



Rewarding Learning

**ADVANCED (A2)
General Certificate of Education
2024**

Technology and Design

Assessment Unit A2 1

assessing

Systems and Control or Product Design

[ATE11]

TUESDAY 4 JUNE, AFTERNOON

**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.

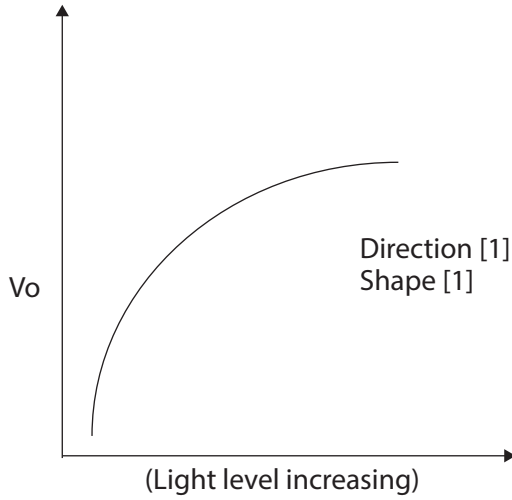
Section A

AVAILABLE MARKS

Electronic and Microelectronic Control Systems

1 (a) (i) Resistance increases as the light level decreases. [1]

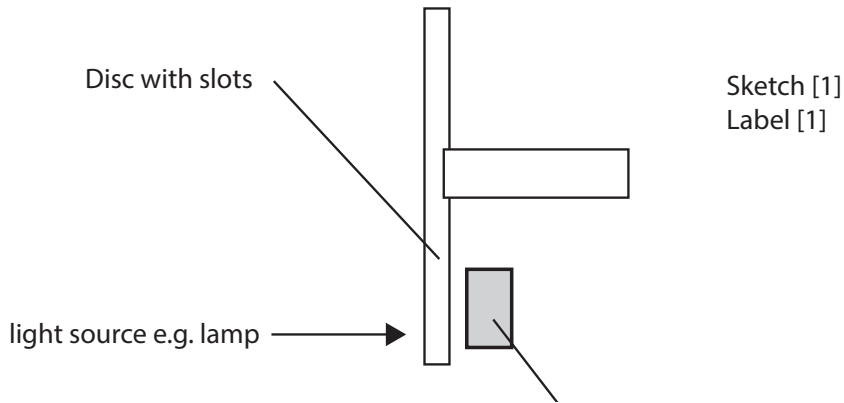
(ii) Sample answer



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

(iii) $5 \times 22/522$ [1] to $5 \times 22/23$ [1]
= 0.21V to 4.78V [1] [3]

(b) (i) Sample answer.



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

(ii) The slower response time of the LDR [1] will limit the rotation speed that can be detected. [1]
Award [2] for a full explanation and [1] for a limited explanation

A slotted optical switch based on a phototransistor. [1]

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

- (c) (i) To ensure that the pulses are directed to the clock input [1] of the frequency divider for 10 seconds only. [1]

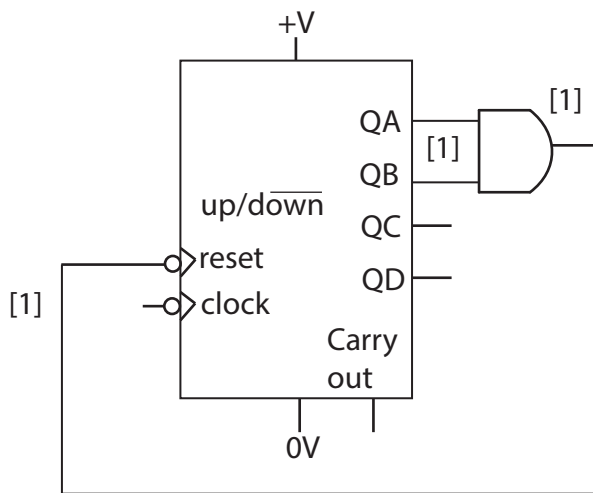
All relevant, valid responses will be given credit. [2]

- (ii) 3×2 (slots) per second = 6 [1]
 6×10 seconds = 60 pulses for 20 m/sec [1]
 Division factor = 3 [1] [3]

- (d) (i) Counter outputs will only reset [1] when the signal transitions from a high to a low voltage.[1]

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

- (ii) Sample answer



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

(e) **Indicative content:**

Main characteristics that make them suitable for the application:

Strain gauges are flexible, meaning that they can replicate the bending/ deformation of the material they are attached to provided that the strain gauge is appropriately bonded.

Deformation of the gauge causes a change in its cross sectional area and length which in turn changes its electrical resistance which can then be utilised to obtain a representative voltage. This makes them reliable as they have a relatively simple and robust composition.

A metal beam will typically experience compression on its top surface and extension on the bottom surface. Strain gauges can be used to detect changes in both compression and expansion as the resistance of the gauge will change with both of these types of deformation.

Strain gauge patterns allow them to detect deformation in the direction of a specific axis. This allows for detailed analysis of metal beam deformation along specific load paths.

Wheatstone bridge explanation:

In practice, the change in the strain of an object is very small resulting in very small changes in the resistance of the gauge. A Wheatstone bridge circuit provides a measurable proportional output voltage corresponding to the change in gauge resistance.

Discussion of issues associated with temperature variations:

The electrical resistance of a strain gauge is vulnerable to temperature

changes from a number of sources including ambient changes and heat caused by the deformation itself. These external and internal temperature changes can cause expansion of the strain gauge and this will introduce thermally-induced apparent strain. This strain can be viewed as an error caused by temperature change. Additionally changes in temperature can cause a change in gauge resistance even if the gauge is not deformed. Temperature compensation is therefore necessary to reduce or offset these thermal effects on the strain gauge measurements.

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MARKS

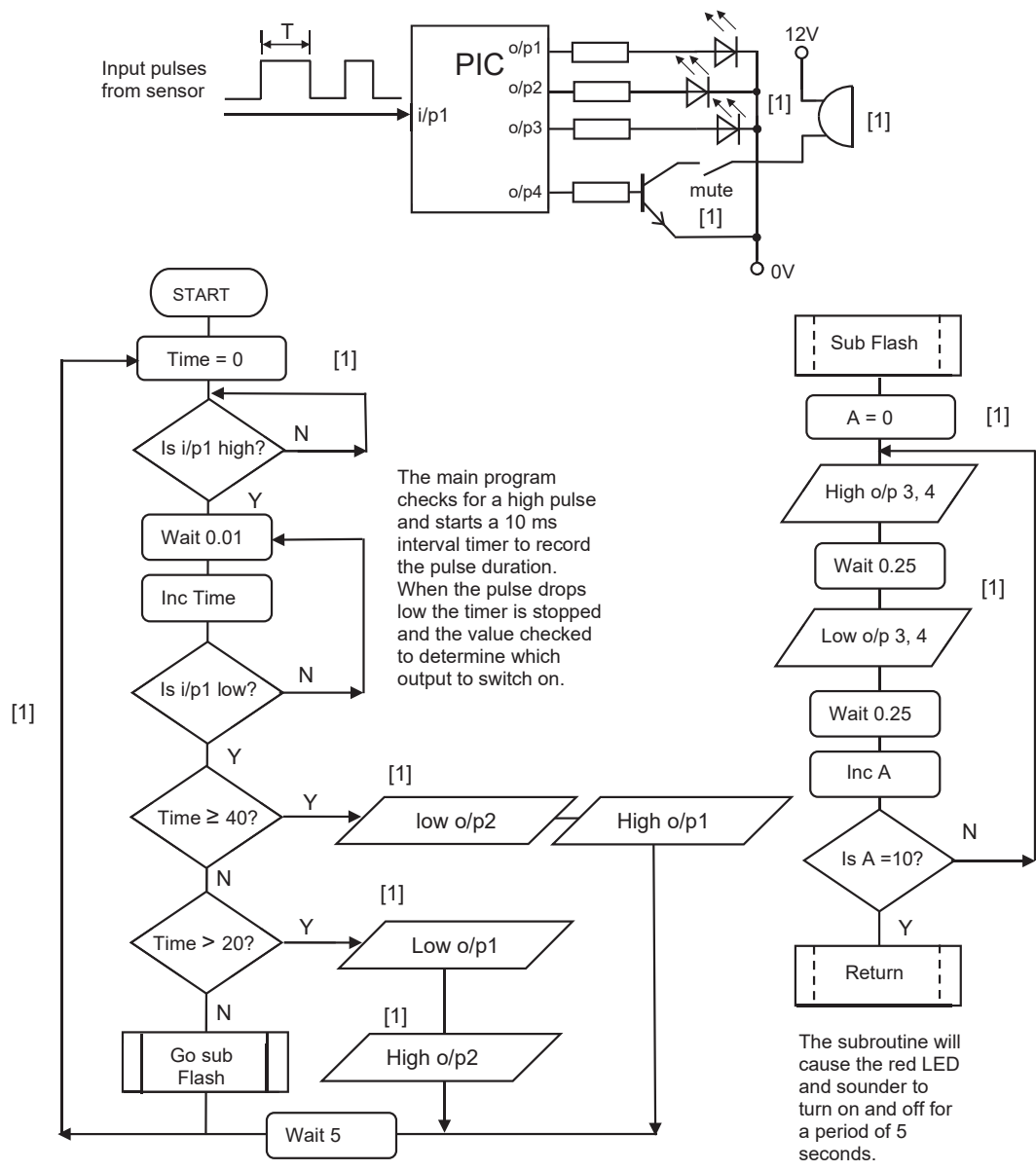
<p>Level 3 The candidate provides an excellent description of two main characteristics of strain gauges. The candidate then provides a detailed explanation of why a Wheatstone bridge is generally used in conjunction with a strain gauge followed by an excellent discussion of the issues associated with temperature variations. 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 a good description of two main characteristics of strain gauges. The candidate then provides a good explanation of why a Wheatstone bridge is generally used in conjunction with a strain gauge followed by a good discussion of the issues associated with temperature variations. 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 a basic description of one main characteristic of strain gauges. The candidate then provides a basic explanation of why a Wheatstone bridge is used in conjunction with a strain gauge followed by a basic discussion of the issues associated with temperature variations. 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]

(f) Sample answer

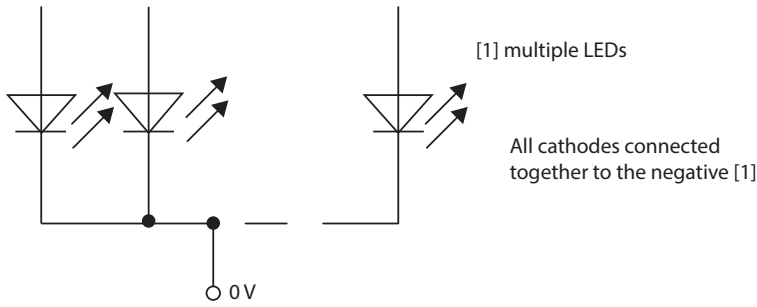
AVAILABLE MARKS



All relevant, valid responses will be given credit.

[10]

2 (a) (i)



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

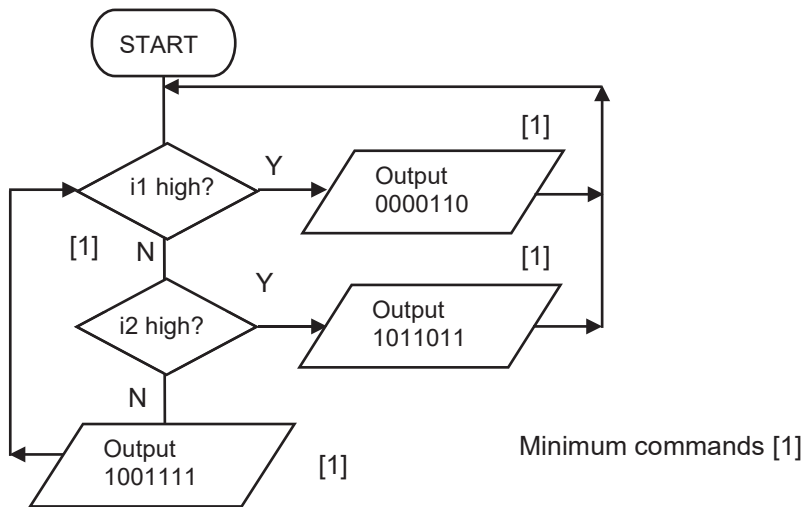
(ii) LED displays generally provide better visibility [1] in brighter light conditions compared to LCD displays.[1]

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

(b) (i) $R = (5 - 3.6) / 0.010$ [1]
 $= 140 \Omega$ [1] [2]

(ii) $P = 0.01 \times (5-3.6)$ [1] $\times 5$ [1]
 $= 70 \text{ mW}$ [1] [3]

(iii) Sample answer



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

(c) (i) The decoder uses the sequential binary input [1] to generate outputs to operate the appropriate seven segments of the display.[1]

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

(ii)

S1	S2	S3	A	B
1	0	0	1	0
0	1	0	0	1
0	0	1	1	1

[1]
[1]
[1] [3]

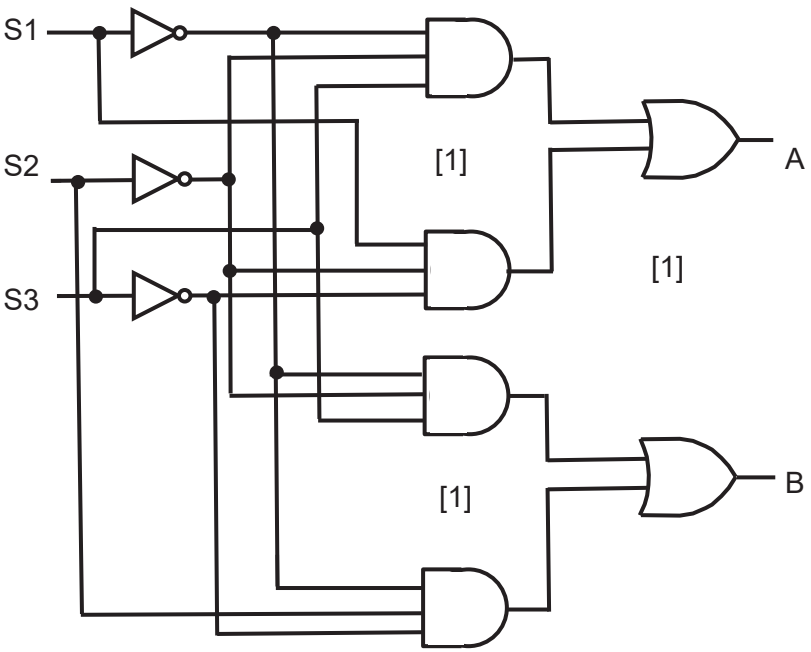
(iii) There are no groups [1] of horizontally or vertically adjacent cells containing '1' [1]

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

(iv) Logic expression for A = $\overline{S1} \cdot \overline{S2} \cdot S3 + S1 \cdot \overline{S2} \cdot \overline{S3}$

Logic expression for B = $\overline{S1} \cdot \overline{S2} \cdot S3 + \overline{S1} \cdot S2 \cdot \overline{S3}$ [2]

(v) Sample answer



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

(vi) A hard wired solution would require more integrated circuits [1] increasing the overall physical size. [1]

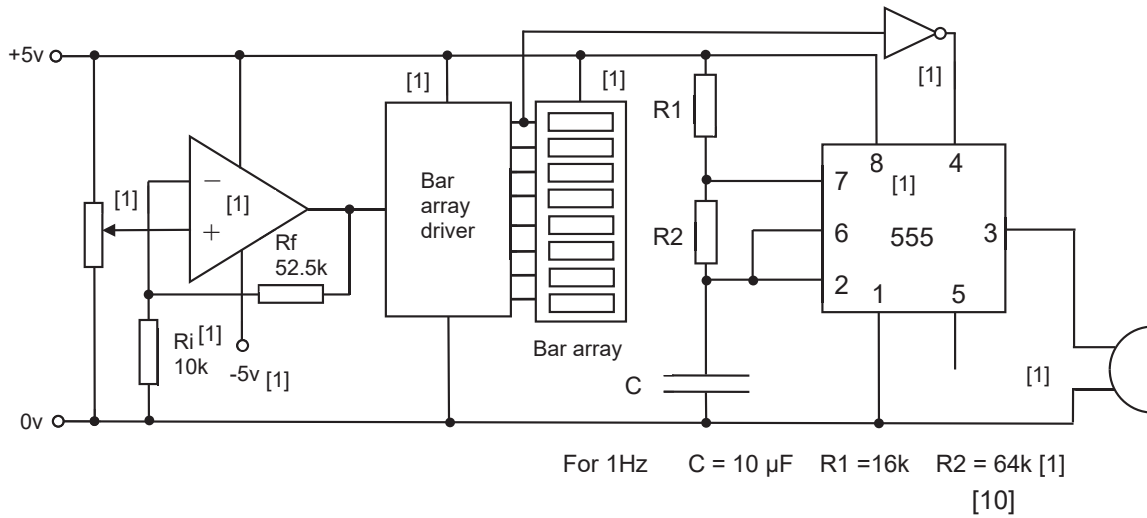
All relevant, valid responses will be given credit. [2]

(d) (i) Gain = 5/0.8 [1]
= 6.25 [1]

[2]

(ii) sample answer

AVAILABLE MARKS



Marks should not be awarded for repetitive drawings which do not show any design thinking.

All relevant, valid responses will be given credit.

[10]

80

Section B

**AVAILABLE
MARKS**

Mechanical and Pneumatic Control Systems

Answer **both** questions in this section.

- 3 (a) (i)** The oil complies with the Society of Automotive Engineers' standard/ classification for viscosity. [1] [1]
 Viscosity is the resistance to flow [1]
 Thin oils have a low viscosity and flow easily/Thick oils have a high viscosity and offer more resistance to flow [1] [2]
All relevant, valid responses will be given credit. [3]

- (ii)** Annotated sketch to include –
 Direction of rotation, ratchet, pawl and spring.

Very good sketch of the main features of a ratchet and pawl mechanism with very good annotation.	3
Good sketch of the main features of a ratchet and pawl mechanism with good annotation.	2
Limited sketch of the main features of a ratchet and pawl mechanism with limited annotation.	1
For a response not worthy of credit	0

[3]

Possible brief explanation of function –
 A ratchet and pawl is a mechanism that allows rotary motion in one direction while preventing motion in the opposite direction.

All relevant, valid responses will be given credit.

(1 × [1]) [1]

- (iii)** Any **three** of the main functions of oil in a mechanical system for example:
- Engine oil inhibits rust and corrosion – ensures longevity of the engine. [1]
 - Engine oil lubricates by forming a protective layer ensuring that the metal parts do not get in contact with each other. [1]
 - Engine oils help in cleaning the engine by carrying impurities to a filter. [1]
 - Engine oils have cooling effect that keeps the upper engine and its running parts cool. [1]

All relevant, valid responses will be given credit.

(3 × [1]) [3]

- (b) (i)** $700 \times 3000 = 2100000$ [1]
 $2100000/1200$ [1] = 1750N [1] [3]

- (ii)** Area A1A2: $((17.5 \times 17.5) \times 3.14) \times 2 = 1923.25 \text{ mm}^2$ [1]
 Outstroke force: $1923.25 \times 0.4 = 769.3 \text{ N}$ [1]
 Dia cylinder B: $(\text{SQRT}(1923.25/3.14)) \times 2 = 49.49 \text{ mm}$ [1] [3]

(c) (i) Indicative content:

Cone clutches

The cone clutch uses two conical surfaces to transmit torque by friction. Advantages – The cone clutch transfers a higher torque than plate or disc clutches of the same size due to the wedging action and increased surface area.

Disadvantages – can be difficult to disengage, due to cone angle. Can grab when engaging.

Diaphragm clutches

A diaphragm clutch uses a diaphragm spring for the engagement and disengagement of the clutch.

Advantages – It is more compact resulting in a thinner clutch housing. The diaphragm clutch has fewer parts so cheaper to maintain and replace.

Diaphragm clutches require less pedal pressure to operate.

Disadvantages – The size and diameter of diaphragm clutch needs to be bigger than conventional helical sprung clutches.

The diaphragm spring can distort due to centrifugal force when at high speeds of rotation.

Centrifugal clutches

Centrifugal clutches use flyweights which transmit drive when the rotation of the hub forces the flyweights outwards until they contact the clutch drum. The friction material transmits the torque from the flyweights to the drum. The drive is then connected.

Advantages – When the engine is idling the drive remains disengaged. Centrifugal clutches engage smoothly and prevent the engine from stalling.

The wearing parts are easy and cost effective to replace.

Disadvantages – The speed that the clutch engages cannot be changed without altering internal components.

Can lose power due to oil or water getting into the housing.

Only suitable for low torque applications.

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<p>Level 3 The candidate's response is excellent in depth and discusses the operation of each clutch type with appropriate advantages and disadvantages presented. 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 form and style are of a high standard.</p>	[7]–[9]
<p>Level 2 The candidate's response is good in depth and discusses the operation of each clutch type with appropriate advantages and disadvantages presented. 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 form and style are of a good standard.</p>	[4]–[6]
<p>Level 1 The candidate's response is basic in depth and discusses the operation of each clutch type with basic advantages and disadvantages presented. 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 form and style are of a basic standard.</p>	[1]–[3]
Response not worthy of credit	[0]

[9]

All relevant, valid responses will be given credit.

(ii) Annotated sketch to include – caliper, brake pads and brake disc.

Very good sketch of the main features of a disc brake mechanism with very good annotation.	3
Good sketch of the main features of a disc brake mechanism with good annotation.	2
Limited sketch of the main features of a disc brake mechanism with limited annotation.	1
For a response not worthy of credit.	0

[3]

Method of activation

The caliper is activated by hydraulic pressure produced from the brake pedal and master cylinder. [1] The brake pads are squeezed against the brake disc surface to create friction. [1]

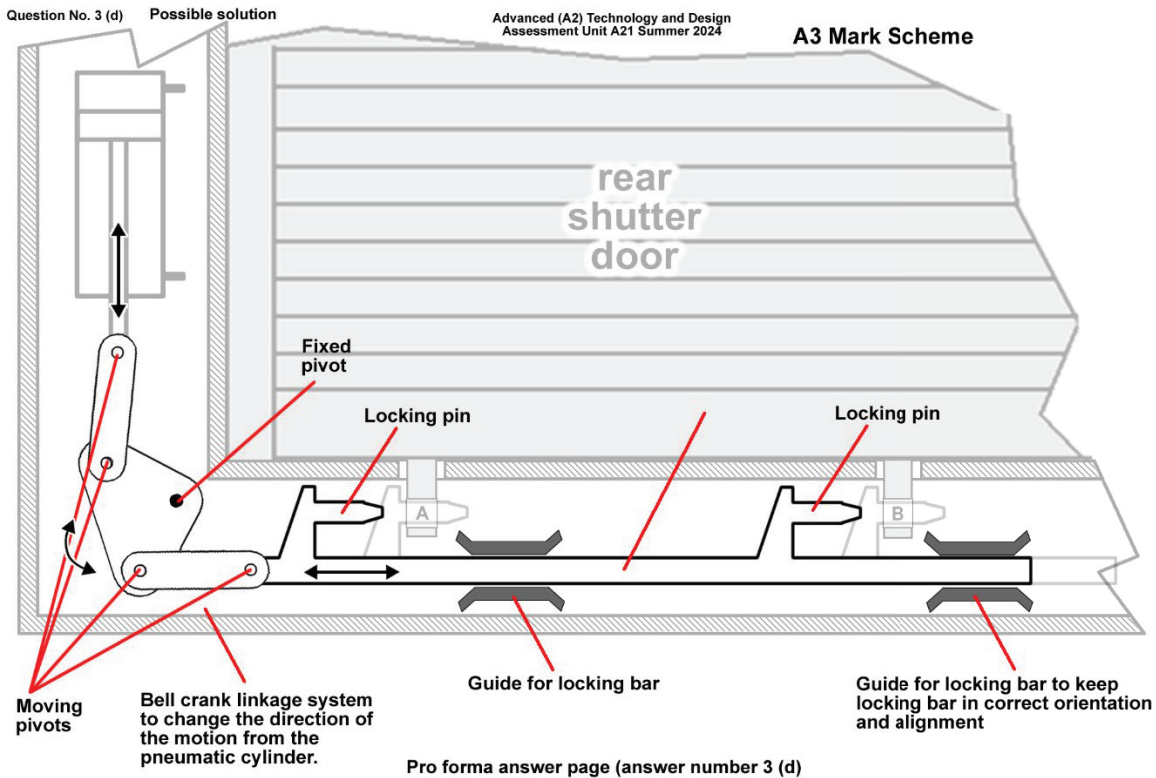
All relevant, valid responses will be given credit.

[2]

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(d) Pro forma - see A3 mark scheme.

AVAILABLE MARKS



Detailed annotated sketches of a mechanical system that presents a suitable solution for a locking system that transmits motion from the pneumatic cylinder to lock the shutter doors. The solution presented incorporates an appropriate mechanical system. Annotation is excellent and identifies the mechanical systems used and conveys the function of the overall system.	[7]–[10]
Good, annotated sketches of a mechanical system that presents a solution for a locking system that transmits motion from the pneumatic cylinder to lock the shutter doors. The solution presented incorporates a mechanical system. Annotation is helpful in conveying the function and systems used in the design.	[4]–[6]
Limited sketches lacking detail required to determine if the design of the mechanism will be able to perform the function required. Limited annotation that identifies and conveys some details but lacking in clarity.	[1]–[3]
The response is not worthy of any credit.	[0]

Marks should not be awarded for repetitive sketches which do not show any design thinking.

All relevant, valid responses will be given credit.

[10]

4 (a) (i) Annotated sketch to include – inner ring, outer ring, double ball race way

Very good sketch of the main features of a self-aligning bearing with very good annotation	3
Good sketch of the main features of a self-aligning bearing with good annotation	2
Limited sketch of the main features of a self-aligning bearing with limited annotation	1
For a response not worthy of credit	0

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

(ii) Any **one** reason why a self-aligning bearing would be used in a mechanical system for example:

- when the shaft may bend during operation. [1]
- when the shaft alignment is difficult due to limited space. [1]

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

(b) Outstroke Volume: $2 \times 2 \times 3.14 \times 5 = 62.8 \text{ cm}^3$ [1]

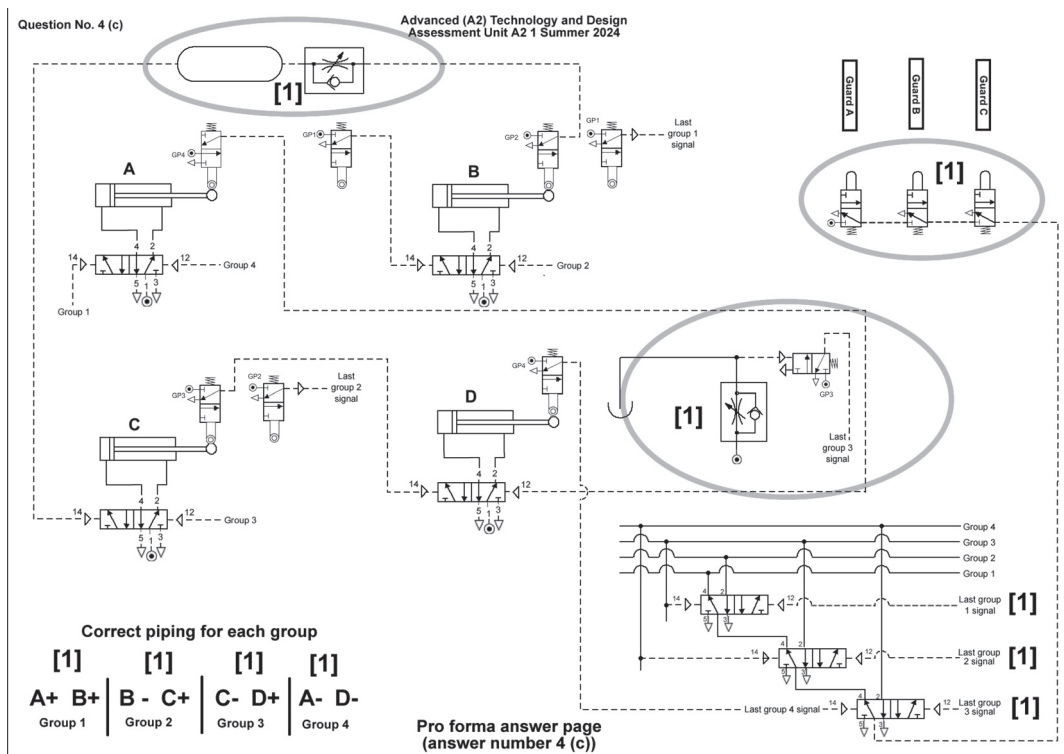
Instroke Volume: $62.8 - 15.7 = 47.1 \text{ cm}^3$ [1]

Total Volume: $62.8 + 47.1 = 109.9 \text{ cm}^3$ [1]

Piston volume \times (gauge pressure + atmospheric pressure) \times No. cycles
 Volume = $(109.9 \times (5.5 + 1.25) \times (2 \times 6) = 8901.9 \text{ cm}^3)/1000$
 = 8.9 litres/min [1]

[4]

(c) Pro forma - see A3 mark scheme



[10]

(d) (i) Clockwise [1]

(ii)

VR	=	Driven	=	A	D	F	G	I	K	M		
		Driver		$\frac{200}{100}$	$\times \frac{120}{75}$	$\times \frac{50}{80}$	$\times \frac{125}{50}$	$\times \frac{240}{60}$	$\times \frac{120}{60}$	$\times \frac{30}{80}$		
				B	C	E	F	H	J	L		
				= 2	$\times 1.6$	$\times 0.625$	$\times 2.5$	$\times 4$	$\times 2$	$\times 0.375$		[1]
				= 15								[1]

[2]

(iii) OUTPUT SPEED = $2400/15 = 160$ RPM [1]

(1 × [1]) [1]

(iv) Work = $20000 \times 5 = 100,000$ J [1]

Power = $100000 / 50 = 2000$ W [1]

80% = 2000 W

Input power = $2000 / 0.8$ [1]

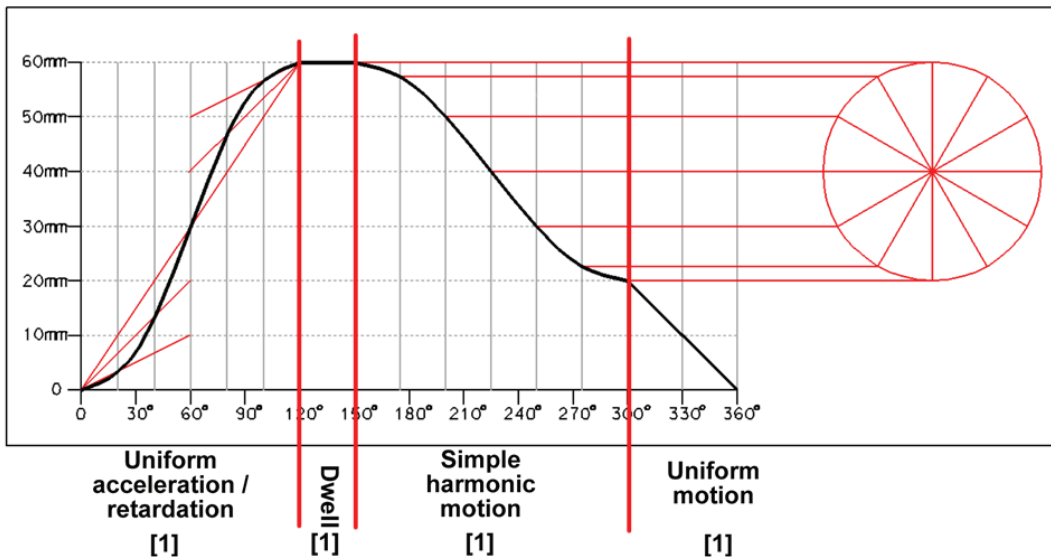
Input power = 2.5 KW [1] [4]

(e) $0^\circ - 120^\circ$ 60mm rise with uniform acceleration / retardation [1]

$120^\circ - 150^\circ$ dwell, [1]

$150^\circ - 300^\circ$ 40mm fall with simple harmonic motion, [1]

$300^\circ - 360^\circ$ 20mm fall with uniform motion. [1]

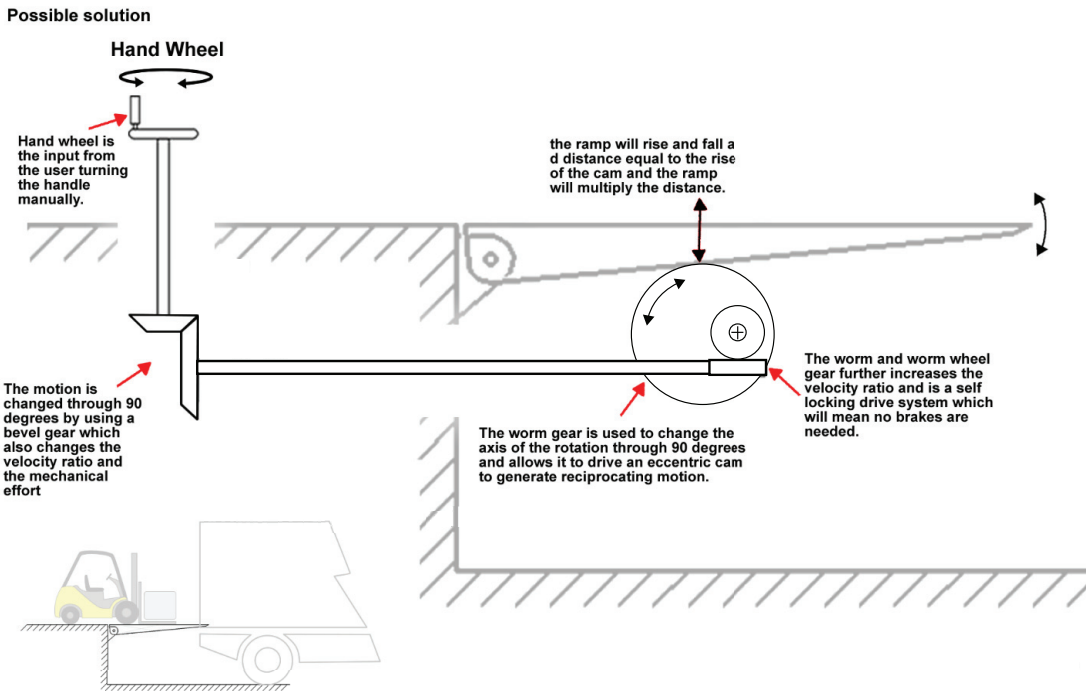


[4]

AVAILABLE MARKS

(f) Pro forma - see A3 mark scheme.

AVAILABLE MARKS



Detailed annotated sketches of a design of a mechanism that transmits the rotational motion from the handwheel through 90 degrees to the base of the ramp. This in turn will incorporate an appropriate mechanical system to enable the pivoted loading ramp angle to be increased or decreased.	[7]–[10]
Both the sketches and annotation are good. The idea represents an improvement. There are some limitations if the mechanism will transmit the rotational motion from the handwheel through 90 degrees to the base of the ramp and if the mechanical system enables the pivoted loading ramp angle to be increased or decreased.	[4]–[6]
Limited sketches lacking detail and appropriate annotation. Difficulties in determining if the design of the mechanism will transmit the rotational motion from the handwheel through 90 degrees to the base of the ramp or if the mechanical system enables the pivoted loading ramp angle to be increased or decreased.	[1]–[3]
The response is not worthy of any credit.	[0]

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

Marks should not be awarded for repetitive sketches which do not show any design thinking.

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Section C

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Product Design

- 5 (a) Products such as the iPhone can be considered as an incremental product. It has had a series of upgrades, part changes, improvements or additional features [1] as the new models have been released. [1] [2]

All relevant, valid responses will be given credit.

- (b) (i) An environmental audit is a documented process carried out by an independent third party [1] to assess the current status of an organisation's compliance with local environmental laws and regulations. [1] [2]

All relevant, valid responses will be given credit.

- (ii) Any **one** reason why it would be beneficial for the company producing the measuring wheel to have complied with an environmental audit for example:
- The public's perception of the company may be more positive.
 - May attract environmental grants. [1]

All relevant, valid responses will be given credit.

- (c) Explanation of **one** main issue regarding sustainability in the manufacture of plastics -

Plastic manufacture requires significant amounts of natural resources such as oil [1]. The extraction and processing of these resources can have negative environmental impacts. [1] [2]

All relevant, valid responses will be given credit.

- (d) (i) The key concept of market penetration is the process of going to market with a product in an existing market [1] in which current or similar products already exist and taking market share from the other competing companies. [1] [2]

All relevant, valid responses will be given credit.

- (ii) Diversification offers a more extensive range of product options [1] which can generate increased sales [1] [2]

All relevant, valid responses will be given credit.

(e) Any **two** main benefits associated with adopting a flexible manufacturing system (FMS) for example:

- FMS helps to create faster production times [1] as downtime is reduced because the production line does not have to be shut down to set up for a different product [1] .
 - If something within the process changes, [1] they can easily adapt and keep production flowing to reduce delays and bottlenecks. [1]
 - FMS requires fewer workers to operate [1] compared to other manufacturing systems so saving on labour costs. [1]
- (2 × [2])

[4]

All relevant, valid responses will be given credit.

(f) **Indicative content:**

Fashion innovators would be interested in the innovation and unique features of a new product.

Fashion innovators are the group of people who adopt a new model of the product first.

Fashion innovators are often trend setters and would want to be seen to adopt the latest model of a new product.

Opinion leaders (celebrities, magazines, early adopters) are the next most likely adopters of a fashion product after the fashion innovators

Opinion leaders often copy the fashion innovators and (put their spin on it) by changing the product into a more popular style.

Opinion leaders can have a strong influence on a product, and so production is increased and it is sold at more retail outlets.

Laggards are the last group to adopt a new product.

Laggards dislike change and accept new things only when forced to.

Laggards consist largely of seniors and those with low socioeconomic status.

<p>Level 3 The candidate has provided suitable detailed explanation of the characteristics of the three consumers. The written presentation is clear and precise and demonstrates very good knowledge of the subject to be considered. Appropriate specialist terms and technological vocabulary used throughout. The candidate uses specialist terms and technological vocabulary used throughout. The candidate used 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 a good explanation of some suitable characteristic of the three consumers. The written presentation is reasonable 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>	[4]–[6]
<p>Level 1 The candidate has provided a limited explanation of the characteristics of the three consumers. The written presentation is limited and demonstrates limited 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]
Response not worthy of credit	[0]

[9]

All relevant, valid responses will be given credit.

- (g) (i) Any **two** main advantages associated with personal selling for example:
- A salesperson is well trained in the approaches and techniques of personal selling.
 - Salesperson can develop very good relationships with customers resulting in repeat business.
 - Personal selling can convey more information than other promotion methods.
- (2 × [1]) [2]

- Any **one** main disadvantage associated with the use of personal selling for example:
- Very expensive to deliver and maintain.
 - Personal sellers are somewhat limited to the number of customers they can cover per day.
- [1]

All relevant, valid responses will be given credit.

- (ii) Any **two** main advantages associated with exhibitions for example:
- Raise awareness – exhibiting is a good way to raise your profiles and generate brand awareness.
 - Build your database – meeting with potential customers at an exhibition helps you to start building your marketing lists and generate qualified sales leads.

- Meet in person - meeting face-to-face with potential customers at an exhibition is a great way to start building relationships with potential customers.

(2 × [1])

[2]

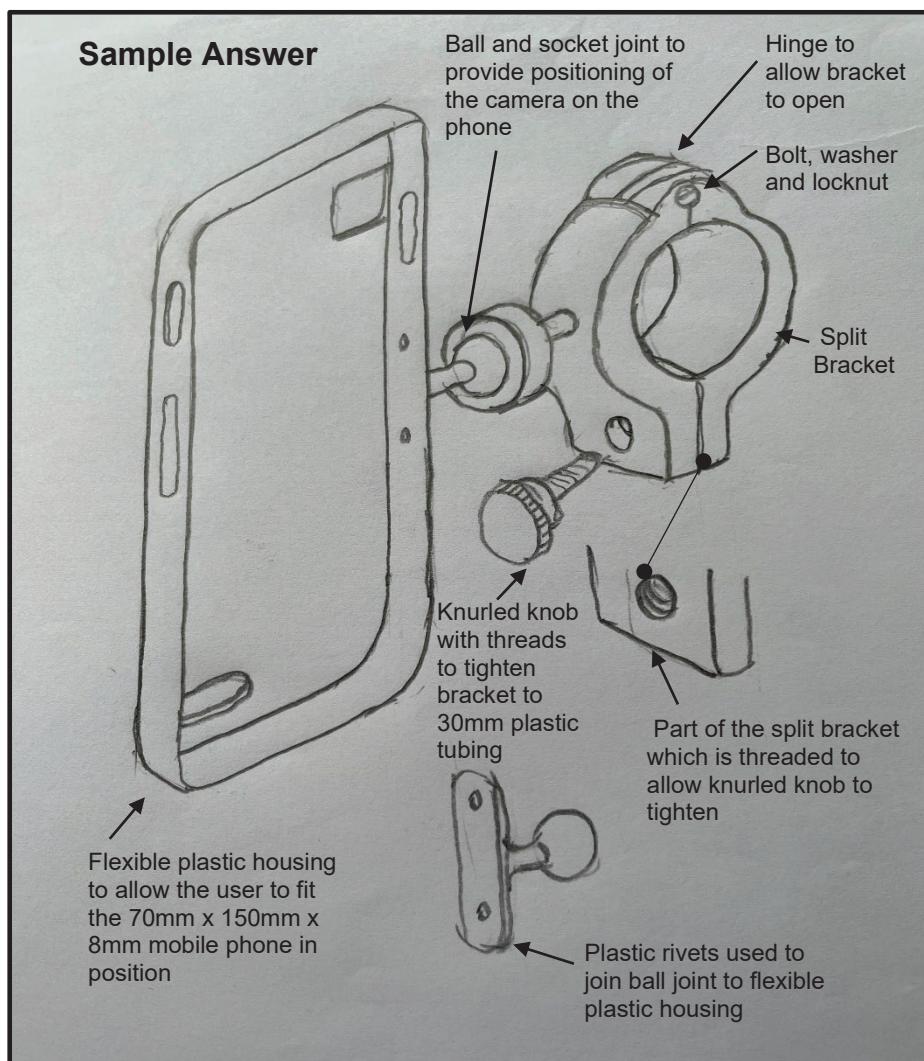
Any **one** main disadvantage associated with the use of exhibitions for example:

- Results aren't guaranteed - despite the investment of exhibiting, the company is not guaranteed any sales leads.
- Potential low turnouts - without the right publicity, exhibitions may not have enough delegates to make it financially viable.

[1]

All relevant, valid responses will be given credit.

(h)



The bracket can be mounted to the side or front of the 30 mm plastic tubing.

An explanation on how the above design has minimised the use of materials and manufacturing processes could be based on some of the following points:

- The dimensional profile of the bracket is reflective of the functional requirements of the design.
- The use of standard components (bolt, washer and locknut, flexible plastic housing, knurled knob) will reduce the need for specialist processes.
- Manufacturing the design in large numbers using injection moulding will reduce the number of secondary processes required.

Description	Marks awarded
Excellent, detailed sketches and annotation representing an appropriate design that will allow the user to quickly and securely attach a mobile phone to the plastic tubing at position X – X. The design allows the user to quickly adjust the angle of the phone to facilitate a recording or image of the display and provides an excellent explanation of how the use of materials and manufacturing processes have been minimised.	[7]–[10]
Good sketches and annotation of a design. The design may be limited in terms of it allowing the user to quickly and securely attach a mobile phone to the plastic tubing at position X – X. The design may also have limitations regarding the user being able to quickly adjust the angle of the phone to facilitate a recording or image of the display and provides a good explanation of how the use of materials and manufacturing processes have been minimised.	[4]–[6]
Basic sketches and annotation of a design. Difficulties in determining if the design would allow the user to quickly and securely attach a mobile phone to the plastic tubing at position X – X. Difficulties in determining if the user would be able to quickly adjust the angle of the phone to facilitate a recording or image of the display and provides a limited explanation of how the use of materials and manufacturing processes have been minimised.	[1]–[3]
Level of response not worthy of credit	[0]

AVAILABLE MARKS

(Marks should not be awarded for repetitive sketches which do not show any design thinking).

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

- 6 (a) Any **two** benefits associated with innovation in product design for example:
- It can increase turnover and improve profitability.
 - It can generate new partnerships and relationships with companies.
 - It can improve brand recognition and value.
- (2 × [1]) [2]

All relevant, valid responses will be given credit.

- (b) (i) In the example of refuse the focus is with the consumer. Consumers can refuse to buy a product, [1] that has not been manufactured from recycled reclaimed materials or if the product is over packaged. Lack of sales and consumer feedback can influence change. [1] [2]

All relevant, valid responses will be given credit.

- (ii) In the example of reuse, designers have worked alongside manufacturers/retailers to offer customers the opportunity to refill liquids, rather than buying a new, container with its contents. [1] Good examples of this are washing up liquid, washing powder and hand wash. The customer reuses the original container and simply buys a refill, saving on packaging and plastic waste. [1] [2]

All relevant, valid responses will be given credit.

- (iii) In the example of the Smart car the designer has managed to reduce the materials used to produce the overall vehicle, [1] reduced the number of components and has reduced the number of manufacturing and assembly processes needed. [1] [2]

All relevant, valid responses will be given credit.

- (c) Any **two** different reasons why a company would relaunch a product into the market for example:

- Consumer Awareness: By relaunching a product in the market, consumers will be curious and excited to know what is new. [1] It will create awareness and consumers will be informed about the characteristics of the products which will generate an increased interest. [1]
 - 2nd chance to make a good impression: After completing the product life cycle or a 1st product launch, the company is more focused [1] to improve and compete in the market and give an impression of a premium product. [1]
 - Acquire more market share: Product is coming with new features and relaunch campaign will give awareness to the consumer. [1] All this effort will help to acquire more market share with the improved product and will help generate sales. [1]
- ([2] × [2]) [4]

All relevant, valid responses will be given credit.

- (d) (i) Car components.
Additive metal manufacturing of car components can reduce the need for complex forming and milling processes. [1] This can reduce the environmental impact as both processes require large amounts of energy and create material waste. [1] [2]

All relevant, valid responses will be given credit.

- (ii) Mobile phone.
There are opportunities at end of the life cycle for refurbishment of mobile phones. [1] Over 95% of the materials in a mobile phone are recovered. The recycling initiatives reduce future greenhouse gas emissions, save energy, conserve natural resources and reduce the environmental impact of the product. [1] [2]

All relevant, valid responses will be given credit.

- (e) (i) Measuring devices – Springs.

When springs are manufactured measuring devices are used to test a sample from a batch [1] to ensure that the key measurements are within an acceptable tolerance. [1] [2]

All relevant, valid responses will be given credit.

- (ii) Fixtures – Door hinges.

A fixture which allows the manufacturer to repeatedly test a manufactured door hinge under specified conditions. [1] By using a specific fixture to hold the hinge more accurate test results can be achieved during quality control testing. [1] [2]

All relevant, valid responses will be given credit.

(iii) Templates – Electric guitar

A very accurate profile of the guitar is generated in the form of templates using a CNC machine. [1] These templates are then placed on the selected wood, drawn around and cut out using table saws and routers. These templates aid accuracy and ensure consistency during manufacture thus assisting quality control. [1] [2]

All relevant, valid responses will be given credit.

- (f) (i) The concept of elasticity of demand is the measurement of change in demand for a product in response to changes in its price. [1] If the price elasticity of demand is more than 1 it is sensitive to change and if it is less than 1 it is less sensitive to change. [1] [2]

All relevant, valid responses will be given credit.

- (ii) Contribution pricing involves similar steps to cost-plus pricing (estimating the average cost of producing and marketing and then adding a mark-up for profit) [1] but is a much more sophisticated version. This is because it takes account of the variation in costs of production for different markets for different levels. [1] [2]

All relevant, valid responses will be given credit.

- (g) (i) One example of a product which incorporates social factors in its design would be the bicycle. Bicycles have been designed to cater for different lifestyles. [1] The differing profiles, use of materials and structures of bicycles for racing, off road, touring and mountain biking are just a few examples of how the designer has incorporated social factors in its design. [1] [2]

All relevant, valid responses will be given credit.

- (ii) Example of a product which incorporates cultural factors in its design, for example clothing. The colours used in clothing needs to take into consideration cultural variations [1] for example red is a common funeral colour in Africa whereas red is a wedding dress colour in traditional China. [1] [2]

All relevant, valid responses will be given credit.

(h) (i)

Description	Marks awarded
Annotated sketch of an innovative and appealing design which communicates that the drone should not be flown at a height exceeding 100 metres.	2
The sketch and annotation are limited and does not represent an innovative and appealing proposal to communicate that the drone should not be flown at a height exceeding 100 metres.	1
Level of response not worthy of credit	0

[2]

Description	Marks awarded
Annotated sketch of an innovative and appealing design which communicates that the flying time for the drone on fully charged batteries should not exceed 30 minutes.	2
The sketch and annotation are limited and does not represent an innovative and appealing proposal to communicate that the flying time for the drone on fully charged batteries should not exceed 30 minutes.	1
Level of response not worthy of credit	0

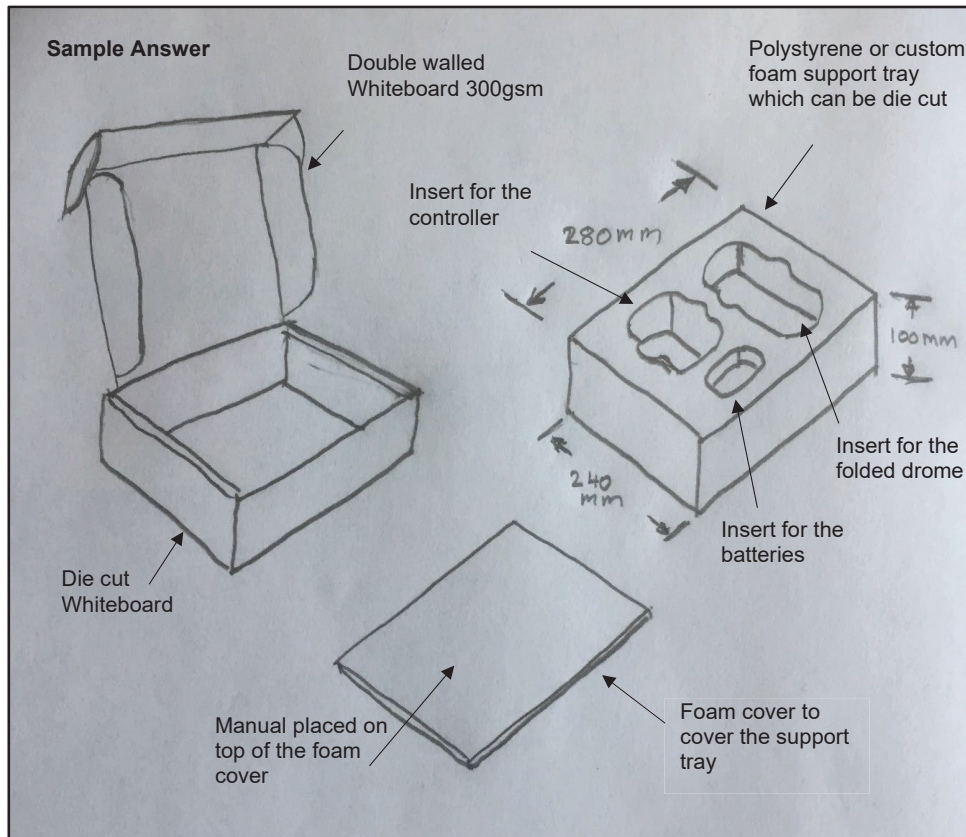
[2]

AVAILABLE
MARKS

(ii)

Description	Marks awarded
Excellent, detailed annotated sketches of an appropriate design that minimises packaging material and space for the drone and accessories. The design provides suitable protection to the contents. Appropriate consideration is given to dimensions and minimising manufacturing processes.	[5]–[6]
Both the sketches and the annotation are good. The design has limitations with regards to it minimising packaging material and space for the drone and accessories. The design provides limited protection to the contents. There are limitations with regards to the dimensions and minimising manufacturing processes.	[3]–[4]
Limited sketches lacking detail and appropriate annotation. Difficulties in determining if the design has minimised packaging material and space for the drone and accessories. Difficulties in determining if the design provides suitable protection to the contents. Difficulties in determining if consideration is given to dimensions and minimising manufacturing processes.	[1]–[2]
Level of response not worthy of credit	[0]

[6]

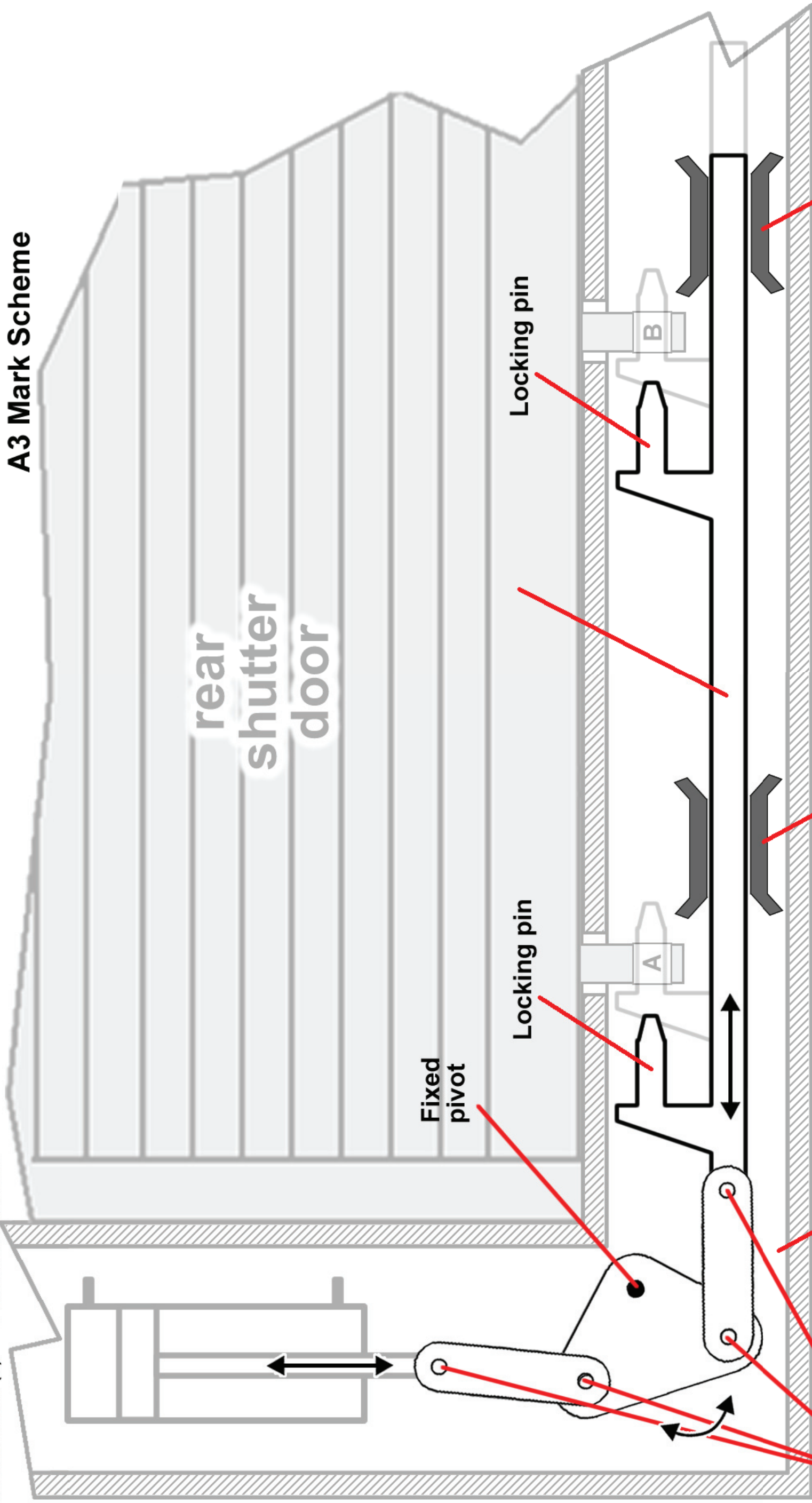


Marks should not be awarded for repetitive sketches which do not show any design thinking.

All relevant, valid responses will be given credit.

80

Question No. 3 (d) Possible solution



A3 Mark Scheme

rear
shutter
door

Fixed
pivot

Locking pin

Locking pin

Bell crank linkage system
to change the direction of
the motion from the
pneumatic cylinder.

Moving
pivots

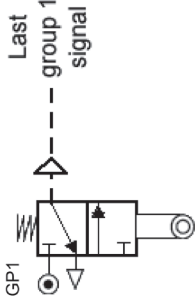
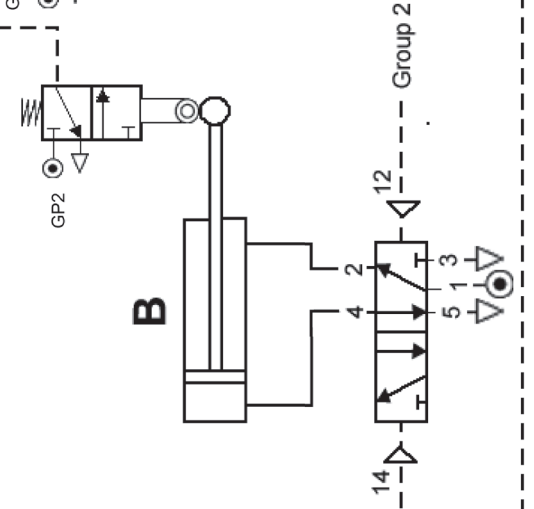
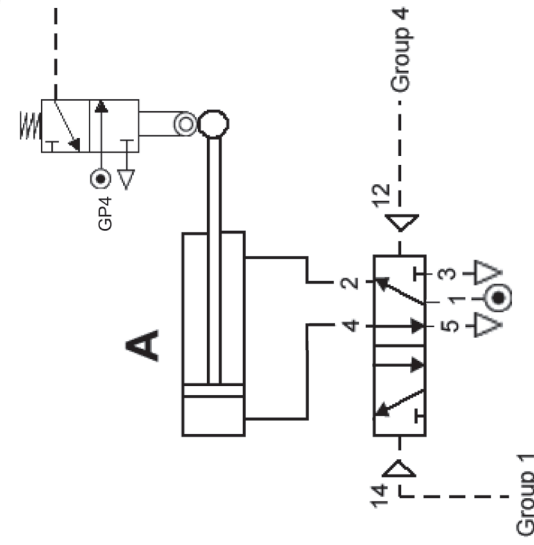
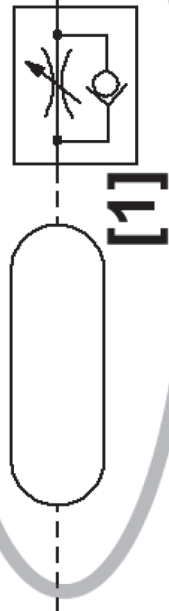
Guide for locking bar

Guide for locking bar to keep
locking bar in correct orientation
and alignment

Pro forma answer page
(answer number 3 (d))

Question No. 4 (c)

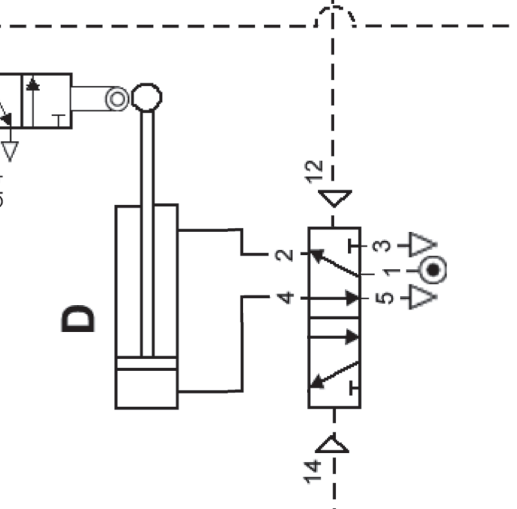
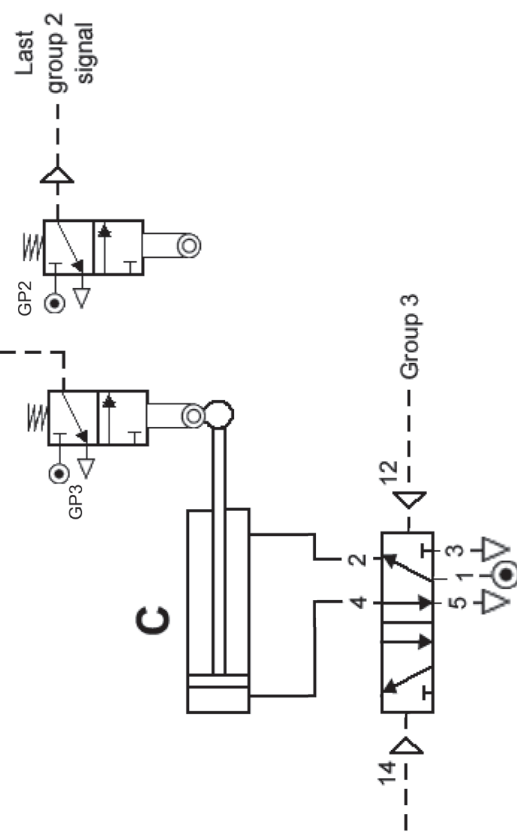
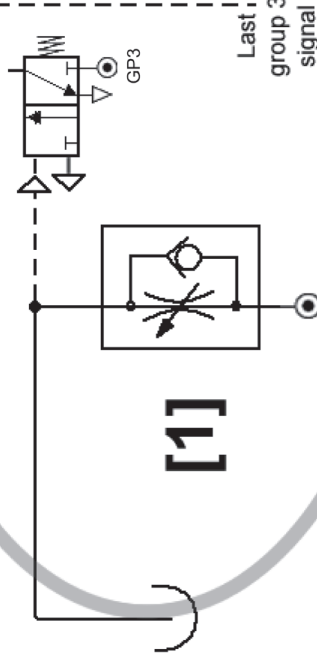
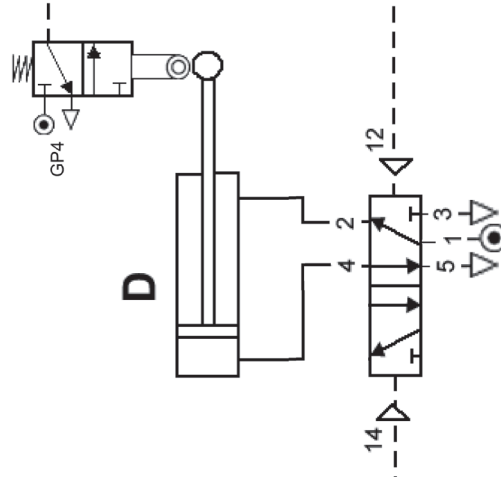
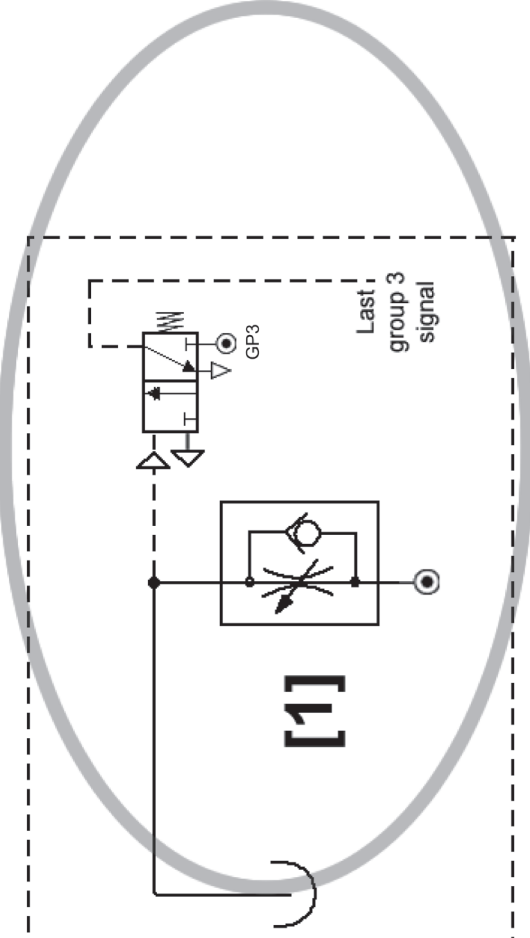
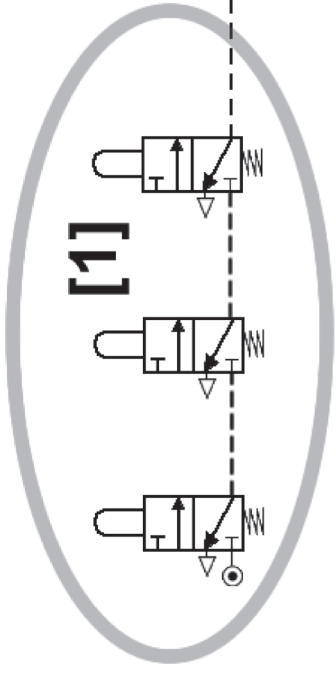
Advanced (A2) Technology and Design Assessment Unit A2 1 Summer 2024



Guard A

Guard B

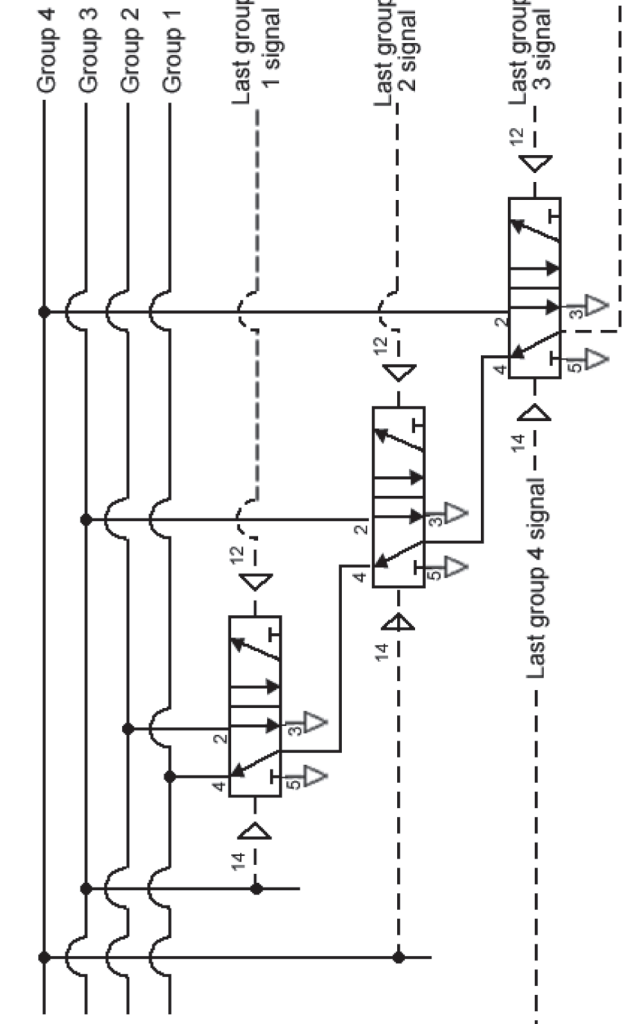
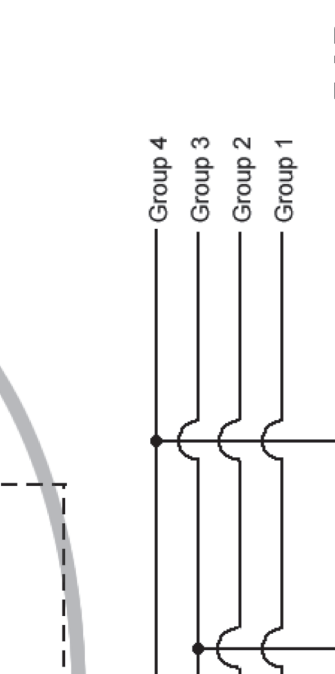
Guard C



Guard A

Guard B

Guard C



Correct piping for each group

[1]	[1]	[1]	[1]
A+	B+	C+	D-
Group 1	Group 2	Group 3	Group 4

Pro forma answer page (answer number 4 (c))

Possible solution

Hand Wheel



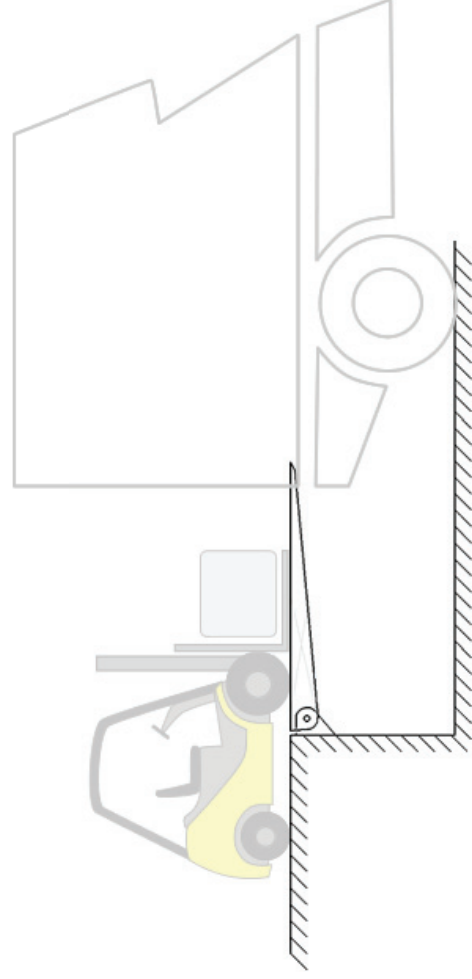
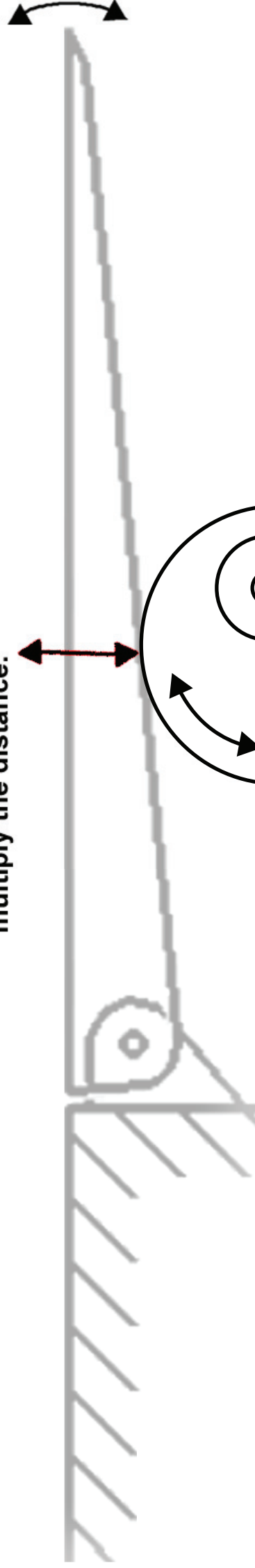
Hand wheel is the input from the user turning the handle manually.

The motion is changed through 90 degrees by using a bevel gear which also changes the velocity ratio and the mechanical effort.

the ramp will rise and fall a distance equal to the rise of the cam and the ramp will multiply the distance.

The worm gear is used to change the axis of the rotation through 90 degrees and allows it to drive an eccentric cam to generate reciprocating motion.

The worm and worm wheel gear further increases the velocity ratio and is a self locking drive system which will mean no brakes are needed.



**Pro forma answer page
(answer number 4 (f))**