



*Rewarding Learning*

**ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2014**

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## **Technology and Design**

**Assessment Unit AS 1**

*assessing*

**Product Design and Systems and Control**

**[AV111]**

**TUESDAY 3 JUNE, MORNING**

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**MARK  
SCHEME**

## **General Marking Instructions**

These mark schemes are intended to ensure that the AS/A2 examinations are marked consistently and fairly. The mark schemes provide examiners with an indication of the nature and range of candidate responses likely to be worthy of credit. They also set out the criteria which they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these general marking instructions which apply to all papers.

### **Quality of candidates' responses**

In marking the examination papers, examiners will be looking for a quality of response reflecting the level of maturity which may reasonably be expected of 17- and 18-year-olds which is the age at which the majority of candidates sit their AS/A2 examinations.

### **Flexibility in marking**

The mark schemes which accompany the specimen examination papers are not intended to be totally prescriptive. For many questions, there may be a number of equally legitimate responses and different methods by which the candidates may achieve good marks. No mark scheme can cover all the answers 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 for the paper concerned.

### **Positive marking**

Examiners are encouraged to be positive in their marking, giving appropriate credit for valid responses 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 for 17- and 18-year-old candidates. Conversely, marks should only be awarded for valid responses and not given for an attempt which is completely incorrect and inappropriate.

### **Types of mark schemes**

Mark schemes for questions which required 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. These questions are indicated on the cover of the examination paper.

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.

### **Quality of written communication**

Quality of written communication is taken into account in assessing candidates' responses to all questions that require them to respond in extended written form. These questions are marked on the basis of levels of response.

## Levels of response

Questions requiring extended written answers are marked in terms of levels of response. In deciding which mark within a particular level to award 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.

In all cases, correct alternative responses will be given full credit.

AVAILABLE  
MARKS

Section A

- 1 (i) Any **one** main specific property of pine from the following:
- Hard and durable.
  - Good stability. [1]
- (ii) Any **two** main advantages of MDF from the following:
- Good strength to weight ratio.
  - Good quality surface finish.
  - It is available in a wide range of sizes. [2]
- (iii) The main purpose of using a stain as a finish is to change the colour of the wood in the kitchen whilst leaving the grain still visible.  
The purpose of using an oil as a finish is to provide a water-resistant, non-gloss finish. [2] 5
- 2 (i) Any **two** main properties associated with mild steel from the following:
- Very ductile.
  - Good tensile strength.
  - Tough and malleable.
- The main disadvantage of using mild steel is that it is:
- Subject to corrosion. [3]
- (ii) Any **two** main reasons why the designer would suggest the use of common forms and sizes from the following:
- Less expensive to purchase.
  - More readily available supply.
  - Be more suited to standard processes and equipment. [2] 5
- 3 (i) Any **one** specific application for the use of polythene from the following:
- (LD) – plastic bags.
  - (HD) – plumbing components. [1]
- Any **two** main properties associated with polythene from the following:
- (LD) – Soft and flexible.
  - (LD) – Tough with good chemical resistance.
  - (LD) – Suitable softening point. [2]
- or
- (HD) – Strong quite tough plastic.
  - (HD) – Resistant to chemical attack.
  - (HD) – High softening point. [2] [3]
- (ii) Any **two** main properties associated with PVC from the following:
- PVC is weather resistant.
  - Tough but flexible.
  - Can be provided in a wide range of colours. [2] 5

			AVAILABLE MARKS
4	(i)	The purpose of lacquering metal components is to prevent them from tarnishing. [1]	5
	(ii)	The process of anodising involves electrolysis and uses acids and electric currents to provide a durable corrosion resistant finish on aluminium. [2]	
	(iii)	Any <b>two</b> specific reasons for using enamelling from the following: <ul style="list-style-type: none"> <li>• Tough finish – making it scratch proof.</li> <li>• Attractive.</li> <li>• Easy to clean and hygienic. [2]</li> </ul>	
5	(i)	Any <b>two</b> main characteristics associated with shape memory alloys from the following: <ul style="list-style-type: none"> <li>• It is an alloy that “remembers” its original, cold-forged shape: returning to the pre-deformed shape when heated.</li> <li>• It is a lightweight, solid – state alternative to conventional actuators.</li> <li>• It can be formed into practically any shape. [2]</li> </ul>	4
	(ii)	One specific application for light-emitting polymers, e.g. thin and lightweight displays for portable electronics.  Any <b>one</b> main characteristic associated with light–emitting polymers from the following: <ul style="list-style-type: none"> <li>• Converts electrical power into visible light.</li> <li>• By engineering the chemical structure of the light–emitting polymers all emission colours can be obtained. [2]</li> </ul>	
6	(i)	Any <b>two</b> main reasons why the blow moulding process may be used from the following: <ul style="list-style-type: none"> <li>• Quick and efficient method.</li> <li>• Capable of producing hollow shapes with good definition.</li> <li>• Low cost when produced in numbers. [2]</li> </ul>	6
	(ii)	Blow moulding – Annotated sketch showing split mould, mandrel, plastic profile and mould opening for ejection. [3] Description. [1] [4]	
7	(i)	Any <b>two</b> main advantages of using CIM from the following: <ul style="list-style-type: none"> <li>• Reduces errors.</li> <li>• Speeds up operations and improves efficiency.</li> <li>• Provides flexibility to changing demands in the market. [2]</li> </ul>	4
	(ii)	Computers in CIM are used for stock control – Any <b>two</b> from the following: <ul style="list-style-type: none"> <li>• To monitor stock bought in from suppliers to be manufactured</li> <li>• To monitor complete products ready for distribution.</li> <li>• To share the above information with other computers to help inform ordering and production. [2]</li> </ul>	

- 8 (i) The term anthropometric data is the data produced by studying the sizes or body measurements of people of all ages. [1]
- (ii) The term ergonomics is the study of the interaction between the human body, products and the surrounding environment.

Any **two** main reasons why it is an important factor from the following:

- Poor ergonomics would result in the consumer not being comfortable when using the product.
- Poor ergonomics could subject the user to mechanical stress on joints and muscles.
- Poor ergonomics could result in poor reviews and consequently poor sales. [3]

For a response not worthy of credit.	[0]
Limited explanation and use of English grammar.	[1]
Clear and coherent explanation using good English grammar.	[2]

Quality of written communication [2]

**Section A**

**AVAILABLE MARKS**

6

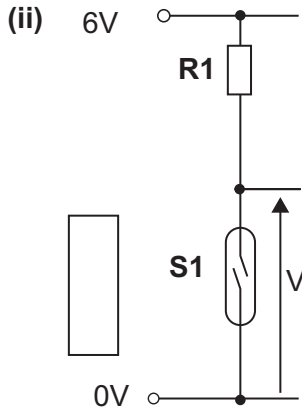
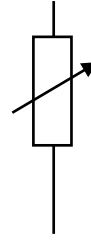
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**Section B**

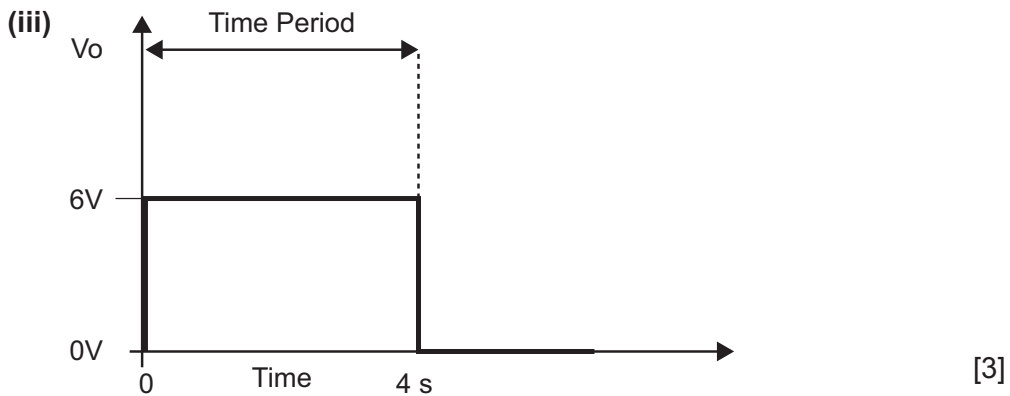
**AVAILABLE MARKS**

- 9 (a) (i) To provide 3 alternative output voltages. [1]  
 (ii) Position 3  $V_o = 30/40 \times 9 = 6.75$  volts. [2]

- (b) (i) Change resistor R2 to a variable type. [2]



Voltage V will initially be high (6V) When a magnet is brought close to the reed switch the contacts in the switch will close and the voltage will drop to 0V to trigger the timer. The magnet must be removed for the timing period to complete.



- (iv)  $C = 4/1.1 \times 6800 = 535 \mu\text{F}$  [2]

- (c) (i) Current gain is the ratio of collector current to base current. [1]

(ii)  $h_{fe} = (12\text{V}/20\Omega) \div (6\text{V} - 0.6/4700) = 522$  [2]

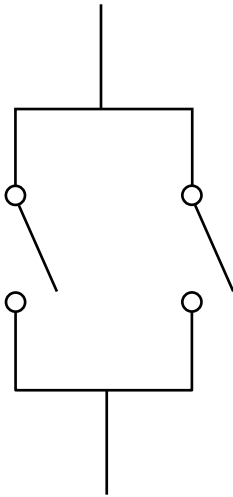
- (d) On/off systems operate in one of two states such as high/low or open/close. Continuous systems may operate on a range of variable states between upper and lower limits. An example of an on/off system is a typical electric kettle where the element is simply switched on or off. An example of a continuous system could be a cordless drill where variable speed of the chuck is achieved by gradually squeezing a trigger control. [3]

Quality of written communication [1]

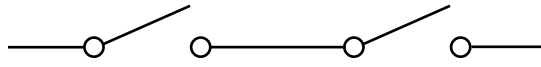
For a response not worthy of credit.	[0]
Clear and coherent explanation using good English grammar.	[1]

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10 (a) OR logic



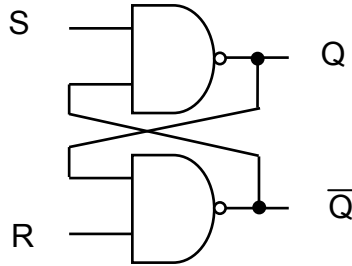
AND logic



[2]

(b) (i) R1 and R2 are pull up resistors that ensure a logic '1' is maintained at the S and R inputs when the switch is open. [2]

(ii)



[2]

(iii)

	S	R	Q	$\bar{Q}$
Position 1	0	1	1	0
Position 2	1	0	0	1

[4]

(c) (i) The required value for the resistor  $R = 5V - 2.2V/10\text{mA} = 280\Omega$  [2]

The power dissipated by the resistor  $R = 10\text{mA} \times 2.8 = 0.028\text{W}$  [1] [3]

(ii)  $330\Omega$  would be a suitable value from the E12 series. While  $270\Omega$  is closer to the required value for R the nearest higher value will ensure that the current is limited to the extent that it will not cause damage to the LEDs. [2]

Quality of written communication [1]

For a response not worthy of credit.	[0]
Clear and coherent explanation using good English grammar.	[1]





**Section C**

**AVAILABLE  
MARKS**

- 11 (a) (i)** Anticlockwise [1]
- (ii)** Self-adjusting jockey wheels are used to remove any slack which could develop when a pulley belt is in use. As the slack can progressively get worse as a result of prolonged use the spring loaded self-adjusting nature of this type of jockey wheel can extend. This firmly pushes the jockey wheel against the pulley belt forcing out any slackness. [2]
- Quality of written communication [1]

For a response not worthy of credit.	[0]
Clear and coherent explanation using good English grammar.	[1]

- (iii)** Efficiency =  $MA/VR \times 100\%$   
 $80 = ?/5 \times 100$   
 $MA = 4$  [2]

- (iv)** B-C = 0 (same shaft)  
 C-D =  $40/80 = 0.5$   
 E-F =  $90/45 = 2$   
 Tot VR =  $0.5 \times 2 = 1$   
 OS = IS/VR  
 $260 = ?/1$   
 F rotates at 260rev/min [2]

- (v)** A-B =  $45/60 = 0.75$   
 C-D =  $40/80 = 0.5$   
 E-F =  $90/45 = 2$   
 G-H =  $40/80 = 0.5$   
 Tot VR =  $0.75 \times 0.5 \times 2 \times 0.5 = 0.375$  [3]

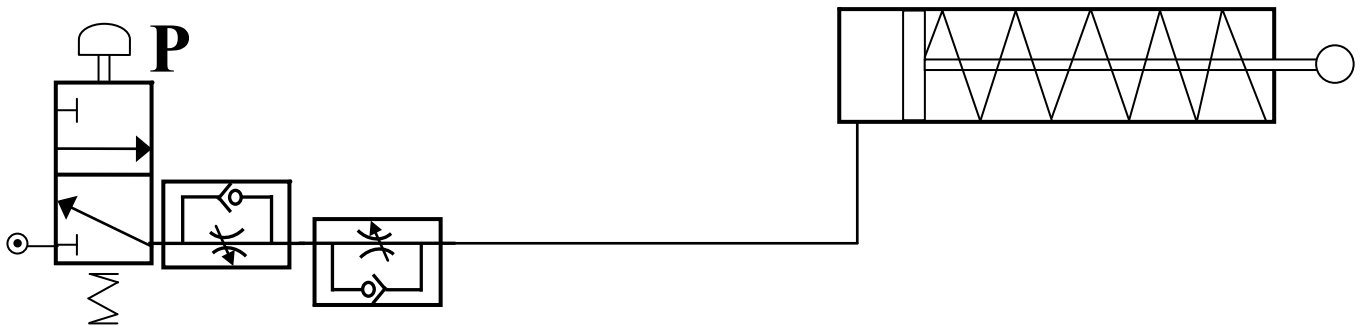
- (vi)** A-B =  $45/60$  OS = IS/VR OS =  $90/0.75 = 120\text{rev/min}$   
 C-D =  $40/80$  OS = IS/VR OS =  $120/0.5 = 240$   
 E-I =  $90/45$  OS = IS/VR OS =  $240/2 = 120$   
 J-K = 120 OS = IS/VR OS =  $120/2 = 60$   
 VR between J-K = 2  
 VR =  $2 = ?/40$   
 K = 80 mm [3]

- (b)** Suitable crank and slider mechanism sketched enabling slider to reciprocate. [2]
- Suitable method used to reduce rotary speed of shaft (for example - worm and wormwheel).
- Method used to connect components, e.g. wormwheel and crank (for example – gears, pulleys or chains and sprockets). Sharing of shafts between components. [4] [6]

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- 12 (a) (i) Exhaust port is used to enable exhaust air to leave the double acting cylinder. [1]
- (ii) Push button [1]
- (iii) Roller trip [1]
- (iv) See sample answer or using alternative method to achieve desired outcome. [1]  
 C and A [1]  
 Not B [1]  
 Slowly [1]  
 Piping and connection [2]
- (v) See sample answer or using alternative method to achieve desired outcome. [1]  
 Or gate between E and D. [1]  
 Three port valves positioned at outstroke of 5PV (roller trip) – both requiring simultaneous activation. [1]  
 Connection and piping. [2]
- (b) See sample answer or using alternative method to achieve desired outcome. [2]  
 Suitable circuit incorporating the positioning of two unidirectional flow control valves at different directions to each other. [2]

AVAILABLE MARKS



Answer 12(b)

- (c) When the 3PV is activated it sends the DAC positive. This also sends air via the 'T' connector to the flow control valve. This restricts the flow of air entering the reservoir. This creates a time delay before the air signal activates the 5PV at ports 12. This signals the DAC to instroke. [2]
- Quality of written communication [1]

For a response not worthy of credit	[0]
Clear and coherent explanation using good English grammar.	[1]

- (d)  $F = P \times A$  [3]  
 Total area =  $3.14 \times 30 \times 30 = 2826$   
 Rod area =  $3.14 \times 3 \times 3 = 28.26$   
 Effective area =  $2826 - 28.26 = 2797.74$   
 $2797.74 \times 0.25 = 699.4 \text{ N}$

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<b>40</b>

Section C

**Section D**

**AVAILABLE  
MARKS**

- 13 (a) (i)** Any **two** specific performance criteria from the following:
- Perform in a range of climatic conditions.
  - To grip litter by applying moderate pressure through the hand grip.
  - To repeatedly grip different size and weight of litter. [2]
- (ii)** Any **two** main criteria that would have influenced the selection of aluminium alloy from the following:
- Good strength to weight ratio.
  - Suitable for outdoor use as it will not rust.
  - Suitable material for applying paint and graphics to. [2]
- (iii)** Any **two** different aspects in support of the view that this is a low cost product from the following:
- Components suitable for large scale production (injection moulding) resulting in lower unit costs.
  - Low level of assembly required.
  - Standard form and size of materials and components. [2]

- (b) (i)** Any **two** main characteristics associated with design rights from the following:
- Design right is a free, automatic right that you get when you create an original design.
  - It gives you the right to stop anyone copying your design for up to 15 years.
  - Design right allows you to stop anyone from copying the shape or configuration of the product, but does not give you protection for any of the 2-dimensional aspects, for example patterns. [2]

Quality of written communication [1]

For a response not worthy of credit.	[0]
Clear and coherent explanation using good English grammar.	[1]

- (ii)** Any **two** main characteristic associated with patents from the following:
- A patent protects new inventions and covers how things work, what they do, how they do it, what they are made of and how they are made.
  - It gives the owner the right to prevent others from making, using, importing or selling the invention without permission.
  - It must be new or have an inventive step that is not obvious to someone with knowledge and experience in the subject. [2]
- (c)** Any **one** main property of carbon fibre reinforced plastic (CFRP) from the following:
- Excellent strength-to-weight ratio.
  - Resistant to many chemical solutions. [1]

- (d) (i) Solution: The handle could incorporate a mechanism used on a crutch (pin or ball, spring and drilled holes on the aluminium channel).

Level of response not worthy of credit.	[0]
A vague sketch lacking detail and appropriate annotation. Difficulty in determining if the design is appropriate and represent improvements.	[1]
Both the sketch and annotation are limited. The idea represents an improvement but lacks the finesse appropriate for the product.	[2]–[3]
Detailed annotated sketch representing an appropriate improvement to the overall design.	[4]

[4]

- (ii) A solution could be based on a plastic catch or wedge that could hold the hand grip in the closed position.

Level of response not worthy of credit.	[0]
A vague sketch lacking detail and appropriate annotation. Difficulty in determining if the design is appropriate and represent improvements.	[1]
Both the sketch and annotation are limited. The design represents an improvement but lacks the finesse appropriate for the product.	[2]–[3]
Detailed annotated sketch representing an appropriate improvement to the overall design.	[4]

[4]

AVAILABLE  
MARKS

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- 14 (a)** Any **two** main reasons why a company would produce models from the following:
- To assess the proportions of the product, its functionality, aesthetics and materials.
  - To test the design quickly and cheaply.
  - A model can be used by a focus group or as part of a survey of potential clients, to discuss their views.
- [2]

- (b)** Any **two** main characteristics associated with critical path analysis from the following:
- It is used to identify key stages and critical points to aid project management.
  - Critical path analysis is used to ensure the project keeps to schedule.
  - A critical path analysis is represented by a network analysis.
- [2]

Quality of written communication [1]

For a response not worthy of credit.	[0]
Clear and coherent explanation using good English grammar.	[1]

- (c)**
- |   |         |
|---|---------|
| Level of response not worthy of credit.   | [0]     |
| Vague description of the CNC process.   | [1]     |
| Limited description of the CNC lathe process outlining some of the stages involved. | [2]–[3] |
| Detailed description of the CNC lathe process and the stages involved.              | [4]     |
- [4]

- (d)** Explanation of any three stages from the five stage risk assessment to include:
1. Hazard identified which could potentially cause harm.
  2. Identify who is at risk and how.
  3. Precautions to be put in place to minimise hazards.
  4. Record your findings and implement them.
  5. Review and update if necessary.
- [3]

- (e) (i)** Solution could be based on a circular red bordered pictogram which could be based on a front outline profile of one large bicycle with bar and rack, a person/face and a red tick (indicating that this is acceptable).

Level of response not worthy of credit.	[0]
A vague sketch. Difficulty in determining if the design is appropriate and conveys the stated information.	[1]
The sketch is limited. The design conveys aspects of the stated information.	[2]–[3]
Detailed and appropriate sketch. The design clearly conveys all aspects of the stated information.	[4]

[4]

- (ii) Solution could be based on an injection moulded plastic bracket which slides over the support bar. One end of the bracket has a circular profile which has an internal taper and is externally threaded. A plastic nut slides over the support bar and as it moves along the threads tightens to secure the bracket in position, e.g. – based on a plastic connection used when fitting a garden hose.

Level of response not worthy of credit.	[0]
A vague sketch lacking detail and appropriate annotation. Difficulty in determining if the design is appropriate, low cost and can be quickly secured to the two supports.	[1]
Both the sketch and annotation are limited. The design is partly cost effective, can be secured to the two supports but lacks the finesse appropriate for the product.	[2]–[3]
Detailed annotated sketch. The design is low cost, can be quickly secured to the two supports and is appropriate for the product.	[4]

[4]

**Section C**

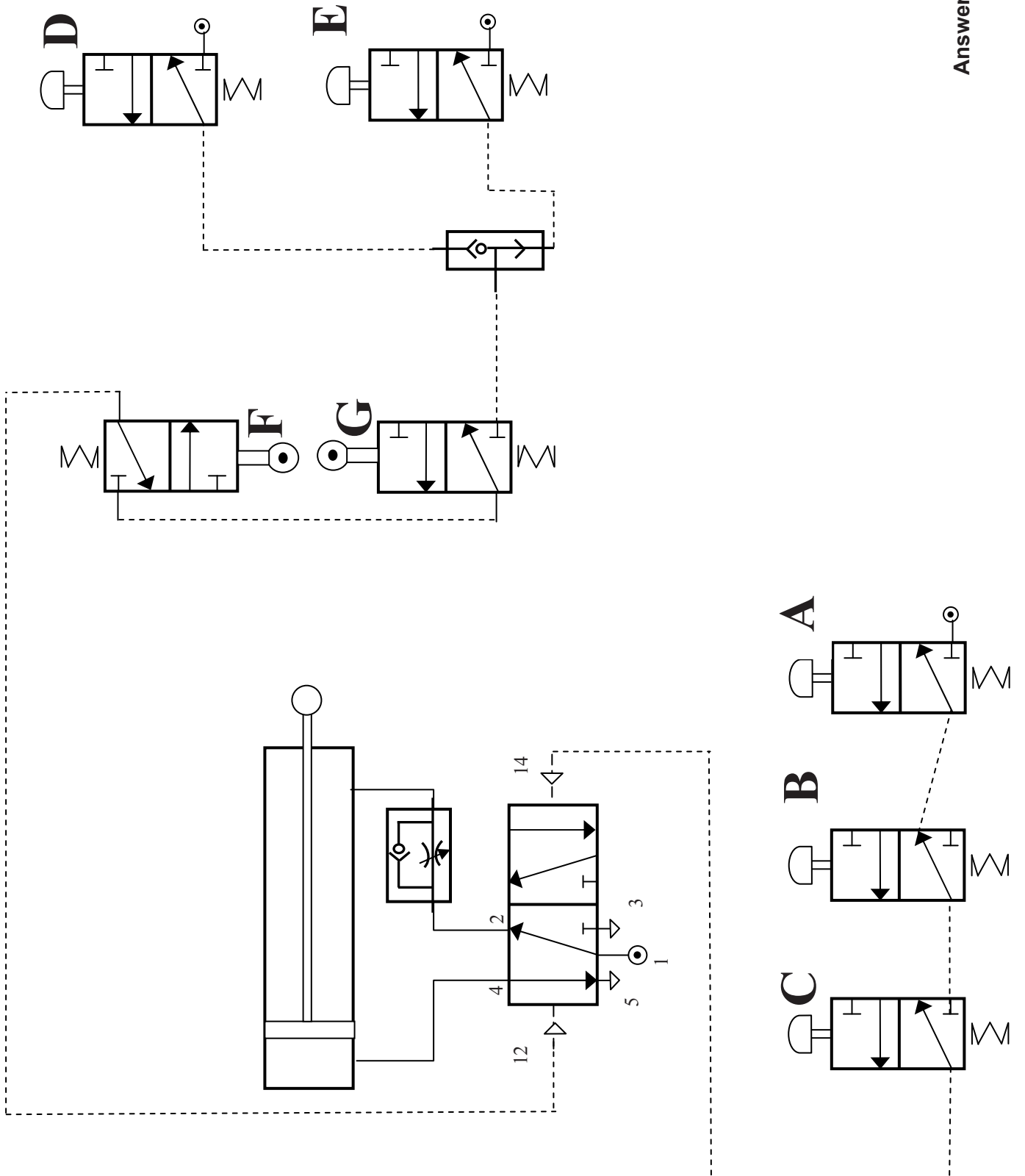
**Total**

**AVAILABLE  
MARKS**

20

**40**

**80**



Answers Q12(iv) and (v)