



ADVANCED
General Certificate of Education
2019

Technology and Design

Assessment Unit A2 1
assessing

Systems and Control or Product Design

[ATE11]

FRIDAY 7 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.

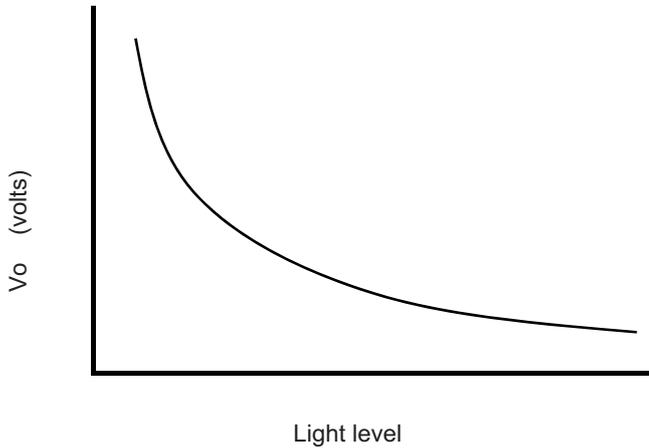
Section A

AVAILABLE MARKS

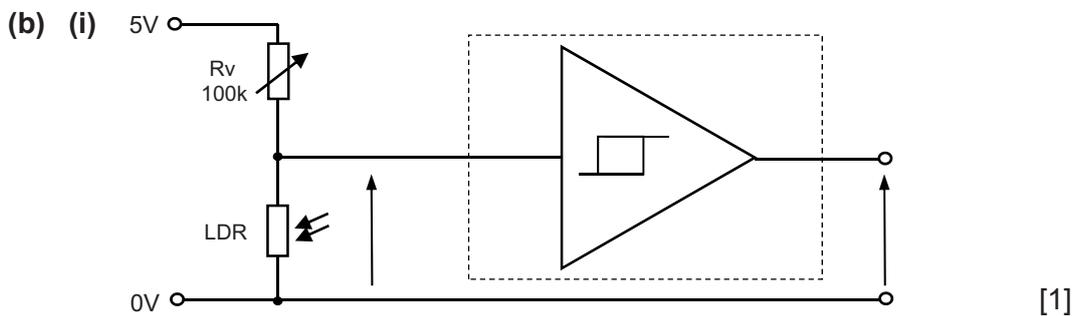
Electronic and microelectronic control systems

1 (a) (i) As light levels increase the resistance of the LDR decreases. **Correct alternative responses will be given full credit.** [1]

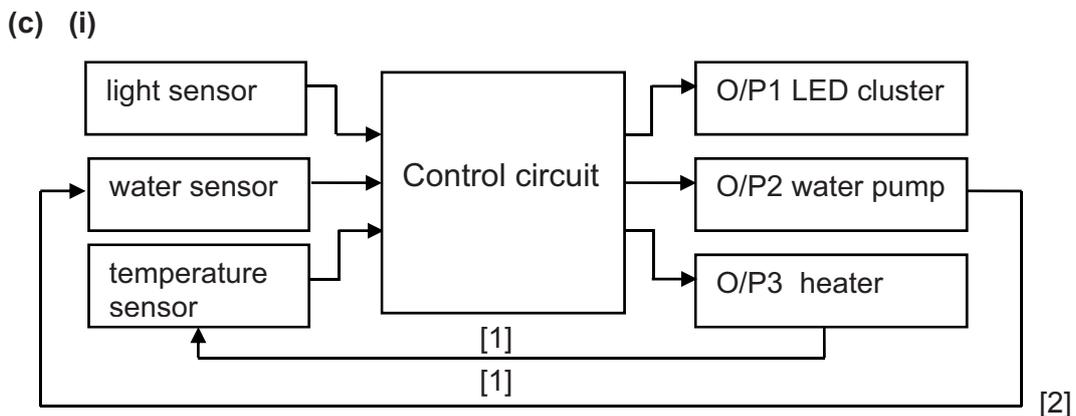
(ii) Curve [1]
Direction of curve [1] [2]



(iii) $V_o \text{ range} = (1000 \div 1050)5 - (70 \div 120)5$ [2]
 $= 1.86 \text{ V}$ [1] [3]



(ii) The output voltage of Schmitt trigger does not change until the analogue input changes beyond preset upper and lower thresholds. Award [2] for a full explanation and [1] for a limited explanation. **Correct alternative responses will be given full credit** [2]

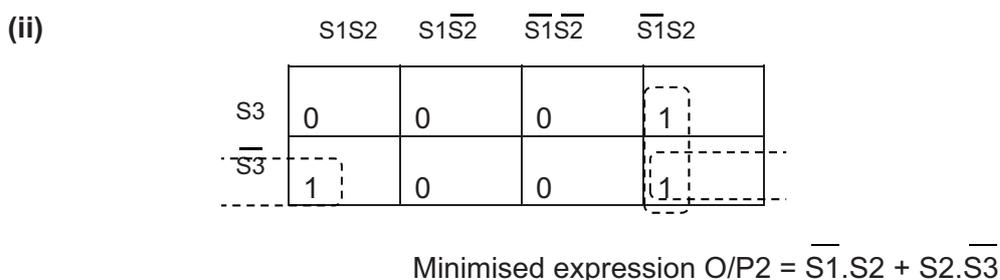


- (ii) In open loop systems the input sensor does not receive any feedback signal from the output condition so there is no means of checking if the desired output condition has been achieved.
Award [2] for a full explanation and [1] for a limited explanation.
Correct alternative responses will be given full credit. [2]

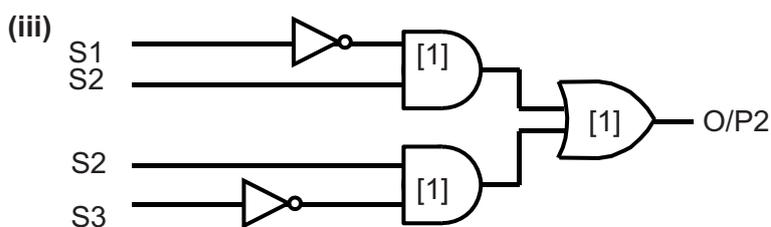
(d) (i)

S3	S2	S1	O/P2
0	1	0	1
0	1	1	1
1	1	0	1

[3]



Alternative types of Karnaugh map will be given full credit [2]



Correct alternative responses will be given full credit. [3]

- (e) **Indicative content:**
Any three specification points from the following:

1. Power supply requirements. A low voltage DC motor could run from the same power supply as the logic circuit but a high voltage or high current requirement will mean some form of electrical isolation is required. This can be achieved by using a semiconductor component such as a transistor or a Darlington pair. The function of these components is to switch on the high voltage supply to the DC motor using the low voltage signal from the control circuit. If the power requirements exceed the capabilities of a transistor then a relay switch can be used.
2. Requirement for components to be protected from back emf. If a transistor or other semiconductor control device is to be used to switch on the DC motor a flywheel diode may be used to prevent damage to the semiconductor when the magnetic field collapses in the electromagnetic coils. The function of the diode is to dissipate the back emf as this will occur each time the power supply to the motor is stopped.
3. One direction or reversal requirements. If the DC motor is to be reversed the current direction in the electromagnetic coils must be reversed. This will require some type of switch/relay arrangement such as a DPDT relay. The function of the DPDT relay is to provide two alternative conducting paths for the current. When the relay is in one switching position the motor will turn in one direction and vice versa.

4. Speed control requirements. The speed of a DC motor can be controlled (but not at very low RPM without losing torque). One method of speed control is to pulse the motor with varying width of pulses at a fixed frequency. A PIC can be employed as a functional component to achieve this. The PIC can be programmed with a range of pulse width patterns and these can be selected by means of digital input or a bit pattern code.

5. 'Noisy' motors caused by commutator brushes. Some DC motors can cause low voltage control circuits to malfunction due to small induced currents caused by the electrical noise. A capacitor soldered across the motor terminals can minimise this. The function of the capacitor is to short circuit these small AC signals.

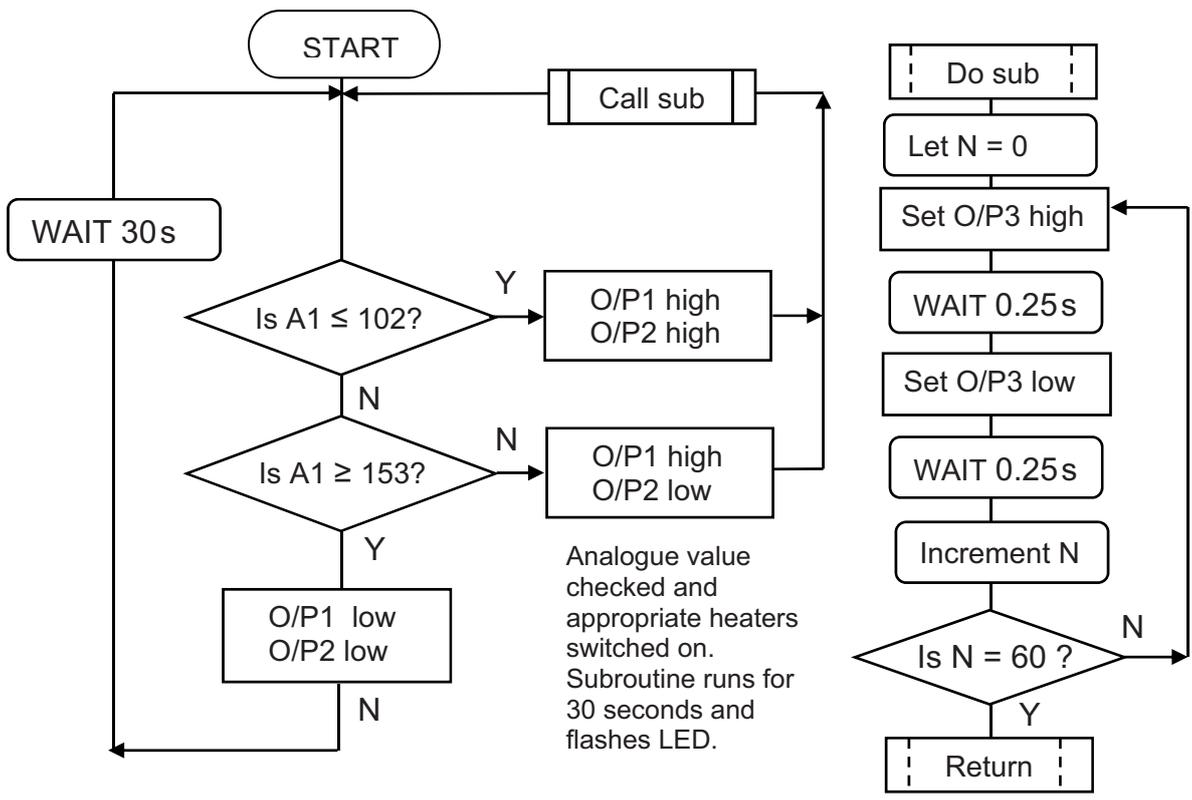
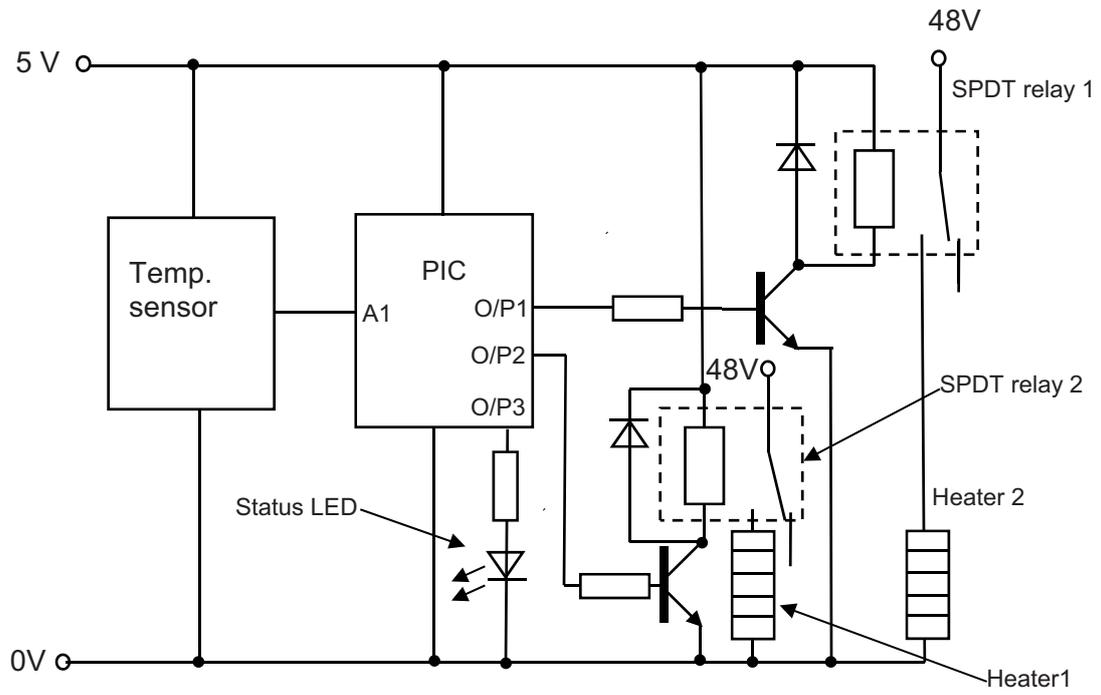
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<p>Level 3 The candidate provides a detailed discussion of three main specific requirements associated with driver circuits for DC motors. The candidate then provides three accurate descriptions of the main functions of the components utilised in the driver circuits. The written presentation is clear and precise and demonstrates excellent 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 discussion of the main specific points associated with driver circuits for DC motors. The candidate then provides a good description of the main functions of the components used in the driver circuits. 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>	<p>[4]–[6]</p>
<p>Level 1 The candidate provides a basic discussion of the main specific points associated with driver circuits for DC motors. The candidate then provides a basic description of the main functions of the components used in the driver circuits. 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>

Correct alternative responses will be given full credit.

[9]

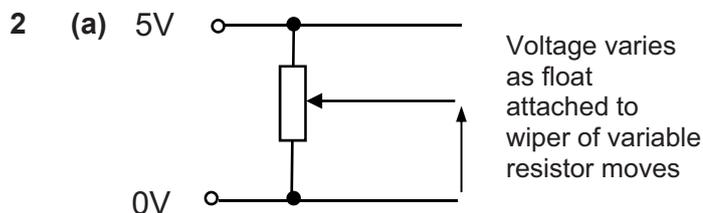
(f) Sample answer



Correct alternative responses will be given full credit

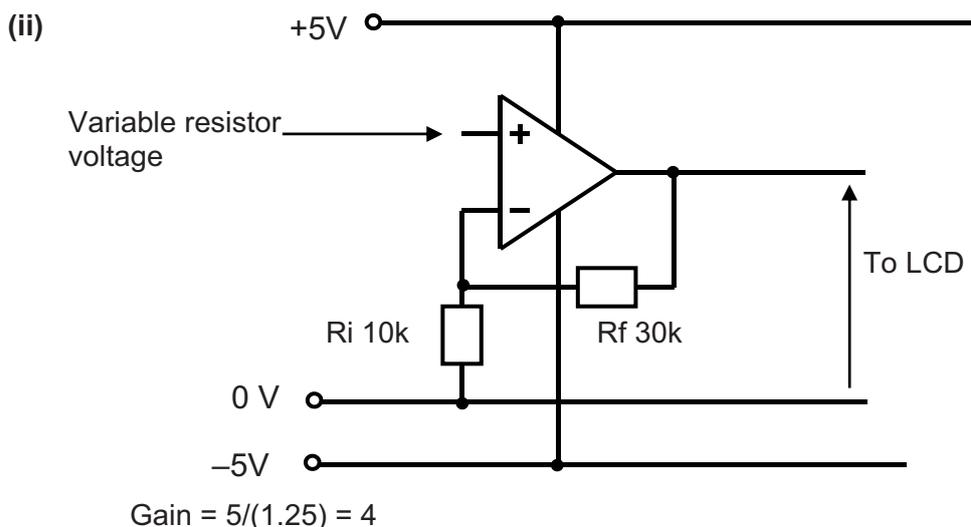
[10]

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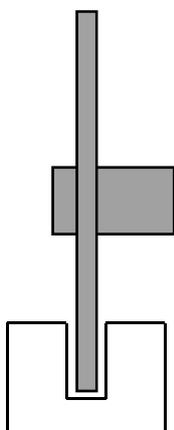
Correct alternative responses will be given full credit. [2]

- (b) (i) One main advantage is that LCD type displays generally have a lower power consumption compared to an LED type display.
Correct alternative responses will be given full credit. [1]



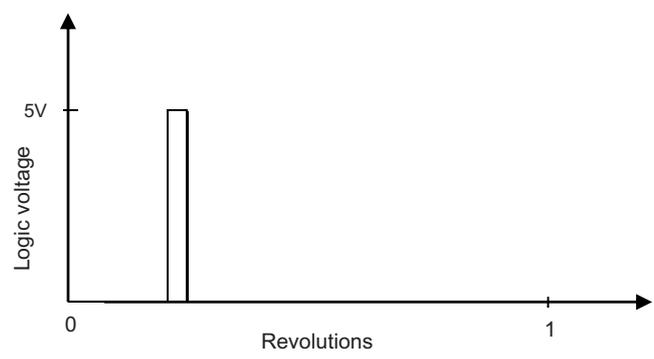
Drawing of non inverting amp [1]
Dual power supply labelled [1]
Calculated gain [1]
Suitable values for Rf and Ri [2]
Correct alternative responses will be given full credit. [5]

- (c) (i) Suitable 2D or 3D sketch showing a slotted optical switch [1] in conjunction with a disc [1]



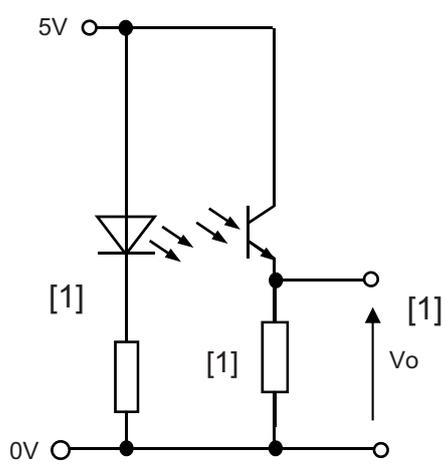
Correct alternative responses will be given full credit. [2]

(ii) Narrow single pulse with steep sides [1]
reaching 5V on voltage axis [1]



[2]

(iii) Sample answer



[3]

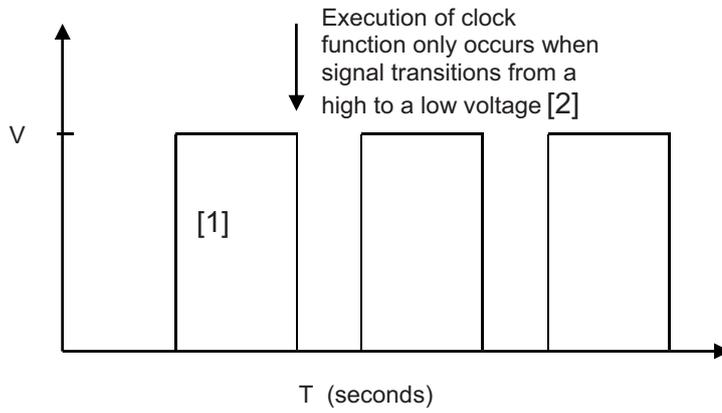
(iv) An optical switch will present no physical resistance to the movement of the paddle.
Correct alternative responses will be given full credit. [1]

(d) (i) The reverse biased Zener begins to conduct as soon as the reverse voltage reaches a pre-determined value. The current flowing through the Zener diode (which is usually limited by a series resistor) remains fairly constant over a wide range of reverse voltages, providing a form of regulation.

Award [2] for a full explanation and [1] for a limited explanation.
Correct alternative responses will be given full credit. [2]

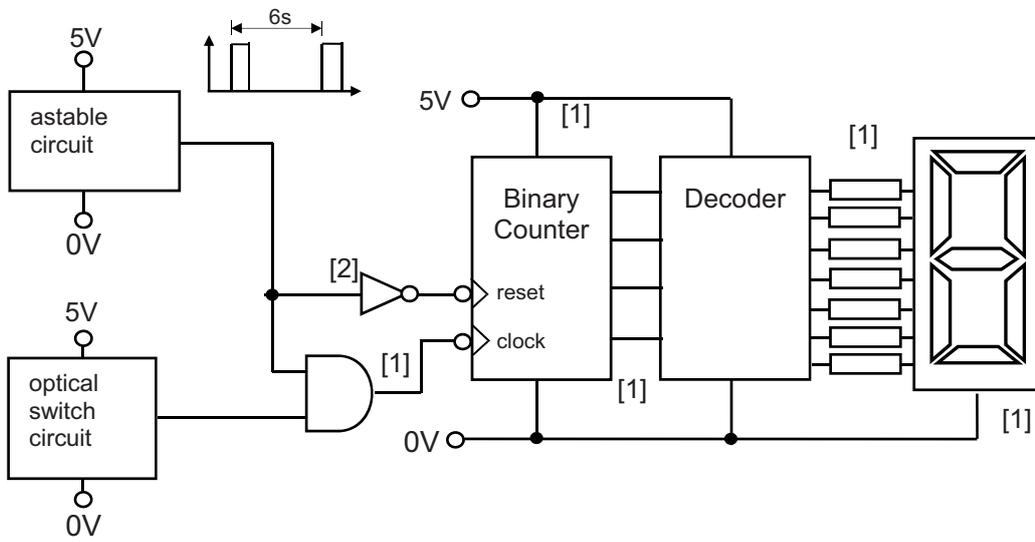
(ii) $R = (9 - 5)/0.01$ [1]
 $R = 400 \text{ ohms}$ [1] [2]

(e) (i)

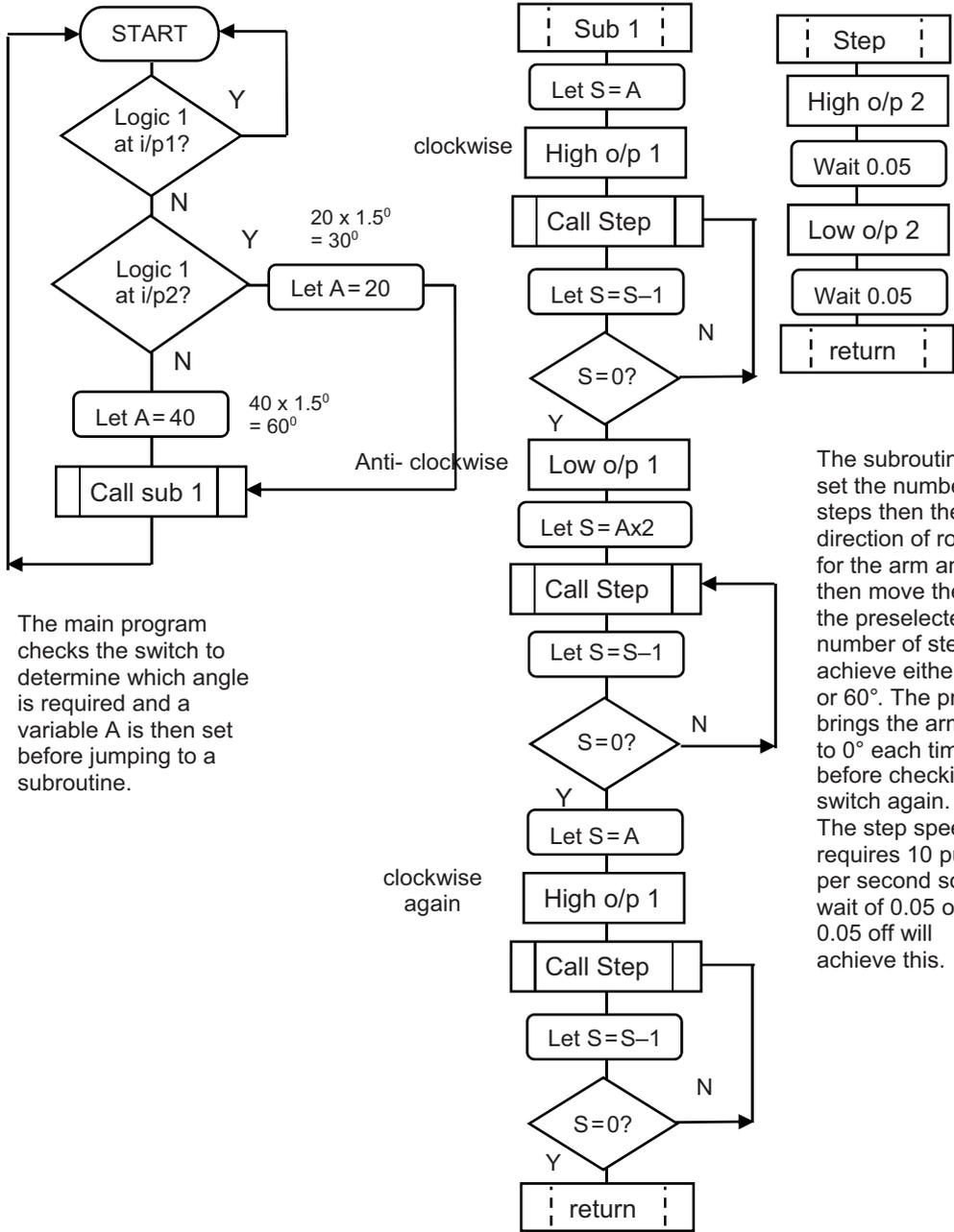
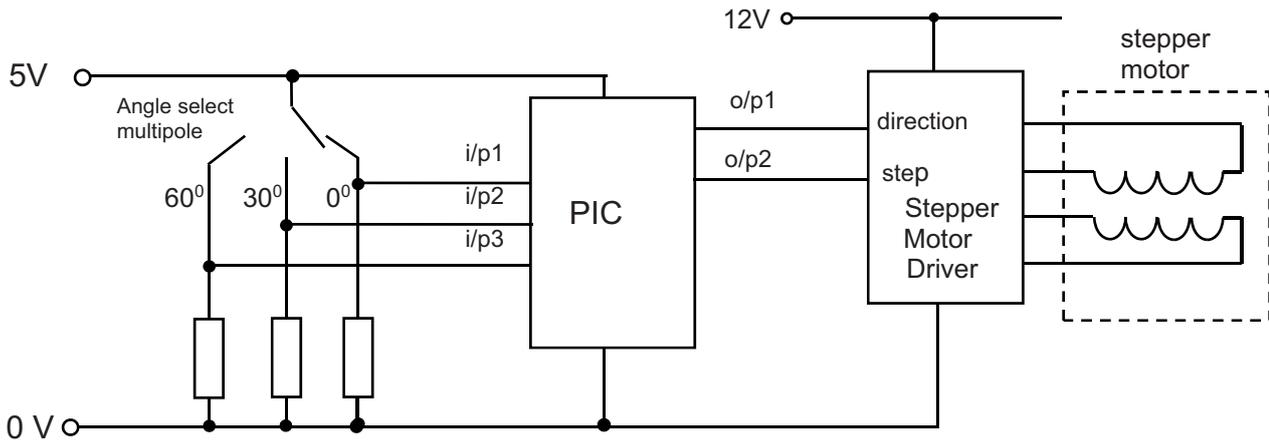


Award [2] for a full explanation and [1] for a limited explanation. [3]

(ii) Sample answer



(f) Sample answer



The main program checks the switch to determine which angle is required and a variable A is then set before jumping to a subroutine.

The subroutine will set the number of steps then the direction of rotation for the arm and then move the arm the preselected number of steps to achieve either 30° or 60°. The program brings the arm back to 0° each time before checking the switch again. The step speed requires 10 pulses per second so a wait of 0.05 on and 0.05 off will achieve this.

Correct alternative responses will be given full credit.

[10]

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Section B

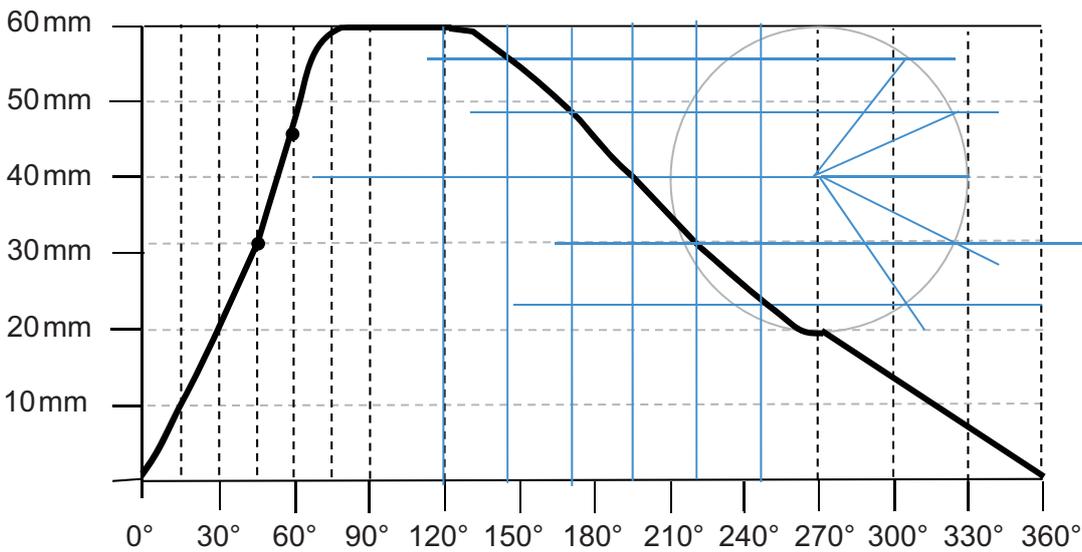
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Mechanical and Pneumatic

- 3 (a) (i) **Possible Risks** [any two]:
 Mechanical system being operated without due care and attention.
 User clothes getting caught on moving parts.
 Fingers/Hands getting injured on moving parts.
 (2 × [1]) [2]

- Possible Procedures** [any two]:
 Ensure guards are fitted on any exposed parts.
 Ensure equipment has been properly maintained.
 Display safety signs and ensure staff have been trained.
 (2 × [1]) [2]
Correct alternative responses will be given full credit.

- (ii) • 0°–90° Uniform Acceleration and Retardation with a rise of 60mm [1]
 • 90°–120° Dwell [1]
 • 120°–270° Simple Harmonic Motion with a fall of 40mm [1]
 • 270°–360° Uniform Velocity with a fall of 20mm [1]



(b) (i)

Excellent sketch of the main features of the CV Joint and excellent annotation.	[3]
Good sketch of the main features of the CV Joint with good annotation.	[2]
Limited sketch of the main features of the CV Joint with limited annotation.	[1]
For a response not worthy of credit	[0]

Correct alternative responses will be given full credit. [3]

CV Joint used in preference to Universal Joint for drive shaft on front wheel drive cars:

- Operate at angles over 20 degrees
- Used when the velocity of the driven shaft must remain constant

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit. [2]

- (ii) A gasket is a mechanical seal that fills the space between two mating surfaces, to prevent leakage from or into the joined objects while under compression. Gaskets allow less-than-perfect mating surfaces on machine parts where they can fill irregularities.

Award [2] for a full description and [1] for a limited description.

Correct alternative responses will be given full credit. [2]

- (iii) A simple pulley system contains one pulley and is used on simple lifting systems.

A compound pulley system contains a range of fixed and moveable pulleys that provide more advantageous mechanical advantage.

Award [2] for a full description and [1] for a limited description.

Correct alternative responses will be given full credit. [2]

(iv) $VR = \frac{\text{riven}}{\text{river}} \times \frac{A}{C} \times \frac{B}{D} \times \frac{E}{F} \times \frac{G}{H}$

$$= \frac{60}{120} \times \frac{120}{120} \times \frac{60}{80} \times \frac{80}{100} \times \frac{60}{120}$$
 [1]

$$= 0.5 \times 1 \times 0.75 \times 0.8 \times 0.5$$

$$= 0.15$$
 [1]

(v) $VR = \frac{\text{riven}}{\text{river}} \times \frac{A}{G} \times \frac{B}{H}$

$$= \frac{60}{80} \times \frac{80}{100} \times \frac{60}{120}$$

$$= 0.75 \times 0.8 \times 0.5$$

$$= 0.3$$
 [1]

$$\text{Efficiency} = \frac{A}{VR} \times 100$$

$$= \frac{0.25}{0.3} \times 100 = 83.333\%$$
 [1]

(c) Indicative content:

Cone Clutch (Two Characteristics):

- The cone clutch uses two conical surfaces to transmit torque by friction.
- The cone clutch transfers a higher torque than a plate clutch of the same size due to the wedging action and increased surface area.
- Cone clutches are robust and can deal with extended forces.

Centrifugal Clutch (Two Characteristics):

- Uses centrifugal force to connect two concentric shafts, with the driving shaft nested inside the driven shaft.
- Disengages with ease
- Very versatile with a variety of outputs.

Example Product: **Go Kart**

Justified Selection of Centrifugal Clutch:

Is much more useful than a direct drive in many applications and would operate at a faster speed.

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<p>Level 3 The candidate discusses two main characteristics of cone clutches and two main characteristics of centrifugal clutches in excellent depth. Justification of selection is clearly explained. The written presentation is clear and precise and demonstrates very good knowledge of the issues 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 discusses two main characteristics of cone clutches and two main characteristics of centrifugal clutches in good depth. Good reference is given to justification. The written presentation is reasonable and demonstrates a 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 reasonable standard.</p>	[4]–[6]
<p>Level 1 The candidate discusses two main characteristics of cone and centrifugal clutches in basic depth. Limited reference is given to justification. The written presentation is limited and demonstrates a limited 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 limited accuracy and the form and style are of a basic standard.</p>	[1]–[3]
Response not worthy of credit	[0]

Correct alternative responses will be given full credit. [9]

(d) (i) See A3 Mark scheme [5]

(ii) See A3 Mark scheme
Correct alternative responses will be given full credit. [5]

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- 4 (a) (i) Open loop – is a simple control system where a typical input controls an output and where there is no feedback. Closed loop – is where there is some kind of measurement or feedback on the system which can then adjust the input.
Award [2] for a full outline and [1] for a limited outline. [2]

A fridge which uses a thermostat to control the temperature and this can rise or fall depending on the temperature inside the fridge.
Correct alternative responses will be given full credit. [1]

- (ii) Drawing of the 3 Pulleys [1]
Connection rope [1]
Correct alternative responses will be given full credit. [2]

(iii)

Excellent sketch of the key features of the taper bearing (including angle of rollers/ outer ring/ enclosed casing) and excellent annotation.	[3]
Good sketch of the key features of the taper bearing with good annotation.	[2]
Limited sketch of the key features of the taper bearing with limited annotation.	[1]
For a response not worthy of credit	[0]

[3]

Applications: Wind turbine axle supports, etc.
Correct alternative responses will be given full credit. [1]

(iv) Volume = $\frac{\square \times D^2 \times \pi}{\square} + \frac{\square(D^2 - d^2) \times \pi}{\square} \times (P + AP)$ [1]
 $= \frac{\square \times 0.8^2 \times \pi}{\square} + \frac{\square(0.8^2 - 0.2^2) \times \pi}{\square} \times (4 + 1.5)$ [1]
 $= (2.0096 + 1.884) \times 5.5$ [1]
 $= 21.41 \text{ cm}^3$ [1]

(v) Area of 1 cylinder = $\frac{5652}{3} = 1884 \text{ mm}^2$ [1]

Force (Outstroke) One Cylinder = Pressure \times Area
 $= 0.5 \times \text{Area } (1884 + \pi 5^2)$
 $= 0.5 \times 1962.5$
 $= 981.25 \text{ N}$ [1]

Force for Three Cylinders = 981.25×3
 $= 2943 \text{ N}$ [1]

- (b) (i) Valve C (NOT Valve) operates on a pressure differential between the main air signal and the amplified exhaust air signal. Valve C eventually activates the 1:4 side of the 5PV after pressure has been exceeded at the top of the valve.
Award [2] for a full explanation and [1] for a limited explanation.
Correct alternative responses will be given full credit. [2]

- (ii) Cylinder Y will activate after Cylinder X goes negative. Due to the two flow control valves its speed can be controlled on both the positive and negative stroke.
- Award [2] for a full explanation and [1] for a limited explanation.
Correct alternative responses will be given full credit. [2]
- (c) See A3 Mark scheme
Correct alternative responses will be given full credit. [10]
- (d) (i) See A3 Mark scheme [6]
- (ii) See A3 Mark scheme
Correct alternative responses will be given full credit. [4]

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Section C

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Product Design

- 5 (a) Needs are associated with things we cannot do without for example food, clothing and shelter. Marketers play no role in creating needs. Demands are things that we would like and arise directly from our needs for example a Mercedes car, a round the world trip. These wants turn into demands when customers have the ability to buy them. Market demands need to be backed with buying power. Marketers can play a significant role in creating demands.

Award [2] for a full distinction between needs and demands and [1] for a limited distinction between needs and demands.

Correct alternative responses will be given full credit. [2]

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

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit. [2]

- (ii) Any **one** main reason why it would be beneficial for the company producing the electronic tablets to have complied with an environmental audit for example:

- May influence in a positive way the public's perception of the company.
- May attract more PR, investment or environmental grants. [1]

Correct alternative responses will be given full credit.

- (c) How the designer has specifically managed to reduce material use for example:

Example 1

Coca-Cola since 2007 has decreased the weight of its packaging by 27% by removing the cardboard tray. The plan is to reduce the amount of material in all their packaging by 25% by 2020 from where it started in 2007.

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit. [2]

Example 2

Dyson engineers reinvented the personal fan. Instead of relying on rotating blades to chop the air they accelerated it through an annular aperture. The surrounding air is drawn in and a smooth, powerful, high-velocity flow is projected out. This fan uses less components and less materials (1.8 kg in weight, this is almost $\frac{1}{2}$ the average weight of competitor fans).

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit [2]

- (d) (i) Any **two** main characteristics associated with fashion innovators for example:

- Fashion innovators would be interested in the innovation and unique features of a new tablet.
- Fashion innovators are the group of people who would adopt a new model of the tablet first.
- Fashion innovators are often trend setters and would want to be seen to adopt the latest model of a new tablet.

Correct alternative responses will be given full credit. [2]

- (ii) Any **two** main characteristics associated with opinion leaders for example:
- 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.
- Correct alternative responses will be given full credit.** [2]
- (iii) Any **two** main characteristics associated with laggards for example:
- 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.
- Correct alternative responses will be given full credit.** [2]
- (e) Any **three** specific benefits that CAD, CAM and CNC could offer a product designer.

Indicative content:

Any **three** specific benefits that CAD could offer a product designer for example :

- All of the required features needed are set within the program, i.e. extrusion, filleting, etc)
- Both 2D and 3D drawings can be created easily by the product designer to show clients.
- Scaling is not required as drawings are created in full size and features like zooming, pan can be used for clarity by the designer.
- CAD can produce very accurate design drawings with snap features polar tracking and specified distances.
- With CAD standards can be applied consistently (e.g. text, dimensions and line type).
- Time saved as once you draw a part it can be saved separately and reused.
- Details of production methods can be taken from the program.

Any **three** specific benefits that CAM could offer a product designer for example:

- Using CAM is very efficient as it produces products or components quicker.
- Using CAM is more cost effective over time and can result in a reduction in labour costs.
- Using CAM can create complicated products or components of a unique shape with uniform repeatability.
- CAM can speed up production of low volume products.
- CAM systems can maximise a full range of production equipment.
- CAM can utilise CAD files and produce a 3D product or component.

Any **three** specific benefits that CNC could offer a product designer for example:

- CNC machines can be used continuously 24 hours a day, 365 days a year and only need to be switched off for occasional maintenance.
- CNC machines are programmed with a design which can then be manufactured hundreds or even thousands of times. Each manufactured product will be exactly the same.

- Less skilled/trained people can operate CNCs unlike manual lathes/ milling machines, etc, which need skilled engineers.
- Training in the use of CNCs is available through the use of ‘virtual software’. This is software that allows the operator to practise using the CNC machine on the screen of a computer. The software is similar to a computer game.
- CNC machines can be programmed by advanced design software such as Solidworks enabling the manufacture of products that cannot be made by manual machines.
- Modern design software allows the designer to simulate the manufacture of his/her idea. This saves time and money.

<p>Level 3 The candidate provides a detailed explanation on three distinctive benefits of CAD, CAM and CNC to a product designer. The written presentation is clear and precise and demonstrates 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 provides a good explanation on three distinctive benefits of CAD, CAM and CNC to a product designer. The written presentation is reasonable and demonstrates good 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 provides a limited explanation on three distinctive benefits of CAD, CAM and CNC to a product designer. 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. 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]

Correct alternative responses will be given full credit. [9]

- (f) (i) An explanation of an appropriate pricing strategy for a chosen product during the introductory stage for example:

Product example – Mobile phone.

In the introductory stage of a new mobile phone there are various pricing strategies which are possible; one option is to price the mobile phone low to stimulate sales and penetrate the potential market, this is known as a market penetration strategy.

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit. [2]

- (ii) An explanation of an appropriate pricing strategy for a chosen product during the decline stage for example:

Product example – Mobile phone.

An appropriate pricing strategy for the mobile phone during the decline stage could well be a cost-plus approach. This strategy is normally used by companies that sell large quantities of mobile phones and operate in a competitive market that is led by price. As a result it is important that mobile phone companies are aware of the competitor's prices to ensure that this pricing strategy is appropriate.

Award [2] for a full explanation and [1] for a limited explanation.

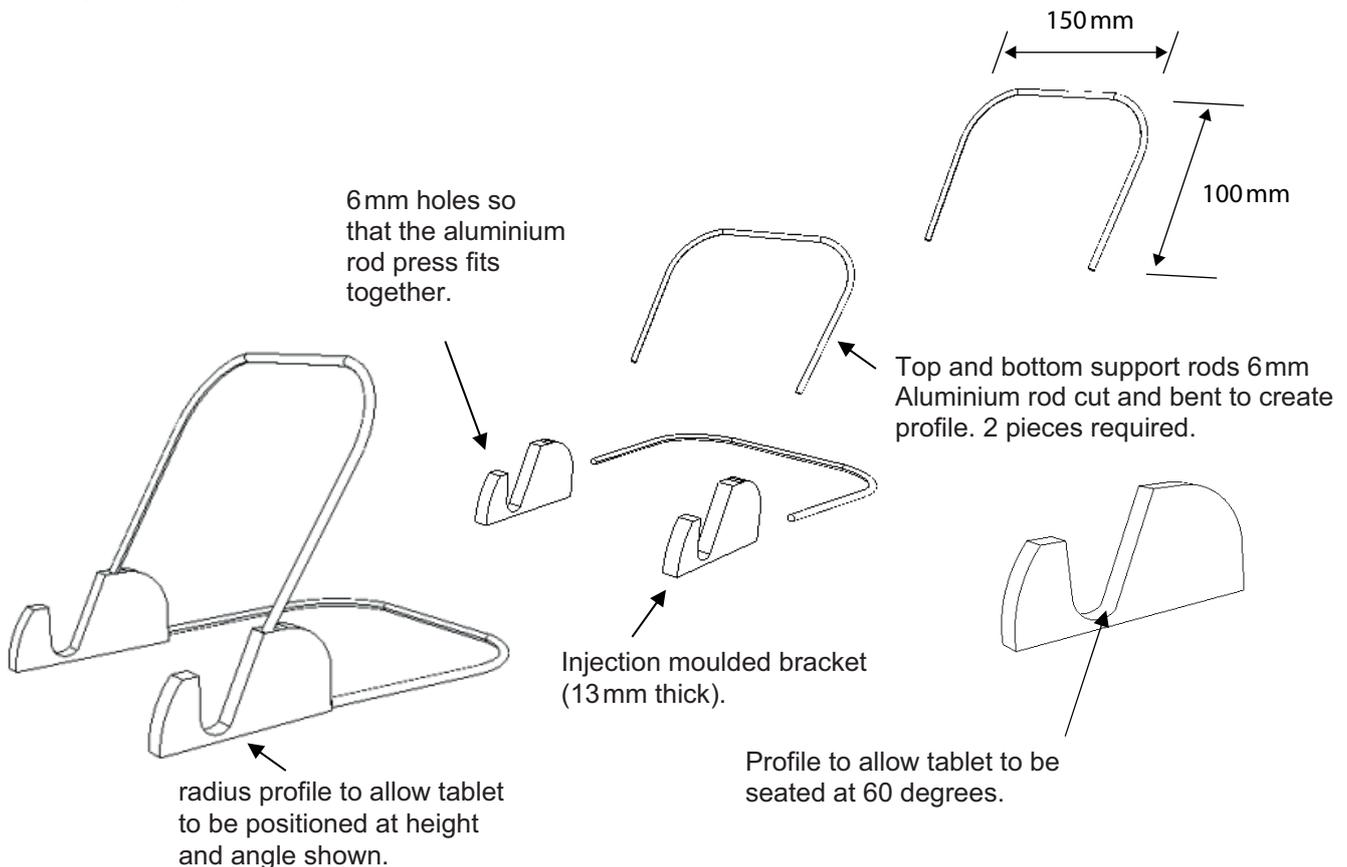
Correct alternative responses will be given full credit. [2]

- (g) Any **two** characteristics which describe the influence of Apple in terms of product design for example:

- Quality design of their products with great attention to detail
- Simplicity of use in all their product range
- Offer great customer service and in store experience.

Correct alternative responses will be given full credit. [2]

(h) **Sample answer**



Explanation:

The dimensions of the support rails and the bracket ensure that the parts will fit within the packaging. The product requires minimal assembly with only two support rods having to be fitted into the brackets. Both the use of materials and processes have been minimised.

The product is suitable for batch production for a number of reasons.

- Common form and sizes of materials are used for the supports.
- Brackets can be injection moulded in batches.
- Jigs can be set up to repeat the profile for the supports
- A minimal number of finishing processes are required.

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Detailed annotated sketches of an appropriate design of a stand which will fit inside the packaging. The design requires minimal assembly, is rigid and allows the user to safely position the tablet at 60 degrees. The design has minimised the use of materials and processes. Detailed explanation of how the design is suitable for batch production is provided.	[7]–[10]
Both the sketches and annotation are good. There are some limitations on how the stand might fit inside the packaging. The design has some limitations in fulfilling minimal assembly, rigidity and if the tablet could be safely positioned by the user at 60 degrees. The design has limitations when minimising the use of materials and processes. Good explanation of how the design is suitable for batch production is provided.	[4]–[6]
Limited sketches lacking detail and appropriate annotation. Difficulties in determining if the design of the stand will fit inside the packaging. In addition it is difficult to determine if the design requires minimal assembly, is rigid and allows the user to safely position the tablet at 60 degrees. The design shows little or no evidence of minimising the use of materials and processes. Limited explanation of how the design is suitable for batch production is provided.	[1]–[3]
Response not worthy of credit	[0]

AVAILABLE
MARKS

Correct alternative responses will be given full credit. [10]

40

- 6 (a) Any **one** role of innovation in the market for example:
- The role of innovation is to provide competition between companies in the same industry which will ultimately benefit the consumer.
 - The role of innovation is to utilise new and emerging technologies to provide consumers with exciting new products.

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit. [2]

- (b) Any **two** main properties of an environmentally friendly plastic which would make it suitable for packaging for example:

- Good tensile strength properties
- biodegradable
- Lightweight material

Correct alternative responses will be given full credit. [2]

- (c) (i) Basic products offer the longest product life cycle of the three. This is because they have a stable and long life cycle because there is a substantial need for the product in the market. These products will not generally decline unless there is a major product innovation to replace the need for the product

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit. [2]

- (ii) The characteristics which give rise to the shape of the graph for a fad product is because these products offer the shortest life-cycle of the three types shown. A life cycle which shows rapid growth, before a very short length of time in maturity, followed by a very steep decline in sales.

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit. [2]

- (d) (i) Any **two** different ways in which product designers and manufacturers can influence the disposal of products for example:
- Designers and manufacturers can recommend the use of finishing processes which facilitate recycling.
 - Designers can ensure that when they design components or products that disassembly and recycling are given a higher priority.
 - Designers can encourage the use of end-of-life programmes which were introduced to reuse or harvest materials back into the market where they are made into new products

Correct alternative responses will be given full credit [2]

- (ii) Any **two** different ways in which product designers and manufacturers can influence pollution control for example:

- Designers can recommend and manufacturers can adopt cleaner technologies and processes.
- Manufacturers can adopt waste minimisation techniques.
- Manufacturers can adopt more appropriate pollution control measures in order to prevent any hazardous materials or substances reaching waterways.

Correct alternative responses will be given full credit [2]

- (e) Any **three** main benefits associated with adopting (FMS) for example:
- FMS is expensive to set up but in the long run will save the company time and money.
 - FMS helps to create faster production times.
 - If something within the process changes they can easily adopt and keep production flowing to reduce delays and bottlenecks.
 - FMS requires fewer workers to operate compared to other manufacturing systems so saving on labour costs.

Correct alternative responses will be given full credit [3]

- (f) How international and/or regional differences have influenced the design of two chosen examples.

Example 1: Car

Left hand drive cars and right hand drive cars are an example of international differences. Vehicles are usually manufactured in LHD and RHD configurations, referring to the placement of the driving seat and controls within the vehicle.

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit. [2]

Example 2: Power outlets

Plug shape varies from country to country, as do voltages and frequencies of electricity. North American power outlets provide 120 volts at 60Hz. European power outlets provide 230volts at 50Hz with voltages varying in other countries. This has influenced the design of voltage converters, plug adaptors and chargers.

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit. [2]

(g) (i) Any **two** main advantages associated with the use of sales promotion as a way of increasing product sales for example:

- Sales promotion encourages consumers to continue purchasing.
- Sales promotion can result in a quick response producing an increase in sales.
- Sales promotions are instantly recognisable and accepted by consumers.

Correct alternative responses will be given full credit. [2]

Any **two** main disadvantages associated with the use of sales promotion as a way of increasing product sales for example:

- May devalue the consumer's perception of the product.
- Net return from each unit is reduced.
- A lot of customer disappointment if there is a failure in the product.

Correct alternative responses will be given full credit. [2]

(ii) Any **two** main advantages associated with the use of personal selling as a way of increasing product sales for example:

- A sales person is well trained in the approaches and techniques of personal selling.
- Sales person can develop very good relationships with customers resulting in repeat business.
- Personal selling can convey more information than other promotion methods.

Correct alternative responses will be given full credit. [2]

Any **one** main disadvantage associated with the use of personal selling as a way of increasing product sales for example:

- Very expensive to deliver and maintain.
- Personal sellers are somewhat limited to the number of customers they can cover per day.

Correct alternative responses will be given full credit. [1]

(h) (i) A specific example of the use of new technology and how this impacts upon environmental concerns.

Example. Hybrid car

The use of new technology which has been developed to run the Hybrid car has had an impact on the environment. The car will run at higher speeds using the petrol engine and at lower speeds will use an electric-battery motor. This will reduce fuel consumption and considerably reduce emissions.

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit. [2]

(ii) A specific example of the use of environmentally friendly manufacturing processes and how this impacts upon environmental concerns.

Example. Steel production.

In the process charcoal replaced a portion of the coal and coke in steelmaking which reduces carbon dioxide emissions. This low emission steelmaking process could potentially slash carbon dioxide emissions and reduce water and energy use around the world.

Award [2] for a full explanation and [1] for a limited explanation.

Correct alternative responses will be given full credit. [2]

(i) (i) **Sample answer.**

Total Height 40 mm - Text size of **36** given equal spacing of 10 mm above and below the text $72/2 = 36$. Style – Arial Black

Total Height 40 mm - Text size of **14** allows for the four bullet points to be read at a comfortable distance but providing adequate spacing. Arial black italics.

<h1>CAR VACUUM CLEANER</h1>	<ul style="list-style-type: none">• <i>For upholstery and interiors</i>• <i>Operates via 12V socket</i>• <i>A 3m cable provided</i>• <i>Comes with three accessories.</i>
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Appropriate Layout [1]
Suitable specific text size to communicate impact. [1]
Suitable specific style to communicate impact. [1]
Justification for the text and style [2]

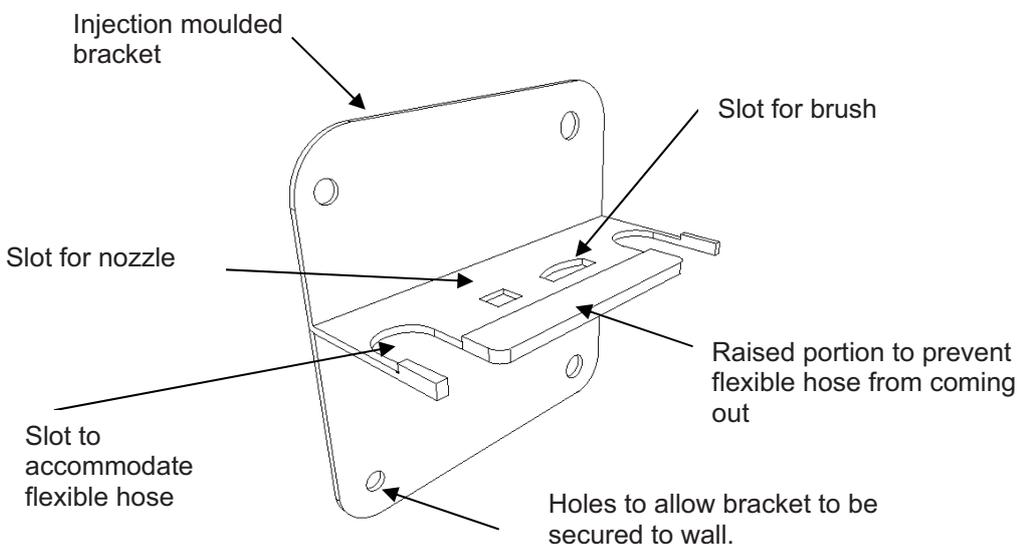
Justification for the text and style.

The selected text size and type provides adequate spacing to provide a clear bold heading with succinct bullet points making it easy to articulate by young adults. The size of text makes it easy to read at an appropriate distance and the contrast of fonts may encourage the user to read all the information.

Award [2] for a full explanation and [1] for a limited explanation.
Correct alternative responses will be given full credit. [5]

(ii) Answer could be based on a low cost wall mounted injection moulded bracket with slots to house the flexible hose, nozzle and brush attachments. The flexible hose press fits into a slot securing it in place. Both the nozzle and the brush fit into a matching slot profile and cannot pass through due to the increase size of the profile.

Additional sketch to provide more detail.



AVAILABLE MARKS

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Detailed annotated sketches of a low cost, innovative design that would securely hold the flexible hose, nozzles and brush attachments whilst allowing the user to quickly remove or replace each attachment as required.	[4]–[5]
Both the sketches and the annotation are good. The design gives some consideration to cost and innovation but has limitations on how it would securely hold the flexible hose, nozzles and brush attachments whilst allowing the user to quickly remove or replace each attachment as required.	[3]
Limited sketches lacking detail and appropriate annotation. Difficulties in determining if the design would be low cost, innovative and would securely hold the flexible hose, nozzles and brush attachments whilst allowing the user to quickly remove or replace each attachment as required.	[1]–[2]
Response not worthy of credit	[0]

Correct alternative responses will be given full credit.

[5]

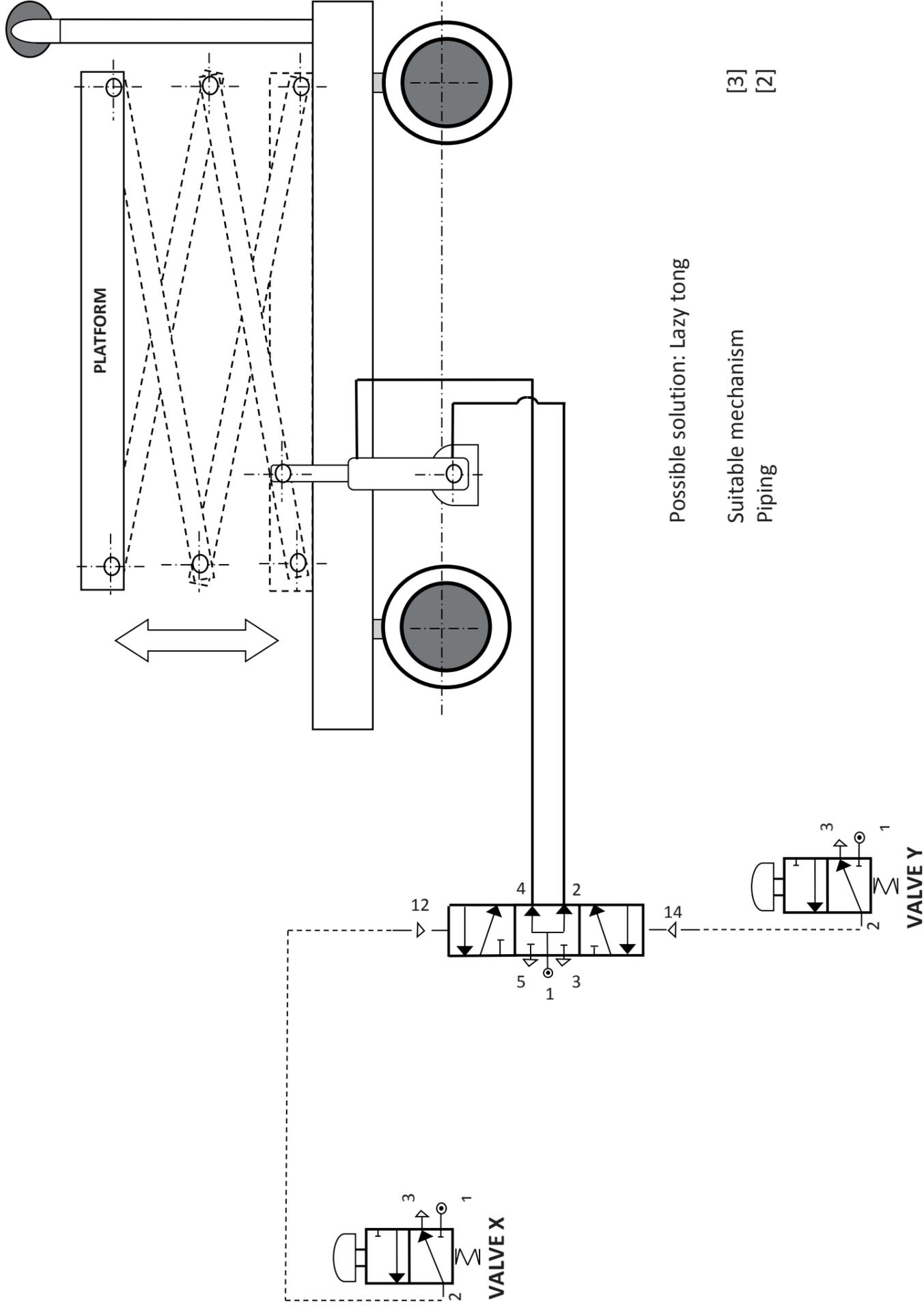
Total

AVAILABLE MARKS

40

80

3d (ii) Sample Answer:



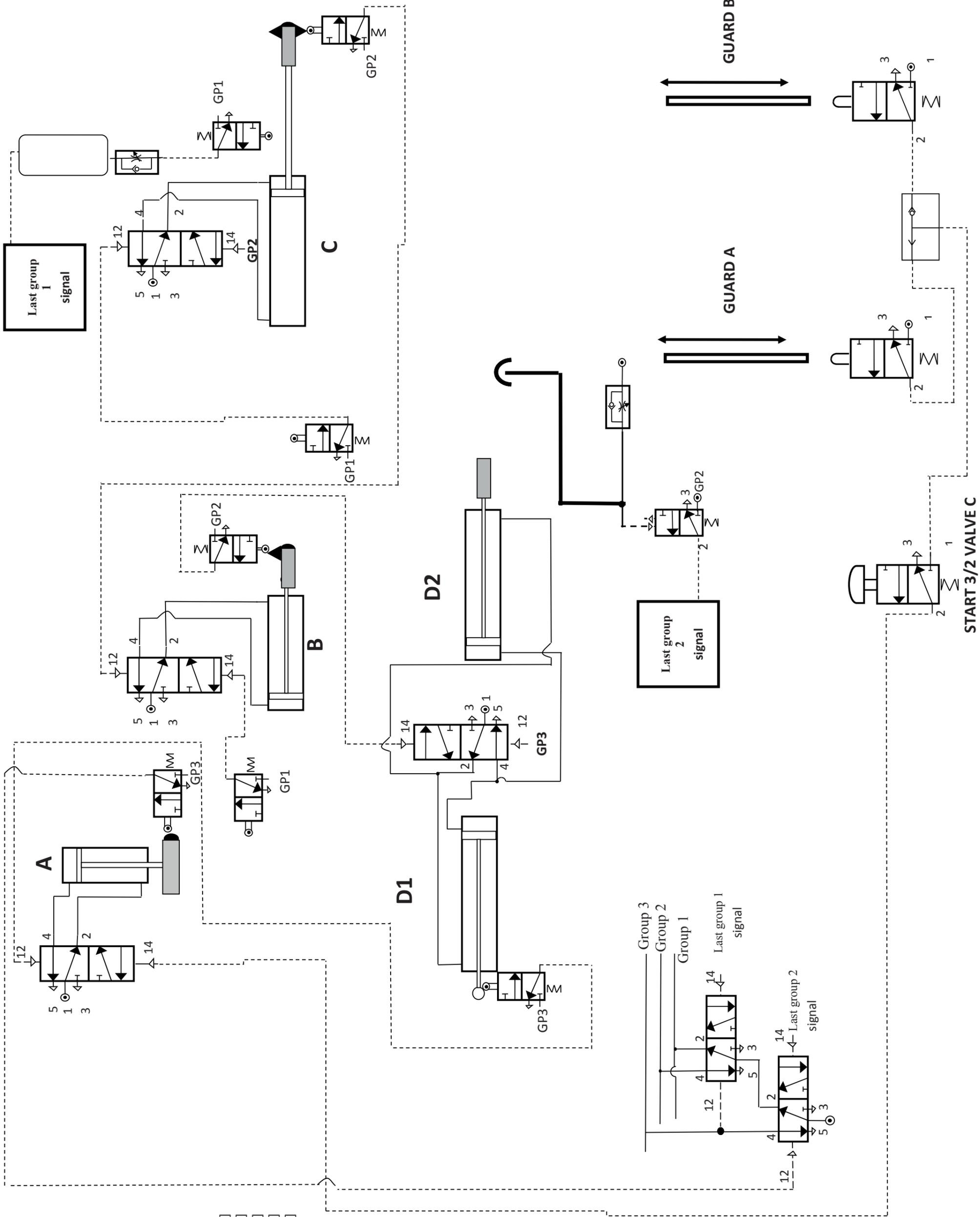
Possible solution: Lazy tong

Suitable mechanism

Piping

[3]

[2]



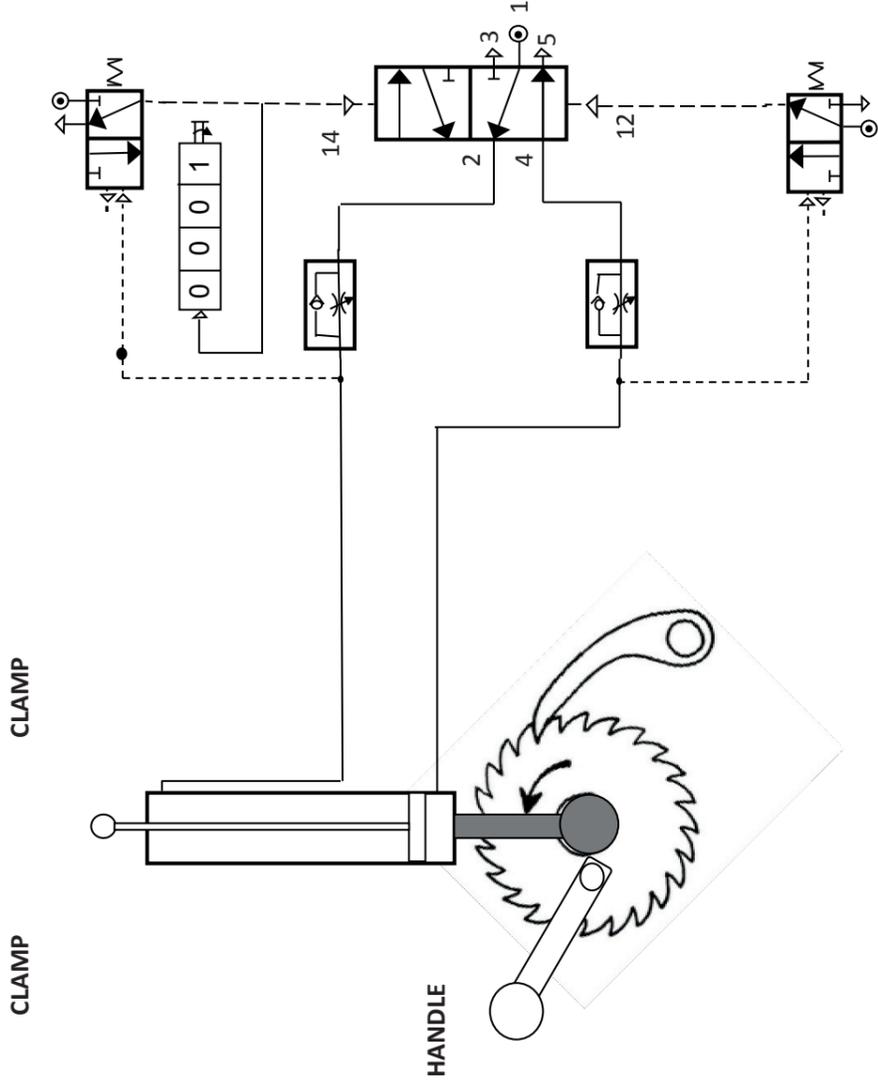
4(c) Mark scheme

A+B+C-/C+B-D1D2+/D1D2-A-

- [2] Start OR and piping
- [3] Group Change-Over Valves
- [1] Time Delay
- [2] Air Bleed
- [2] Piping

4d (i) and (ii) Sample Answers:

- Speed Control [2]
- Counter [1]
- Ratchet and Pawl to lock cylinder at a set angle [2]
- Non-Contact method [1]



- Correct piping of Proximity Sensor/ Diaphragm 3/2 [1]
- Correct piping [1]
- Toggle clamp [2]

