presentation is good and demonstrates an adequate knowledge of the subject to be considered. Some specialist terms and technological vocabulary used throughout. The candidate uses good spelling, punctuation and grammar, and the form and style are of a reasonable standard.</p>	<p>[4]–[6]</p>
<p>Level 1 The candidate provides basic reasons for using an LED type display rather than an LCD type display for the beam testing application. The candidate then describes in basic detail one method of multiplexing that can be employed to drive an LED type display and provides a basic explanation of the advantages of the chosen method of multiplexing. The written presentation is basic and demonstrates limited knowledge of the subject to be considered. Little use is made of specialist terms and technological vocabulary. The candidate uses basic spelling, punctuation and grammar with little accuracy, and the form and style are of a limited standard.</p>	<p>[1]–[3]</p>
<p>Response not worthy of credit</p>	<p>[0]</p>

All relevant, valid responses will be given credit.

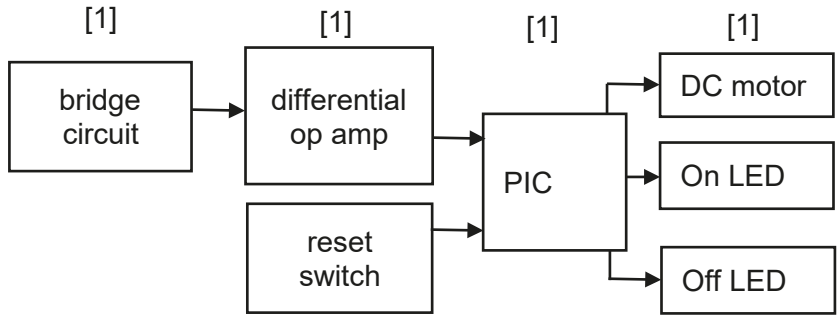
[9]

(d) (i) $2.1/5 \times 255$ [1]
 $= 107$ [1]

[2]

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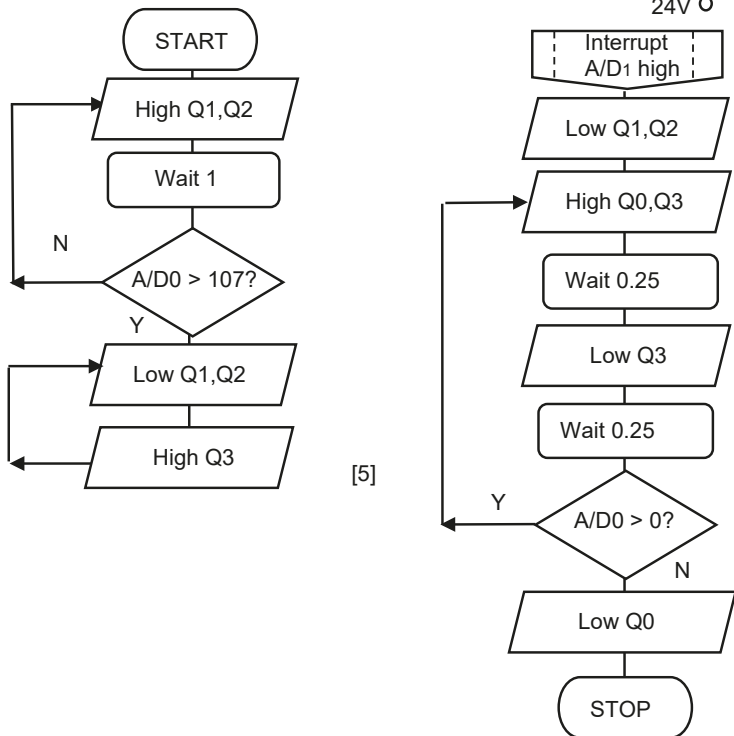
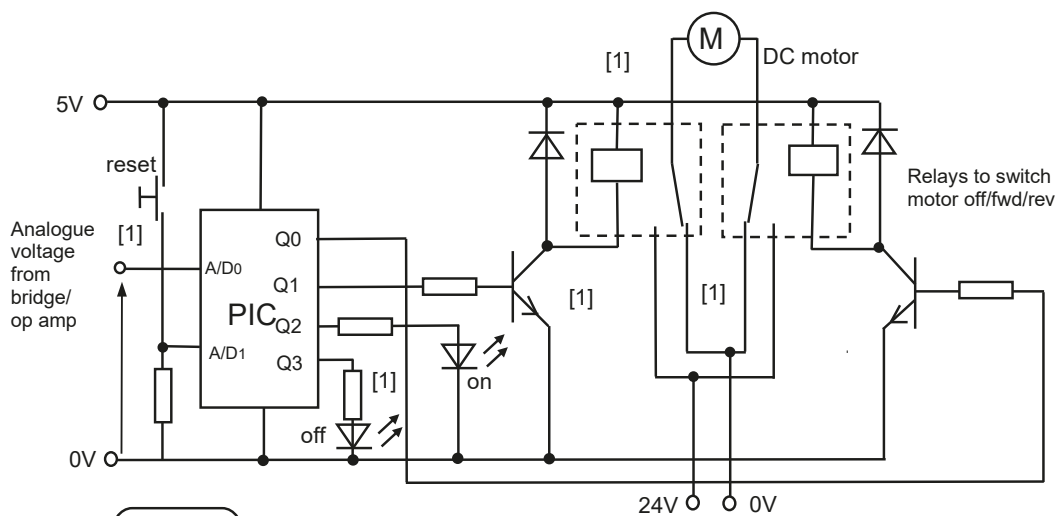
(ii)



All relevant, valid responses will be given credit.

[4]

(e) sample answer



[5]

All relevant, valid responses will be given credit.

[10]

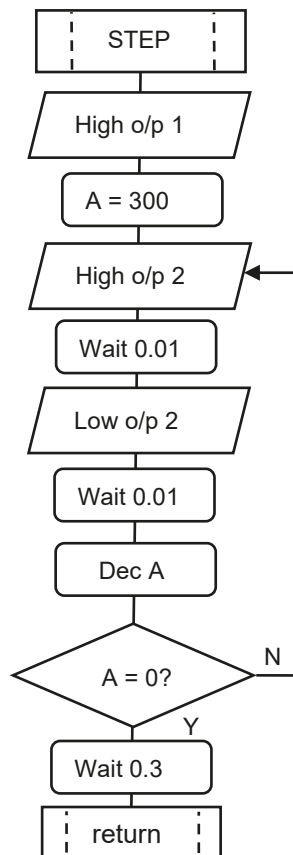
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- 2 (a) (i) Feedback loop drawn from either heater or motor [1] to temperature sensor or PIC [1] [2]
- (ii) A regulator will output a constant [1] voltage regardless of the current load placed on it, up to its current capacity. [1] [2]
- Drawback – inefficiency due to power dissipation. [1] [1]

All relevant, valid responses will be given credit.

- (b) (i) $360/1.8 = 200$ [1]
 $200 \times 15 = 3000$ [1]
 $3000/60 = 50 \text{ Hz}$ [1] [3]
- (ii) $360/1.8 = 200$
 $200 \times 1.5 = 300 \text{ steps}$ [1] [1]

(iii) sample answer

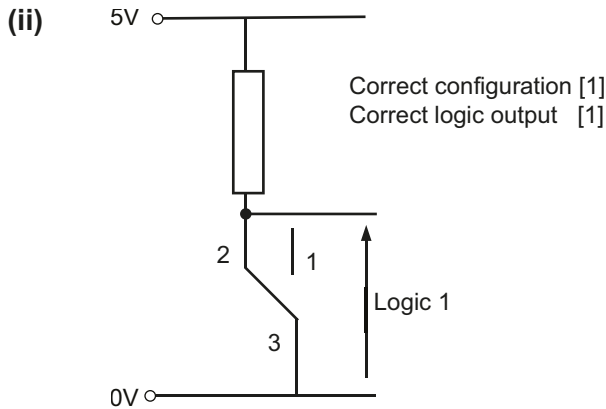


Value for step wait [1]
 Count loop [2]
 Wait [1]
 Return [1]
 Minimum number of commands [1]

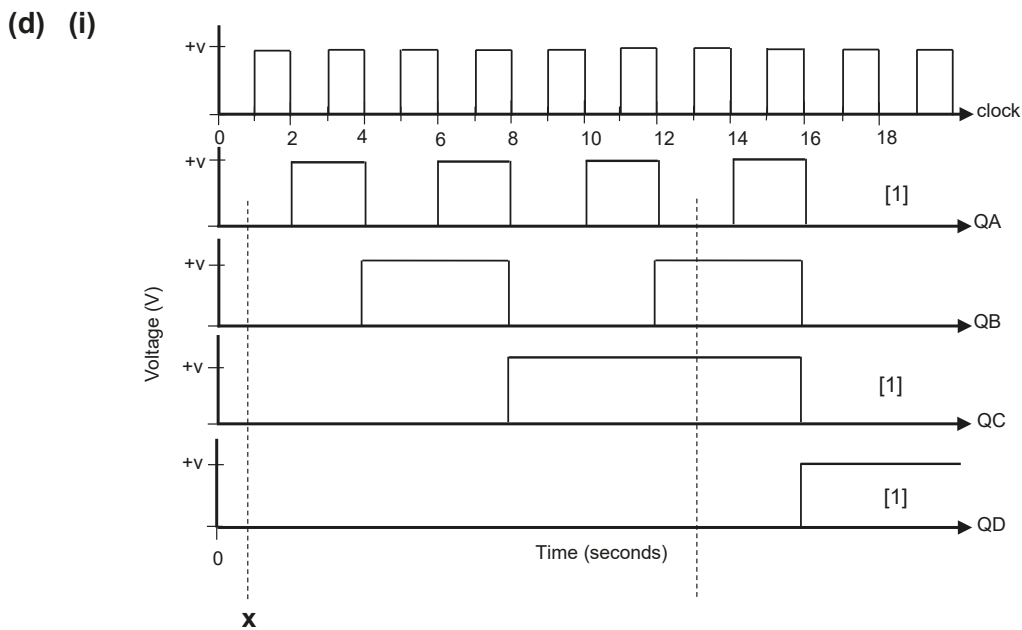
All relevant, valid responses will be given credit. [6]

- (c) (i) Microswitches are generally non-latching [1] therefore require a spring to return the switch contacts to their normal condition [1]

All relevant, valid responses will be given credit. [2]



All relevant, valid responses will be given credit. [2]



[3]

(ii) Appropriate position of line [1]

All relevant, valid responses will be given credit.

Binary equivalent of 6 = 0110 [1]

(iii) The output QA of the binary counter has a frequency of half the clock [1] frequency so can be considered as a divide by 2 output. [1]

All relevant, valid responses will be given credit. [2]

(iv) A BCD counter follows sequence of binary numbers [1] from 0000 to 1001 and then returns to 0000 and repeats. [1]

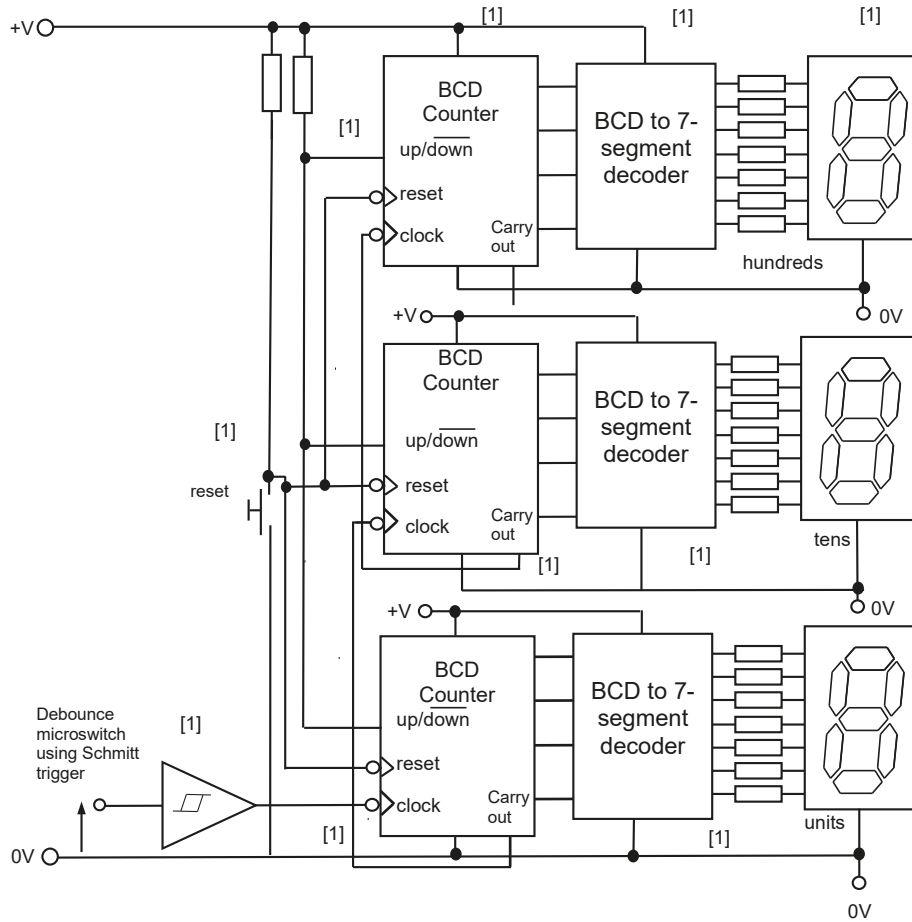
All relevant, valid responses will be given credit. [2]

(e)

A	B	C	D	a	b	c	d	e	f	g
1	0	0	0	0	1	1	0	0	0	0
1	1	0	0	1	1	1	1	0	0	1

A,B,C,D [1] a,b,c,d,e,f,g [1] [2]

(f) sample answer



All relevant, valid responses will be given credit.

[10]

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Section A

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Section B

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Mechanical and Pneumatic Control Systems

Answer **both** questions in this section.

3 (a) Any **one** advantage of chain and sprocket systems for example:

- Simple to repair and replace, [1] resulting in lower maintenance. [1]
- High torque transmission [1] capable of transmitting high torque loads, making them suitable for heavy-duty applications. [1]

Any **one** disadvantage of chain and sprocket systems for example:

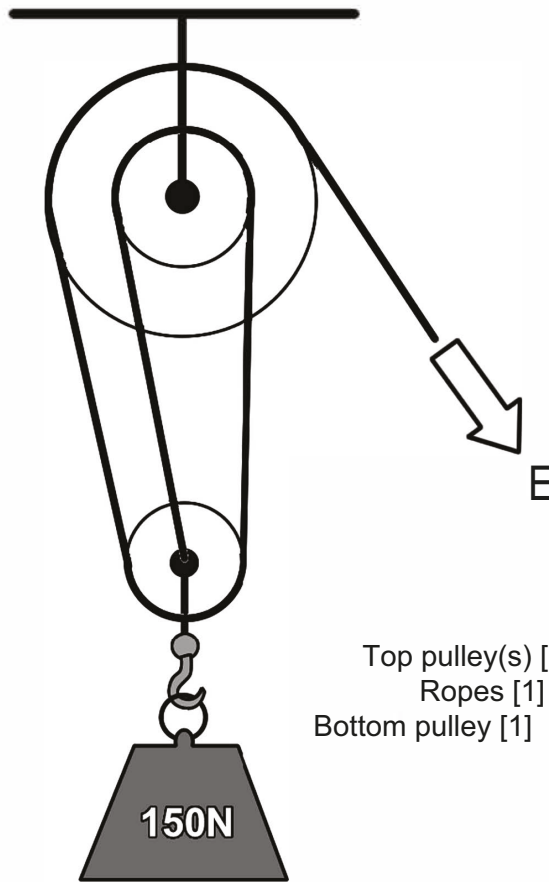
- Chains and sprockets can generate noise and vibrations during operation, [1] especially at high speeds. [1]
- Chain and sprocket systems require regular maintenance to ensure proper functioning. [1] This includes lubrication to prevent wear. [1]

(2 × [2])

[4]

All relevant, valid responses will be given credit.

(b) (i)



Top pulley(s) [1]
Ropes [1]
Bottom pulley [1]

[3]

(b) (ii) $150\text{N} / 3 = 50\text{N}$

[1]

- (c) (i) Annotation to include:
spider and yokes.

Very good sketch of the main features of a universal joint with very good annotation.	[3]
Good sketch of the main features of a universal joint with good annotation.	[2]
Limited sketch of the main features of a universal joint with limited annotation.	[1]
For a response not worthy of credit.	[0]

[3]

- (ii) Any specific application for example:

- Car drive shaft.
- Car steering column.

[1]

All relevant, valid responses will be given credit.

- (d) Outstroke force.

$$\text{Area cylinder A} = (80 \times 80) \times 3.14 = 20096 \text{ mm}^2 \quad [1]$$

$$\text{Outstroke force cylinder A} = 20096 \times 0.5 = 10048 \text{ N}$$

$$\text{Outstroke force cylinder B1} = 10048/2 = 5024 \text{ N} \quad [1]$$

$$\text{Area B1} = 5024/0.5 = 10048 \text{ mm}^2$$

$$\text{Diameter B1} = (\text{SQRT}(10048/3.14)) \times 2 = 113 \text{ mm} \quad [1]$$

[3]

- (e) **Indicative content:**

Mechanical Components:

- Limited operating speed: Mechanical systems often have limitations on their operating speed due to factors such as inertia, friction, and backlash. This can affect the overall efficiency and response time of the system.
- Limited power transmission capabilities: Mechanical systems may have limitations in terms of the amount of power they can transmit. Higher power requirements may require larger and heavier components, which can limit their practicality.
- Vulnerability to wear and tear: Mechanical components can experience wear and tear over time due to friction and mechanical stresses. This can result in reduced efficiency and the need for regular maintenance and replacement.

Pneumatic Components:

- Limited precision: Pneumatic systems generally have lower precision compared to other types of systems, such as electrical or hydraulic systems. This can limit their suitability for applications that require high accuracy.
- Compressibility and elasticity: Air is compressible and can exhibit elasticity, which can result in pressure fluctuations and unwanted oscillations in the system. This can affect the stability and control of the system.

- Air leakage: Pneumatic systems are prone to air leakage, especially at connection points or seals. This can result in decreased efficiency, reduced system performance, and the need for regular leak detection and maintenance.

Hydraulic Components:

- Maintenance and leakage: Hydraulic systems require regular maintenance and inspection to prevent leaks, as hydraulic fluid can escape through seals and connections.
- Incompressible fluid: Unlike air in pneumatic systems, hydraulic fluid is incompressible, which means any change in fluid volume requires a large force. This can lead to the need for larger and more powerful components.
- Unsuitable for use in food/pharmaceutical production due to risk of contamination.

<p>Level 3 The candidate response is excellent in depth and discusses limitations associated with the use of mechanical, pneumatic and hydraulic components and systems. The written presentation is clear and precise and demonstrates excellent knowledge of the issues to be considered. Appropriate specialist terms and technological vocabulary is used throughout. The candidate uses excellent spelling, punctuation and grammar, and the form and style are of a high standard.</p>	[7]–[9]
<p>Level 2 The candidate response is good in depth and discusses limitations associated with the use of mechanical, pneumatic and hydraulic components and systems. The written presentation is good and demonstrates good knowledge of the issues to be considered. Some specialist terms and technological vocabulary are used throughout. The candidate uses good spelling, punctuation and grammar, and the form and style are of a good standard.</p>	[4]–[6]
<p>Level 1 The candidate response is basic in depth and discusses limitations associated with the use of mechanical, pneumatic and hydraulic components and systems. The written presentation is basic and demonstrates basic knowledge of the issues to be considered. Little use is made of specialist terms and technological vocabulary. The candidate uses spelling, punctuation and grammar with basic accuracy and the form and style are of a basic standard.</p>	[1]–[3]
For a response not worthy of credit.	0

All relevant, valid responses will be given credit. [9]

(f) (i) Annotation to include – Housing and shaft races, bearings and cage.

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Very good exploded sketch of the main features of a thrust bearing with very good annotation.	[4]–[5]
Good sketch of the main features of a thrust bearing with good annotation.	[2]–[3]
Limited sketch of the main features of a thrust bearing with limited annotation.	[1]
For a response not worthy of credit.	[0]

All relevant, valid responses will be given credit. [5]

(ii) Any specific application for example:

- Car clutch bearing.
- Machine lead screws.

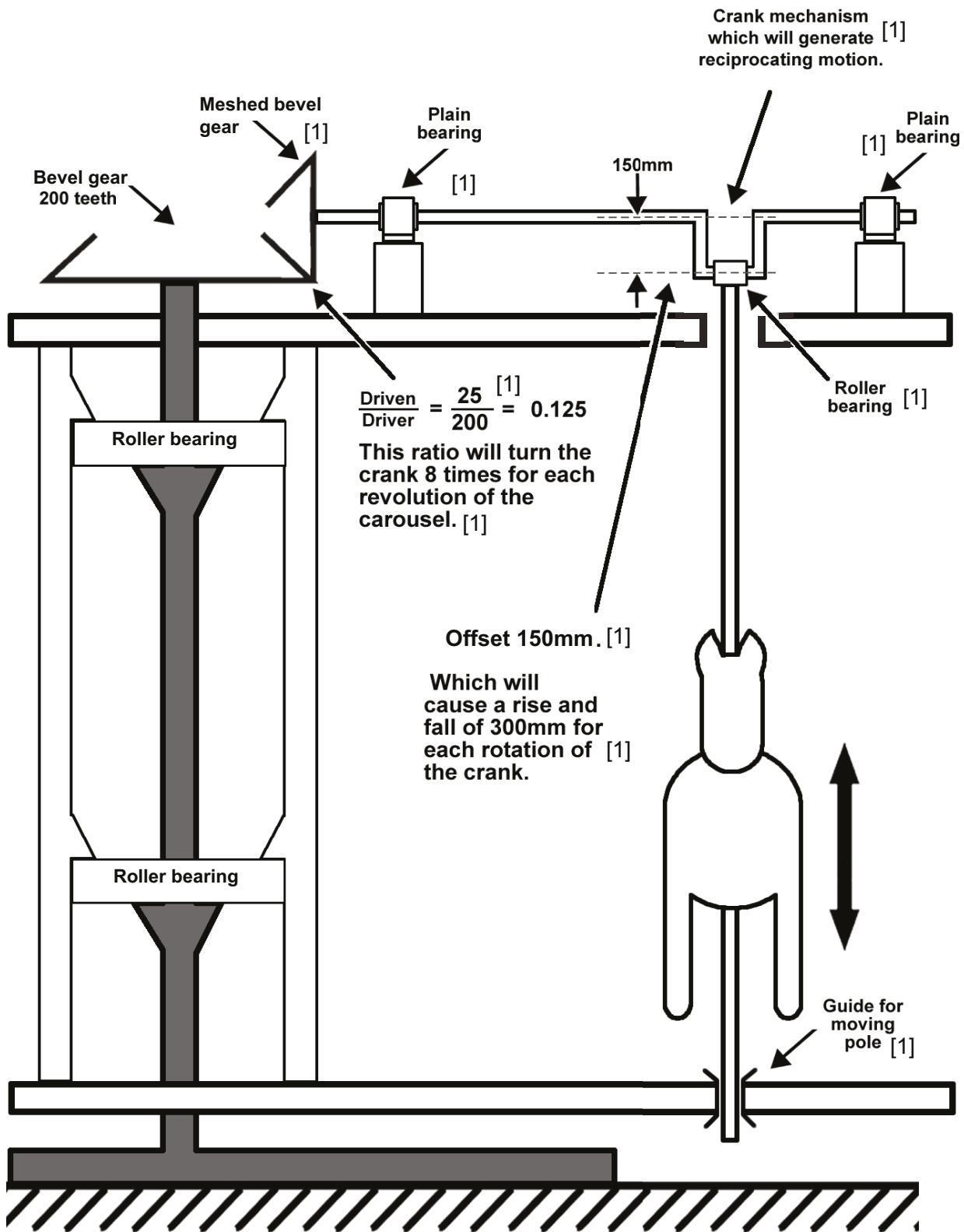
All relevant, valid responses will be given credit. [1]

(g) See pro forma on page 15.

Very good annotated sketches of a mechanical system that presents a plausible solution to transmit and convert motion from the bevel gear to cause the required motion. The solution presented incorporates an appropriate mechanical system and indicates the motion and constrains of the mechanical parts. Annotation is very good and identifies the mechanical systems used and explains the function of the overall system.	[7]–[10]
Good annotated sketches of a mechanical system that presents a solution to transmit and convert motion from the bevel gear to cause the required motion. The solution presented incorporates a mechanical system and indicates the motion and constrains of the mechanical parts. Annotation is helpful in explaining the function and systems used in the design.	[4]–[6]
Limited sketches lacking the detail required to determine if the design of the mechanism will be able to perform the function required. Limited annotation that identifies and explains some details but lacking in clarity.	[1]–[3]
For a response not worthy of credit.	0

All relevant, valid responses will be given credit. [10]

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Pro forma MS page
(answer number 3 (g))

40

4 (a) (i)

$$\frac{\text{Driven}}{\text{Driver}} = \frac{125}{50} \times \frac{240}{80} \times \frac{320}{40} \times \frac{250}{100} \times \frac{100}{100} = 150$$

A	C	E	G	I	J
2.5	3	8	2.5	1	[1]

[2]

(ii)

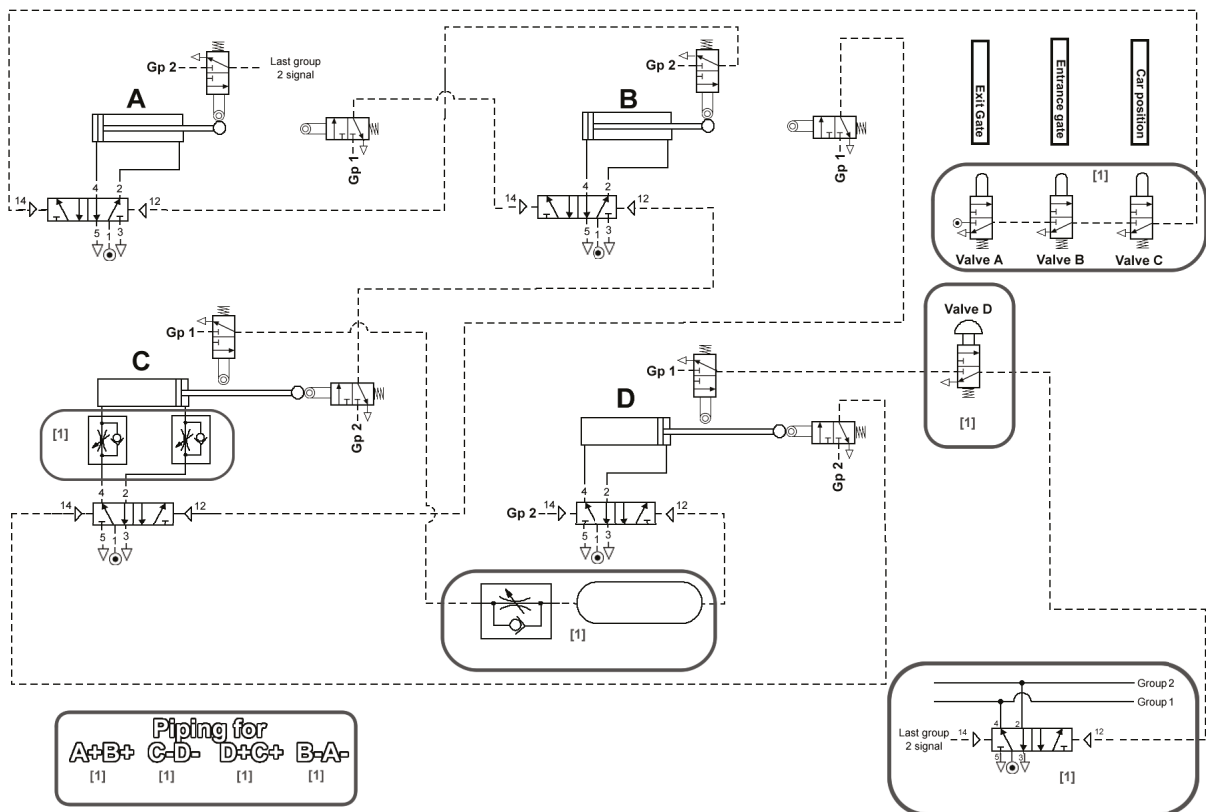
Motor speed	4000 rpm	
VR	94	
Output speed =	42.6 rpm	[1]
Driver wheel diameter =	300 mm	
Wheel circumference =	942 mm	
linear speed = $0.942 \times 42.6 = 40.1$	m/min	[1]

[2]

(b) Pro forma

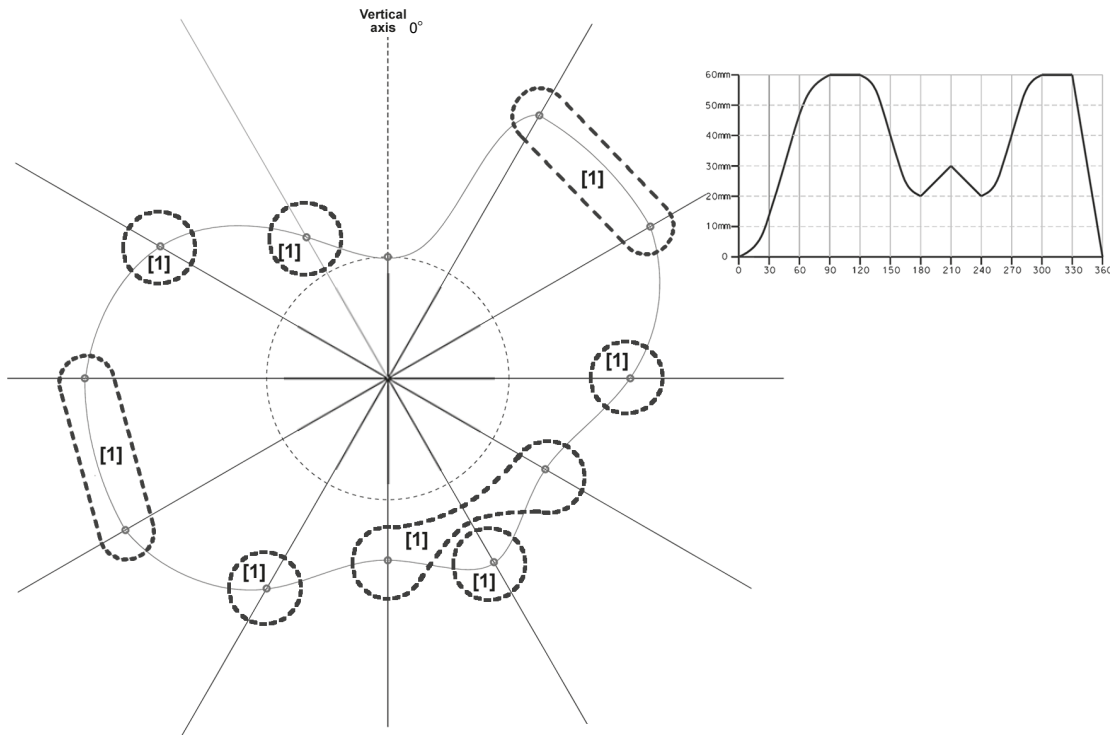
[9]

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(c) Pro forma – see A3 Mark Scheme

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Cam profile drawn in correct rotation [1]

[9]

(d) (i) The spring maintains the contact [1] between the rubber seal and the rotating shaft [1]

[2]

(ii)

height = 40 m m

mass = 15000 N N

work done = $40 \text{ m} \times 15000 \text{ Nm} = 600 \text{ kJ}$ [1]

Time taken = 30 s

Power required = $600 \text{ kJ} / 30\text{s} = 20 \text{ kW}$ [1]

Hoist efficiency = 75%

Power input = $(20 \text{ kW} \times 100) / 75 = 26.7 \text{ kW}$ [1] [3]

(iii)

Motor torque 2000 Nm

Work done 6500000 J

Angular displacement = work done/torque

Angular displacement = $6500000 / 2000 = 3250 \text{ rad}$ [1]

shaft revs = $3250 / 6.28$ [1] = 517.5 revs [1] [3]

(e) See Pro forma

Very good annotated sketches of a system that presents a plausible solution to transmit and convert motion from the pneumatic cylinder to cause the required motion. The solution presented incorporates an appropriate mechanical system and indicates the motion and constraints of the mechanical parts. Annotation is excellent and identifies the mechanical systems used and explains the function of the overall system.	[7]–[10]
Good annotated sketches of a system that presents a solution to transmit and convert motion from the pneumatic cylinder to cause the required motion. The solution presented incorporates a mechanical system and indicates the motion and constraints of the mechanical parts. Annotation is helpful in explaining the function and systems used in the design.	[4]–[6]
Limited sketches lacking detail required to determine if the design of the system will be able to perform the function required. Limited annotation that identifies and explains some details but lacking in clarity.	[1]–[3]
The response is not worthy of any credit.	[0]

[10]

All relevant, valid responses will be given credit.

Section B

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Section C

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Product Design

- 5 (a) Needs are associated with products that meet a basic human requirement [1] whereas demands are associated with what the customer would like [1]

All relevant, valid responses will be given credit. [2]

- (b) (i) Any **two** characteristics associated with growth, for example:

- Product sales increase significantly.
- Marketing costs will be lower than in the introduction phase as awareness of the product has been created.
- Product begins to make more profit.

(2 × [1]) [2]

All relevant, valid responses will be given credit.

- (ii) Any **two** characteristics associated with maturity, for example:

- Production volumes increase and as a result costs are lowered.
- Product sales peak and market saturation is reached.
- More competitors enter the market.

(2 × [1]) [2]

All relevant, valid responses will be given credit.

- (c) (i) Market research will benefit a company by allowing a business to understand consumer needs [1] which reduces the risk of the product or service failing. [1]

All relevant, valid responses will be given credit. [2]

- (ii) Any **two** different examples of market research and how they are used to collect information, for example:

- Explanatory Research [1]

This is research that is carried out to explain a behaviour or trend in the market. [1]

- Exploratory Research [1]

This is research that is carried out when a problem is not clearly defined or understood by a business. [1]

- Descriptive Research [1]

This is research carried out to provide an accurate description of a trend that is occurring. [1]

(2 × [2])

All relevant, valid responses will be given credit. [4]

(d) (i) Any **one** specific example how the national government has influenced environmental issues through product design, for example:

- The government influenced environmental issues by the development of specific recycling bins for a range of domestic and industrial waste. [1] The recycling has resulted in less waste going to landfill and the reuse of existing materials. [1] [2]

(ii) Any **one** specific example how the EU has influenced environmental issues through product design for example:

- Eco-Labeling – The EU developed a labelling system which rated the energy efficiency of domestic products such as fridges, washing machines and tumble dryers [1] This label indicated to customers the level of efficiency of the product which may influence sales. [1] [2]

All relevant, valid responses will be given credit.

(e) Advantages and Disadvantages of biodegradable plastics.

Any **two** advantages of biodegradable plastics, for example:

- Biodegradable plastics take less time to break down after being thrown away.
 - Biodegradable plastics are made from biomass and are completely renewable resources.
 - Biodegradable plastics are better for the environment, as little or no harm is done to the earth when recovering fossil fuels.
- (2 × [1]) [2]

Any **one** disadvantage, for example:

- When dumped in landfills, biodegradable plastic may create methane.
- Biodegradable waste can contain toxins.

All relevant, valid responses will be given credit. [1]

(f) (i) Responsible sourcing is an ethical approach to sourcing materials needed for manufacture. [1] It's when an organisation such as the Forestry Stewardship Council (FSC) source products and services in an ethical, sustainable and socially conscious way. [1]

All relevant, valid responses will be given credit. [2]

(ii) Explain what is meant by embodied energy.

Embodied energy is a calculation of all the energy that is used to produce a material or product, [1] including mining or extracting the raw material, manufacturing the individual parts, assembly and transporting the raw materials including the final product. [1]

All relevant, valid responses will be given credit. [2]

- (g) (i) Any **two** advantages of the use of CAM, for example:
- Rapid data storage and retrieval.
 - It facilitates the repetition of the manufacturing process.
 - It reduces labour costs.
- (2 × [1])

All relevant, valid responses will be given credit. [2]

- (ii) Any **one** disadvantage of the use of CAM, for example:
- Issues with regard to the security of data.
 - High initial investment – plant and training.

All relevant, valid responses will be given credit. [1]

- (h) Any **two** other ICT systems which could be used in the design and manufacture of the accessories for example:

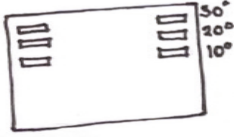
- to communicate with customers of the accessories [1] (both nationally and internationally) webcams, video conferencing and messaging apps. [1]
 - to order parts for the accessories [1], ensure stock levels and schedule manufacture. [1]
 - used in marketing the accessories [1] (website) sales and online market research. [1]
- (2 × [2])

All relevant, valid responses will be given credit. [4]

(i) Sample answer could be:

Material used is acrylic that has been laser cut out for accuracy. The surface is 5mm extra on each side than the dimensions of the laptop base.

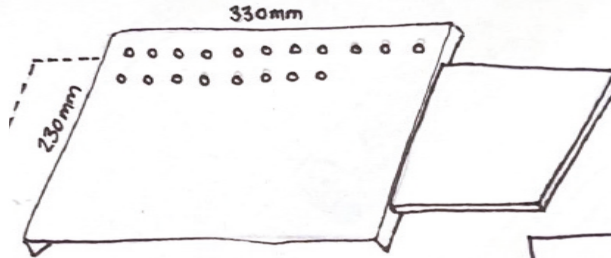
Three set slots cut into the base to allow legs to slot into and provide three different angles of 10°, 20° and 30°.



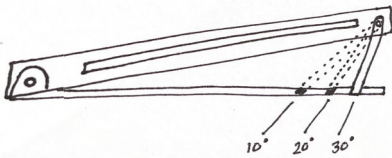
Line bent



Dimensions are 330mm x 230mm with 5mm holes on the surface.



Solid acrylic leg shown in position with aluminium bar allowing range of motion.



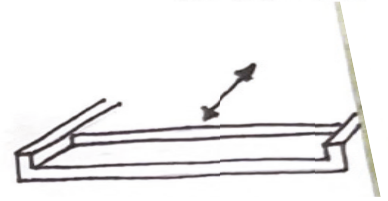
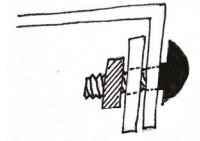
Solid leg that rotates to three different angles.

Surface of the stand is covered in 5mm holes to allow air flow to base of the laptop.

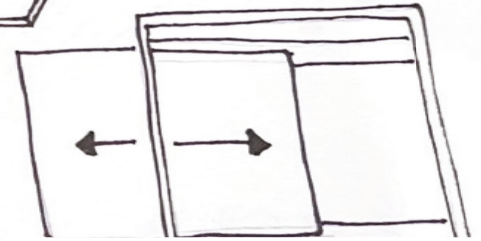


Product collapsed down with all aspects folded inside it.

Plastic fastener used to hold the layers together.



Integrated rails on the underside of the stand to allow the mouse surface to slide easily from one side to the other.



Exterior surface can slide to either side to allow a left or right handed user to use an exterior mouse.

AVAILABLE MARKS

AVAILABLE MARKS

Very good annotated sketches of a lightweight, compact, easily assembled stand. This will allow the user to quickly set the laptop at an angle between 10° and 30° and will allow airflow around the laptop when in use. The design provides a retractable surface for use with an exterior mouse for either a left or right-handed user. Suitable dimensions for the design are evident.	[6]–[8]
Both the sketches and the annotation are good. The design has limitations with regards to it being an appropriate lightweight, compact, easily assembled stand. This may allow the user to quickly set the laptop at an angle between 10° and 30° and allow airflow around the laptop when in use. There are limitations in regards to the retractable surface for use with an exterior mouse for either a left or right-handed user. There are limitations in regards to the suitability of the dimensions of the design.	[4]–[5]
Limited sketches lacking detail and appropriate annotation. Difficulties in determining if it is an appropriate lightweight, compact, easily assembled stand. This may not allow the user to set the laptop at an angle between 10° and 30° or allow airflow around the laptop when in use. Difficulties in determining if there is a suitable retractable surface for use with an exterior mouse for either a left or right-handed user. Limited consideration given to dimensions of the design.	[1]–[3]
The response is not worthy of any credit.	[0]

AVAILABLE MARKS

Suitable material [1]
Appropriate manufacturing process for small scale production [1] [10]

40

- 6 (a) (i) Inclusive design means a designer/manufacturer producing a product which users of differing ages and abilities can use easily. [1]
- All relevant, valid responses will be given credit.** [1]
- (ii) Any **two** ways a new product arises, for example:
- New technology being introduced.
 - A gap in the market identified by market research.
 - Government/European legislation.
- All relevant, valid responses will be given credit.** [2]
(2 × [1])
- (b) Designed for maintenance. An example could be a torch. Designing for maintenance could be changing batteries, replacing a bulb, or replacing a part which has become worn. [1] The use of screw fitting or the use of non-specialist equipment within the product. [1]
- All relevant, valid responses will be given credit.** [2]
- (c) (i) An appropriate pricing strategy for the introduction stage could be: Penetration pricing. A business will set a low price to initially attract new customers away from their competitors [1] and then once the customers are hooked, the business will raise the price of the product. [1]
- All relevant, valid responses will be given credit.** [2]
- (ii) An alternative pricing strategy for the maturity stage could be: Competitive pricing. In competitive pricing, a business will charge a similar or lower price than their competitor's [1] making their product more attractive to consumers and increasing their market share. [1]
- All relevant, valid responses will be given credit.** [2]
- (d) **Indicative content:**
- Recycle – Design for ease of disassembly and ensure that materials are clearly labelled for recycling purposes. The Dyson cleaner has a high percentage of high-grade recyclable materials which are clearly identified for sorting purposes. In addition, the electrical parts of the product have been designed to be fully recyclable.
- Refuse – Refuse is to refrain from buying and using products that you do not need. This includes items that are not essential, have excessive packaging, are single-use, or are not energy efficient. By refusing anything that is unnecessary, you can reduce waste coming into your household. Refusing to buy products that are not environmentally sustainable or are not necessary can help reduce your ecological footprint.
- Rethink – Vehicle manufacturers have rethought designs for new models using smart data to create a vehicle much lighter than its previous model. In addition, rethinking through the life cycle assessment helped manufacturers to see it was more sustainable to incorporate materials from local sources rather than materials sourced from/across the globe.

<p>Level 3 The candidate has provided suitable practical example(s) for rethink, refuse and recycle. They provide an excellent explanation of how these R's have been specifically incorporated into the design of their chosen examples. The written presentation is clear and precise and demonstrates an excellent knowledge of the subject to be considered. Appropriate specialist terms and technological vocabulary used throughout. The candidate uses excellent spelling, punctuation and grammar, and the form and style are of a high standard.</p>	[7]–[9]
<p>Level 2 The candidate has provided some suitable practical example(s) for rethink, refuse and recycle. They provide a good explanation of how these R's have been specifically incorporated into the design of their chosen examples. The written presentation is good and demonstrates an adequate knowledge of the subject to be considered. Some specialist terms and technological vocabulary used throughout. The candidate uses good spelling, punctuation and grammar, and the form and style are of a good standard.</p>	[4]–[6]
<p>Level 1 The candidate has provided basic practical example(s) for rethink, refuse and recycle. They provide a basic explanation of how these R's have been specifically incorporated into the design of their chosen examples. The written presentation is basic and demonstrates basic knowledge of the subject to be considered. Little use is made of specialist terms and technological vocabulary used throughout. The candidate uses spelling, punctuation and grammar with limited accuracy and the form and style are of a basic standard.</p>	[1]–[3]
The response is not worthy of any credit.	[0]

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MARKS

[9]

(e) Outline **two** characteristics associated with the Memphis movement, for example:

- It was a reaction to the slick, black, humourless design of the 1970s with its minimalist design, [1] all of which were visually similar and in the eyes of the Memphis group, devoid of personality and individualism. [1]
- They created limited production creations of unusual objects and functional designs [1] featuring plastic laminate surfaces, bright colours and bold patterns. [1]
- They encapsulated post-modernist design in the 1980s, challenging perceptions of 'good design' through their gaudy ornamental and decorative products, [1] providing form over function. [1]

(2 × [2])

[4]

All relevant, valid responses will be given credit.

- (f) (i) Technology push is an approach which attempts to interest the market in new products based on new technological advancement such as a smart phone. [1] The consumer or end market have not requested this product or identified it as a need. [1]

All relevant, valid responses will be given credit. [2]

- (ii) Market pull is an approach which attempts to provide products that the market demands such as gluten free products. [1] Detailed analysis of market research identified the need for gluten free products and consequently a new range of products entered the market. [1]

All relevant, valid responses will be given credit. [2]

- (g) Any **two** main advantages associated with the use of trade fairs for example:
- Very good for making new contacts and renewing old ones.
 - Access to a large number of potential buyers.
 - Instant feedback on products and pricing.

Any **two** main disadvantages associated with the use of trade fairs, for example:

- They are expensive.
- Time consuming.
- They are very competitive.

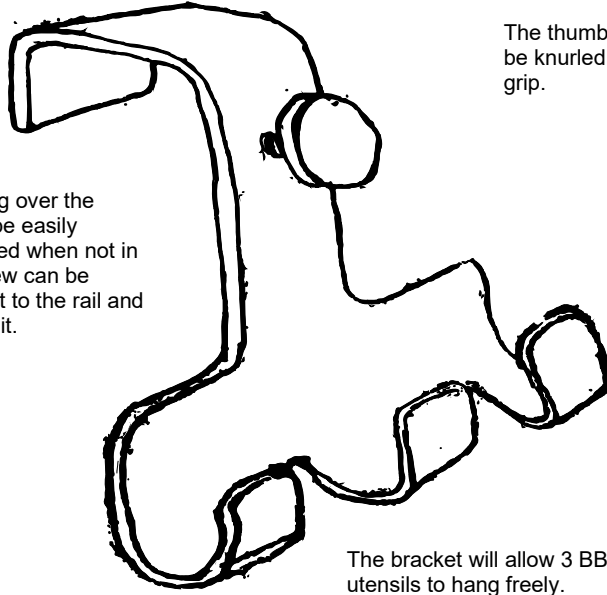
All relevant, valid responses will be given credit.

(4 × [1])

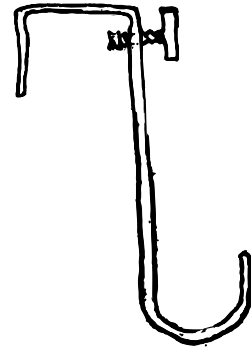
[4]

(h) (i) Sample answer could be:

The bracket will hang over the utensil rail and can be easily attached and removed when not in use. The thumb screw can be tightened to secure it to the rail and loosened to remove it.



The thumb screw could be knurled to improve grip.



Bracket made from stainless steel which is appropriate for outdoor use.

The bracket will allow 3 BBQ utensils to hang freely.

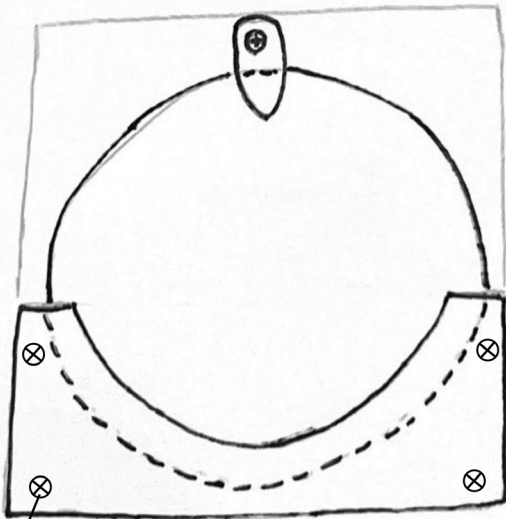
<p>Very good annotated sketches of an appropriate bracket that could be securely fixed to the new tubular metal utensil rail on the front of the BBQ and hold the three utensils shown. The design allows the utensils to hang vertically to prevent food contamination. The bracket is easily attached and removed from the utensil rail.</p>	<p>[4]–[5]</p>
<p>Both the sketches and the annotation are good. The design has limitations with regards to the bracket being securely fixed to the new tubular metal utensil rail on the front of the BBQ in order to hold the three utensils shown. There are limitations in regards the design allowing the utensils to hang vertically to prevent food contamination. There are limitations in regards the bracket being able to be easily attached and removed from the utensil rail.</p>	<p>[3]</p>
<p>Limited sketches lacking detail and appropriate annotation. Difficulties in determining if the design is an appropriate bracket which could be fixed to the new tubular metal utensil rail on the front of the BBQ. Difficulties in determining if the design will hold the three utensils shown and if the design will allow the utensils to hang vertically to prevent food contamination. Difficulties in determining if the bracket is able to be easily attached and removed from the utensil rail.</p>	<p>[1]–[2]</p>
<p>The response is not worthy of any credit.</p>	<p>[0]</p>

AVAILABLE MARKS

[5]

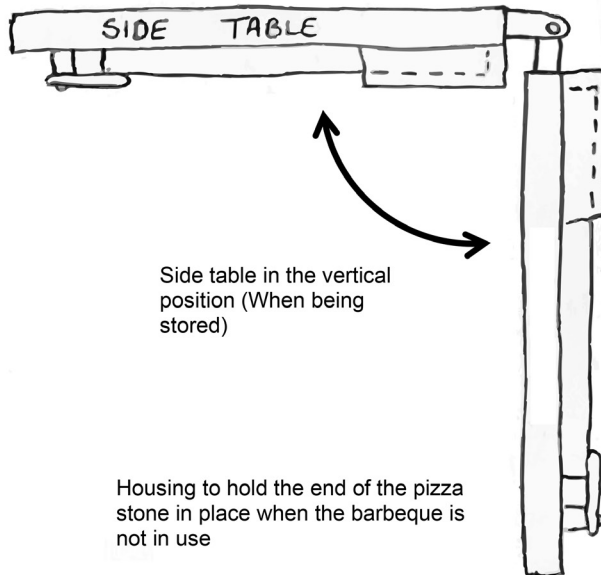
(ii) Sample answer could be:

Housing on the underside of the side table with a housing and rotary latch



Self tapping screws to fix to steel box section

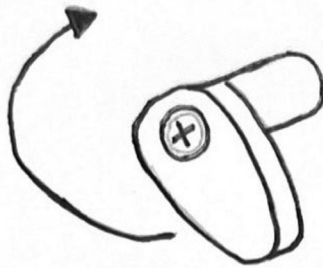
Side table in the horizontal position (In use)



Side table in the vertical position (When being stored)

Housing to hold the end of the pizza stone in place when the barbecue is not in use

Rotary latch to hold the pizza stone in the housing when the side table is folded down and the barbecue is not in use

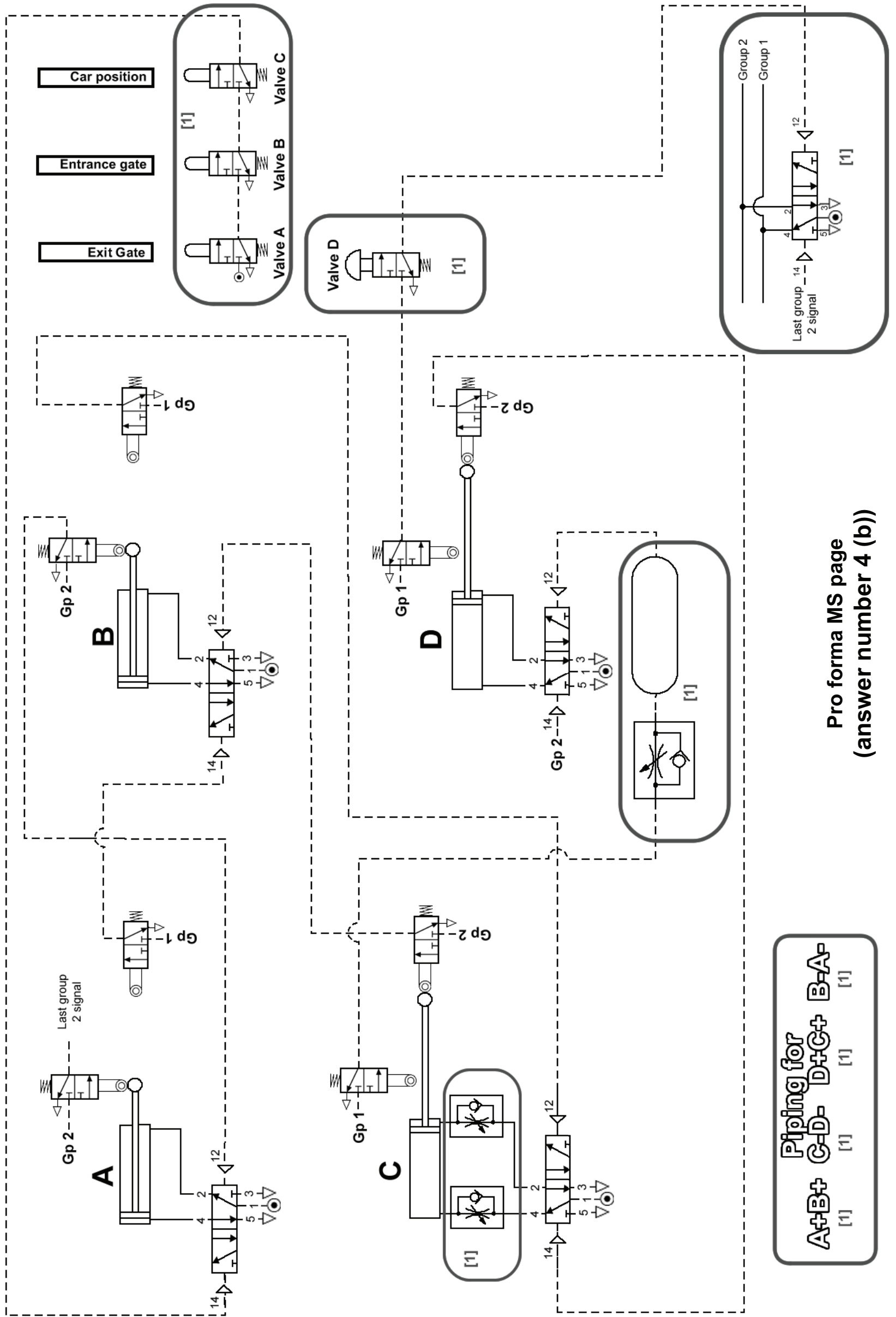


AVAILABLE MARKS

Very good annotated sketches of an appropriate method of attaching the pizza stone to the underside of the side table. The pizza stone is easily attached and removed when necessary and is securely held when the barbecue is not in use.	[4]–[5]
Both the sketches and the annotation are good. The design has limitations with regards to the method of attaching the pizza stone to the underside of the side table. There are limitations in determining if the pizza stone is easily attached and removed when necessary and may not be securely held when the barbecue is not in use.	[2]–[3]
Limited sketches lacking detail and appropriate annotation. Difficulties in determining if it is an appropriate method of attaching the pizza stone to the underside of the side table. Difficulties in determining if the pizza stone could be easily attached and removed when necessary and is not securely held when the barbecue is not in use.	[1]
The response is not worthy of any credit	[0]

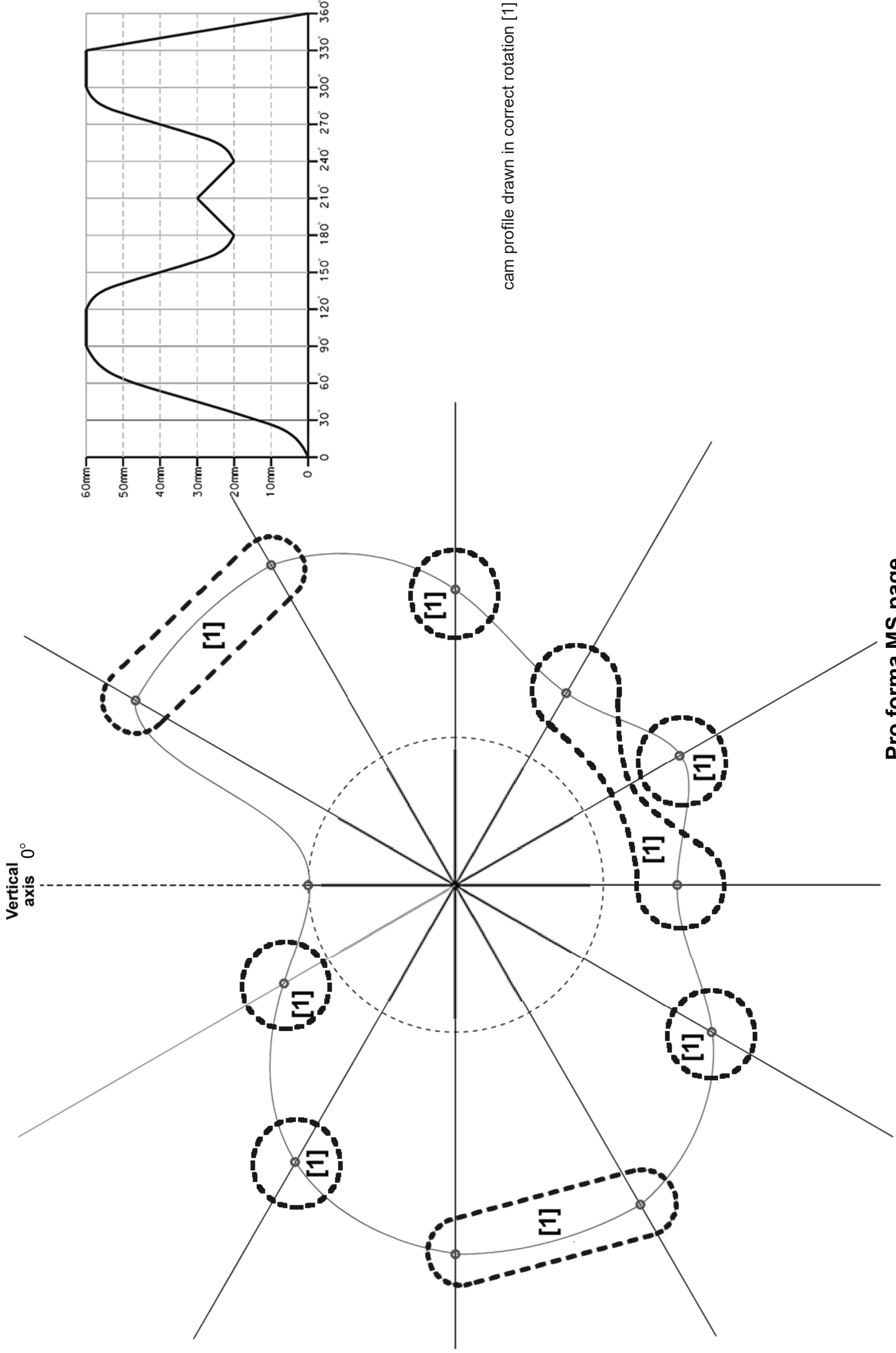
[5]	40
Section C	80
Total	80

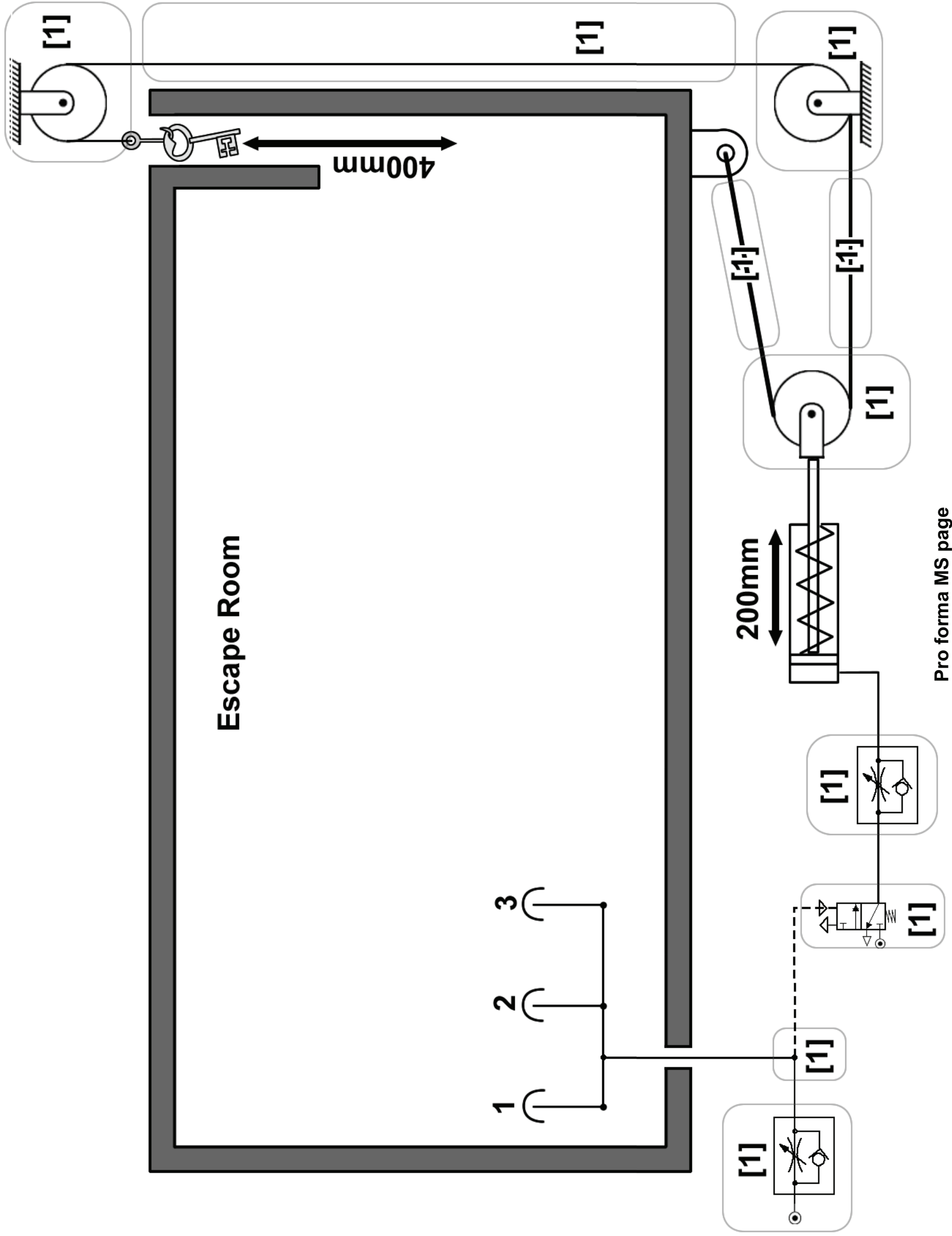
AVAILABLE MARKS
40
80
80



Piping for
A+B+ [1] **C-D-** [1] **D+C+** [1] **B-A-** [1]

Pro forma MS page
(answer number 4 (b))





[10]

Pro forma MS page
(answer number 4 (e))