



*Rewarding Learning*

**ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2023**

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## **Technology and Design**

**Assessment Unit AS 1**

*assessing*

**Systems and Control or Product Design**

**[STE12]**

**FRIDAY 19 MAY, AFTERNOON**

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**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.

Section A

AVAILABLE MARKS

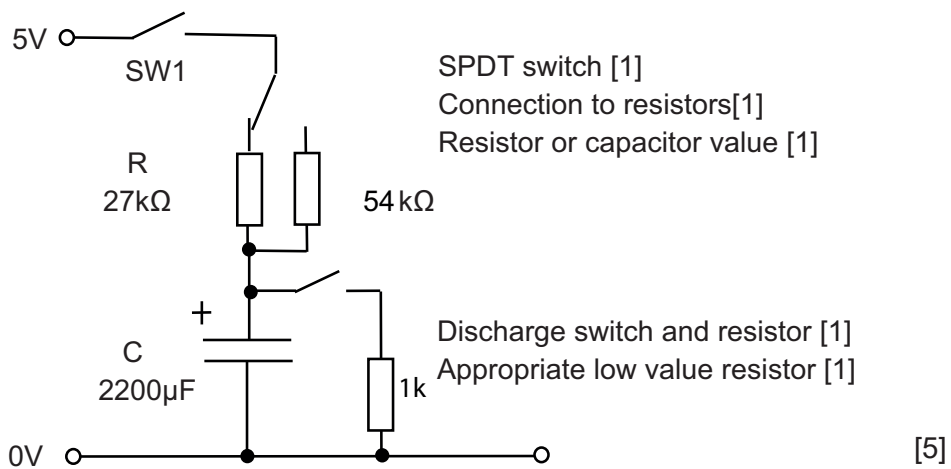
Electronic and Microelectronic Control Systems

- 1 (a) (i)  $27000 \times 0.0022$  [1]  
 = 59.4 seconds [1] [2]
- (ii) For large capacitance values (over  $1\mu\text{F}$ ) [1] only electrolytic types are generally available. [1]

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

**Correct alternative responses will be given full credit.**

(iii) sample answer



**Correct alternative responses will be given full credit.**

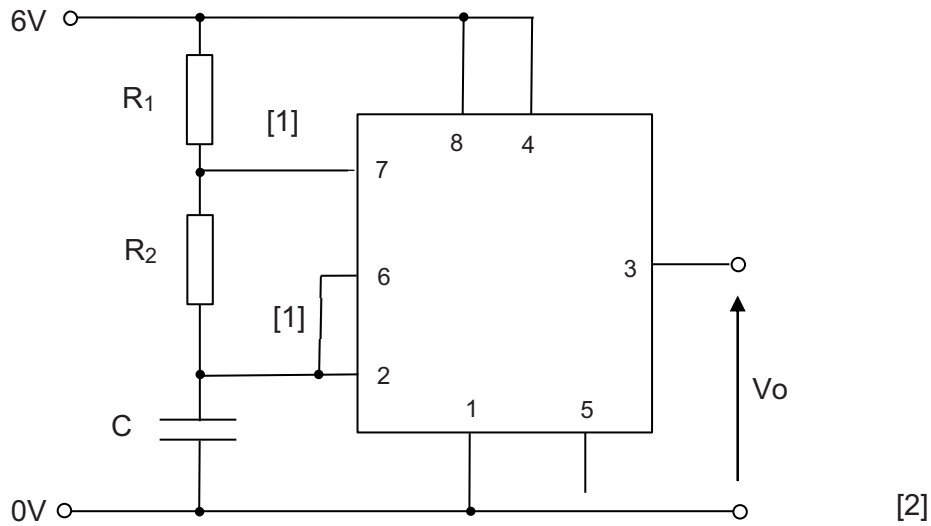
- (b) (i) When the voltage supplied to the trigger drops below 1/3 of the supply voltage, [1] the output goes 'high' or turns on. [1]

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

**Correct alternative responses will be given full credit.**

- (ii) Discharge [1]

- (iii) sample answer



**Correct alternative responses will be given full credit.**

- (c) (i) Ratio 3:2 [1]

(ii)  $f = 1.44 / (10 \times 10^3 + 40 \times 10^3) \times 470 \times 10^{-9}$  [1]  
 $= 1.44 / 0.0235$  [1]  
 $= 61.3 \text{ Hz}$  [1] [3]

(iii)  $R = 6 - (2 \times 2.2) / 0.015$  [1]  
 $= 107 \text{ Ohms}$  [1] [2]

2 (a) (i) OR [1]

(ii) To ensure that the voltage at the base of a transistor is 'pulled down' or grounded [1] to prevent stray charges when either of the switches is open. [1]

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

**Correct alternative responses will be given full credit.**

(iii)  $R = (5 - 0.7)/(0.25/40)$  [2]  
= 688 Ohms [1] [3]

(iv)  $P = 5 \times 0.2$  [1]  
= 1 W [1] [2]

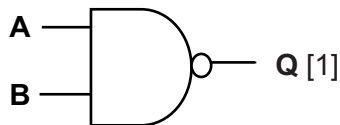
(b) (i) on/off [1]

The logic circuit gates only have two output states [1] therefore the motor will either be turned on or off. [1]

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

**Correct alternative responses will be given full credit.**

(ii)



output Q
1
1
1
0

 [1]

[2]

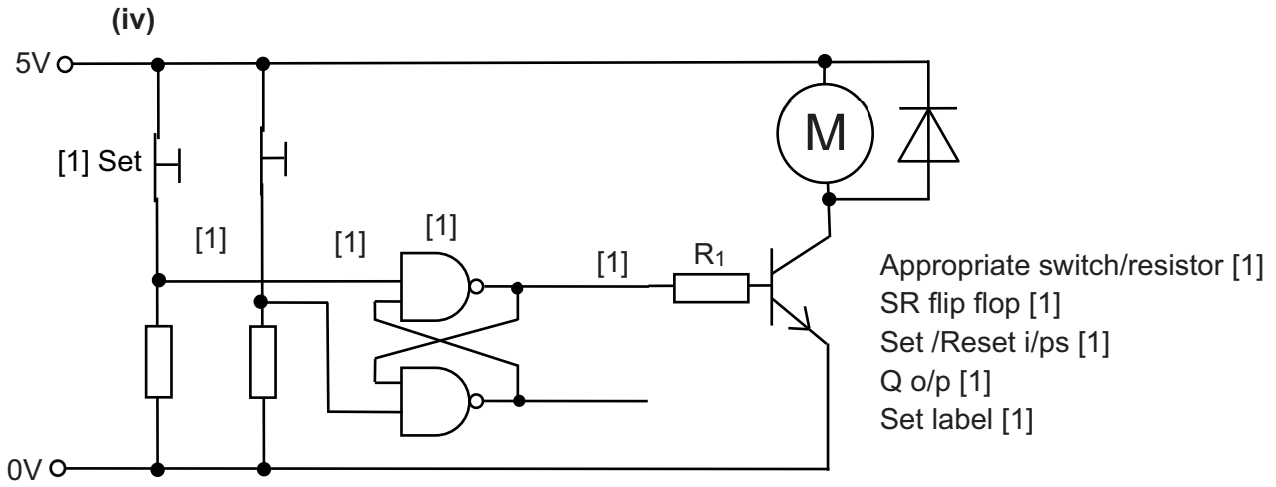
AVAILABLE  
MARKS

(iii) The SR flip flop has two stable or 'holding' output states [1] that can be changed only by applying a signal to the appropriate input. [1]

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

**Correct alternative responses will be given full credit.**

AVAILABLE MARKS



**Correct alternative responses will be given full credit.**

[5]

**Section A**

20
<b>40</b>

Section B

AVAILABLE  
MARKS

Mechanical and Pneumatic Control Systems

3 (a) Any **one** safety issue which arises when using a mechanical system for example:

- Injury due to moving parts. [1]
- Injury due to loose clothing caught on moving parts. [1]

**One** main procedure which could minimise the injury due to moving parts for example:

- Ensure all guards are in place. [1]
- Ensure that the mechanical system has been properly maintained. [1]

[2]

**Correct alternative responses will be given full credit.**

(b) (i) The velocity ratio between Gear A and Wormwheel F.

$A-C = 100/100 = 1$	[1]	
$D-E = 70/35 = 2$	[1]	
$Worm-F = 60/1 = 60$	[1]	
$VR = 1 \times 2 \times 60 = 120$	[1]	[4]

(ii) The output speed at Shaft Y if the motor rotates at 720 rev/min.

$VR \text{ between Gear A and wormwheel} = 120$		
$VR \text{ between pulley G and H } 60/40 = 1.5$	[1]	
$VR \text{ Total} = 120 \times 1.5 = 180$	[1]	
$\text{output speed at Shaft Y } 720/180 = 4\text{rev/min}$	[1]	[3]

(iii) Efficiency =  $MA/VR \times 100$   
 =  $64/80 = 0.8$   
 =  $0.8 \times 100 = 80\%$

[1]  
[1] [2]

(c) Jockey wheel  
 Spring loading  
 Annotation

[1]  
[1] [2]

- (d) (i) Completion of valve A, valve B and piping  
 Piping of valve B to 5PV  
 DAC instroke slowly

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

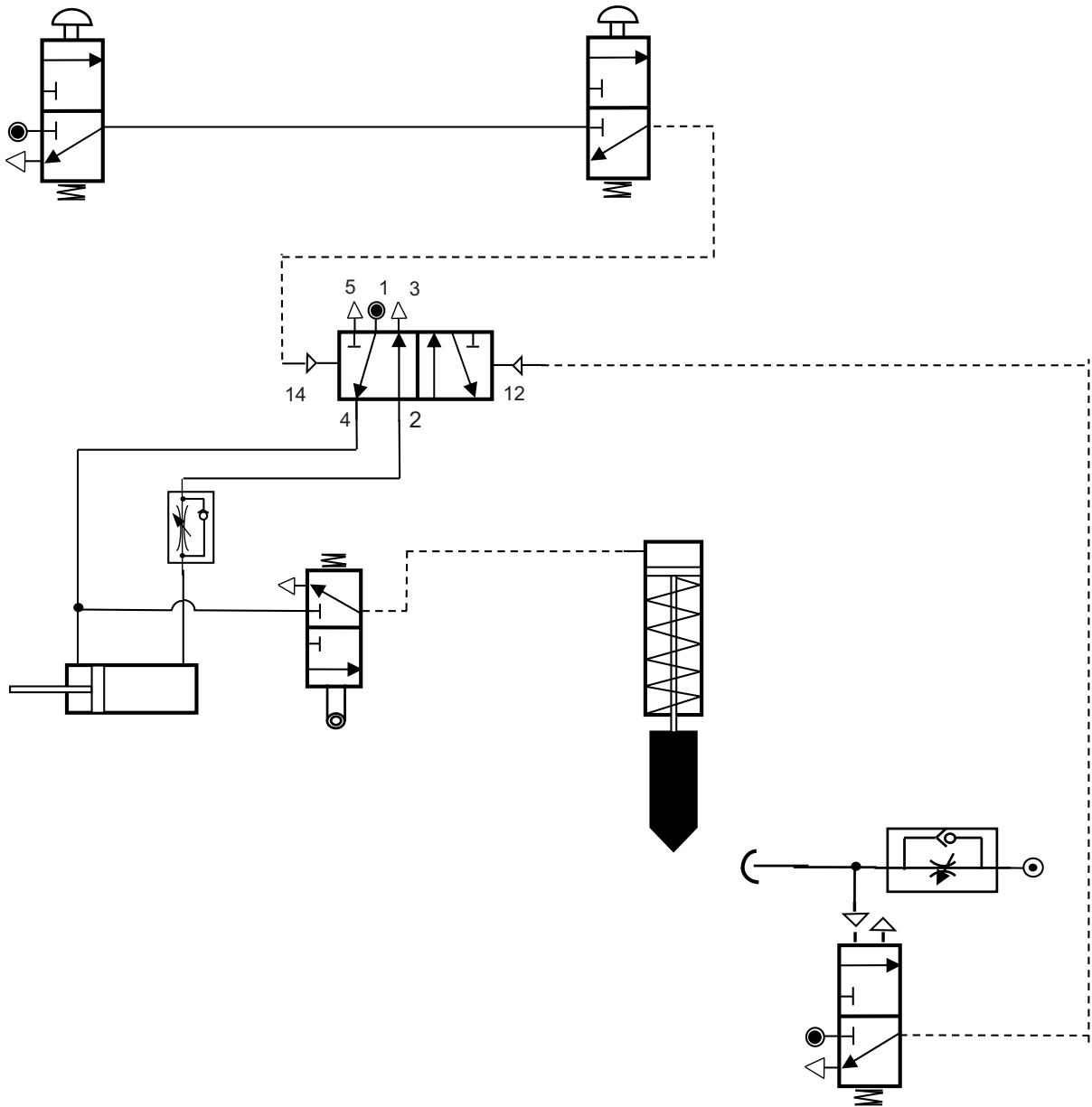
**Correct alternative responses will be given full credit.**

- (ii) Completion of air-bleed  
 Piping of air-bleed to 5PV  
 Piping of valve C to SAC  
 Piping of air of valve C from the line connecting the 5PV to the front of the DAC

[1]  
 [1]  
 [1]  
 [1] [4]

**Correct alternative responses will be given full credit.**

AVAILABLE MARKS
20



- 4 (a) The difference between reciprocating and oscillating motion is that a reciprocating motion has a repeated up and down motion or back-and-forth motion [1] whereas an oscillating motion has a curved backwards and forwards movement that swings on a pivot point or axis. [1]

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

**Correct alternative responses will be given full credit.**

- (b) (i) Correct sketch of the profile for an eccentric cam [1]  
 Correct sketch of a flat follower [1] [2]

**Correct alternative responses will be given full credit.**

- (ii) The cam profile may be in dwell for part of the rotation causing the follower to remain stationary. [1] The cam profile then causes the follower to rise slowly before suddenly dropping when it reaches and passes the peak. [1]

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

**Correct alternative responses will be given full credit.**

- (c) Annotation of the bell crank linkage [1]  
 3 pivot points [1] [2]

**Correct alternative responses will be given full credit.**

- (d) Key [1]  
 Keyway [1]  
 Annotation of key and keyway [1] [3]

**Correct alternative responses will be given full credit.**

- (e)  $F = P \times A$  and  $\pi = 3.14$ .

Piston rod area =  $3.14 \times 5 \times 5 = 78.5 \text{ mm}^2$  [1]

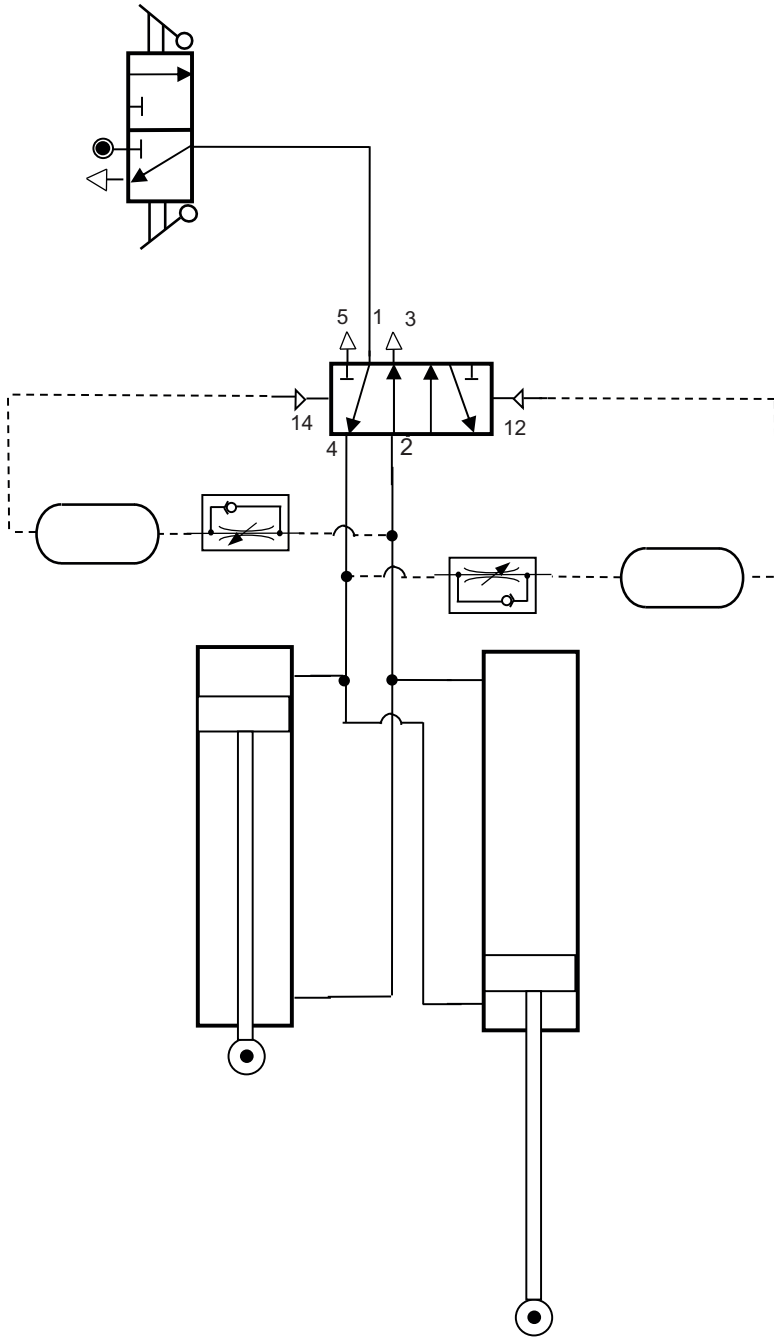
Area  $\times$  air pressure =  $78.5 \times 2 = 157 \text{ N}$  [1]

$706.5 \text{ N} + 157 \text{ N} = 863.5 \text{ N}$  [1] [3]

- (f) 3PV Lever set reset and ports  
 Air supply from 3PV to 5PV  
 Correct piping of DAC A and DAC B  
 Time delay which automatically makes DAC A instroke as DAC B outstrokes.  
 Another Time delay which automatically makes DAC A outstroke as DAC B instroke.

- [1]  
 [1]  
 [1]  
 [2]  
 [1] [6]

AVAILABLE MARKS	
	20
<b>Section B</b>	<b>40</b>



Correct alternative responses will be given full credit.

**Section C**

**AVAILABLE  
MARKS**

**Product Design**

- 5 (a)** The term fitness for purpose refers to the fact that the designer must ensure that the product must do what it was designed to do. [1]

Any **two** reasons why the company would want to ensure that their products are fit for purpose for example:

- Help improve sales of the product.
- Could enhance the reputation of the company.
- Could reduce the number of customer returns.

(2 × [1]) [2]

**Correct alternative responses will be given full credit.**

- (b)** Any **two** reasons why one-off production is considered to be a more costly scale of production than batch production for example:
- One-off takes longer to manufacture than batch [1] and so more labour intensive. [1]
  - One-off requires more highly skilled workers than batch [1] and so requires higher level of pay. [1]
  - One-off material costs can be higher than batch [1] material costs due to the economies of scale. [1]

Award [2] for a full response and [1] for a limited response.  
(2 × [2]) [4]

**Correct alternative responses will be given full credit.**

- (c)** An annotated sketch of the die cutting process to include the card in position, die/sharp knife which is pressing down and cutting through the material which is clamped .

Description	Marks awarded
A detailed sketch. The annotation covers the main aspects of the die cutting process.	[4]
The sketch is good. The annotation covers some of the main aspects of the die cutting process.	[2]–[3]
The sketch is limited. Annotation is limited with regards to the main aspects of the die cutting process.	[1]
Level of response not worthy of credit	[0]

[4]

**Correct alternative responses will be given full credit.**

(d) (i) Any **two** characteristics associated with a trademark for example:

- It is used to identify and distinguish its products from those of others.
- The trademark must be morally acceptable.
- It must not be deceptive.

(2 × [1])

[2]

**Correct alternative responses will be given full credit.**

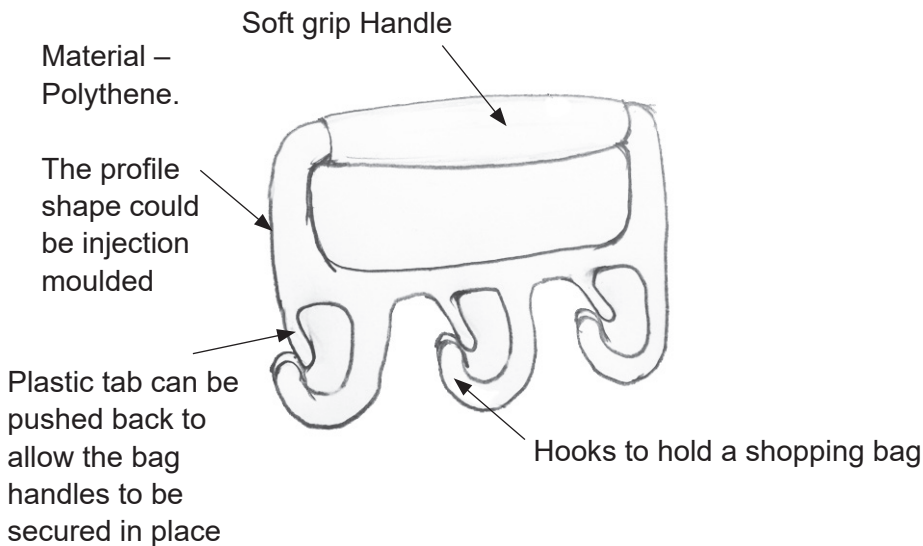
(ii) Any **one** reason why it would be beneficial for the company to secure a trademark for example:

- Knowing that they have protection against infringement by other business will give the company a sense of security.
- It could improve sales figure if people can clearly identify and distinguish its products from others in a similar market.

[1]

**Correct alternative responses will be given full credit.**

(e) Sample annotated sketch



Description	Marks awarded
A detailed, annotated and appropriate design of a hand-held shopping bag carrier handle which is suitable for a left or right-handed person and can allow the user to quickly attach and secure up to three filled shopping bags.	[4]
Both the sketches and annotation are good. The design of the hand-held shopping bag carrier handle represents a possible solution. It may be limited in terms of its appropriateness for a left or right-handed person or if it is capable of holding up to three shopping bags.	[2]–[3]
Limited sketches, lacking detail and appropriate annotation. Difficulties in determining if the hand-held shopping bag carrier handle design is appropriate for a left or right-handed person or if it is capable of holding up to three shopping bags.	[1]
Level of response not worthy of credit	[0]

[1] for an appropriate material

[1] for an appropriate manufacturing process.

[6]

20

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MARKS

6 (a) (i) A design specification is a statement of the qualities that a design must possess in order for it to be a good solution to the problem. [1]

(ii) Any one specific criterion that the designer would need to include in a manufacturing specification for the car window flag holder for example:

- How the holder is to be manufactured.
- The specific materials to be used to manufacture the holder.

(1 × [1]) [1]

**Correct alternative responses will be given full credit.**

(b) Letters S and A in the acronym SCAMPER –

Think about substituting part of the problem with something else [1] which can often result in new ideas. [1]

Think about adapting an existing idea or ideas [1] to solve a problem or create a different product. [1]

Award [2] for a full explanation and [1] for a limited exploration. [4]

**Correct alternative responses will be given full credit.**

(c) Any **two** reasons why the company may want to use glass reinforced plastic (GRP) for the car window flag holder for example:

- It is lightweight.
- It provides a weather resistant finish.
- Can be produced in a variety of colours.

(2 × [1]) [2]

**Correct alternative responses will be given full credit.**

(d) Any **two** main characteristics associated with concurrent engineering for example:

- An essential factor is that there is good communication between all stages.
- Stages of the design process can overlap.
- Aim is to design/manufacture with maximum efficiency.

(2 × [1]) [2]

**Correct alternative responses will be given full credit.**

(e) Quality assurance (QA) procedures are the holistic actions taken to design and manufacture a safe and effective product [1] whereas quality control (QC) procedures are specific tests used to verify that a product is safe and effective after manufacture. [1]

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

**Correct alternative responses will be given full credit.**

(f) (i) The influence that miniaturisation has had on for example computers, is that parts have got smaller, lighter, occupy less space, consume less

energy, require less material to manufacture, [1] yet offer more data storage and process at higher speeds. [1]

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

**Correct alternative responses will be given full credit.**

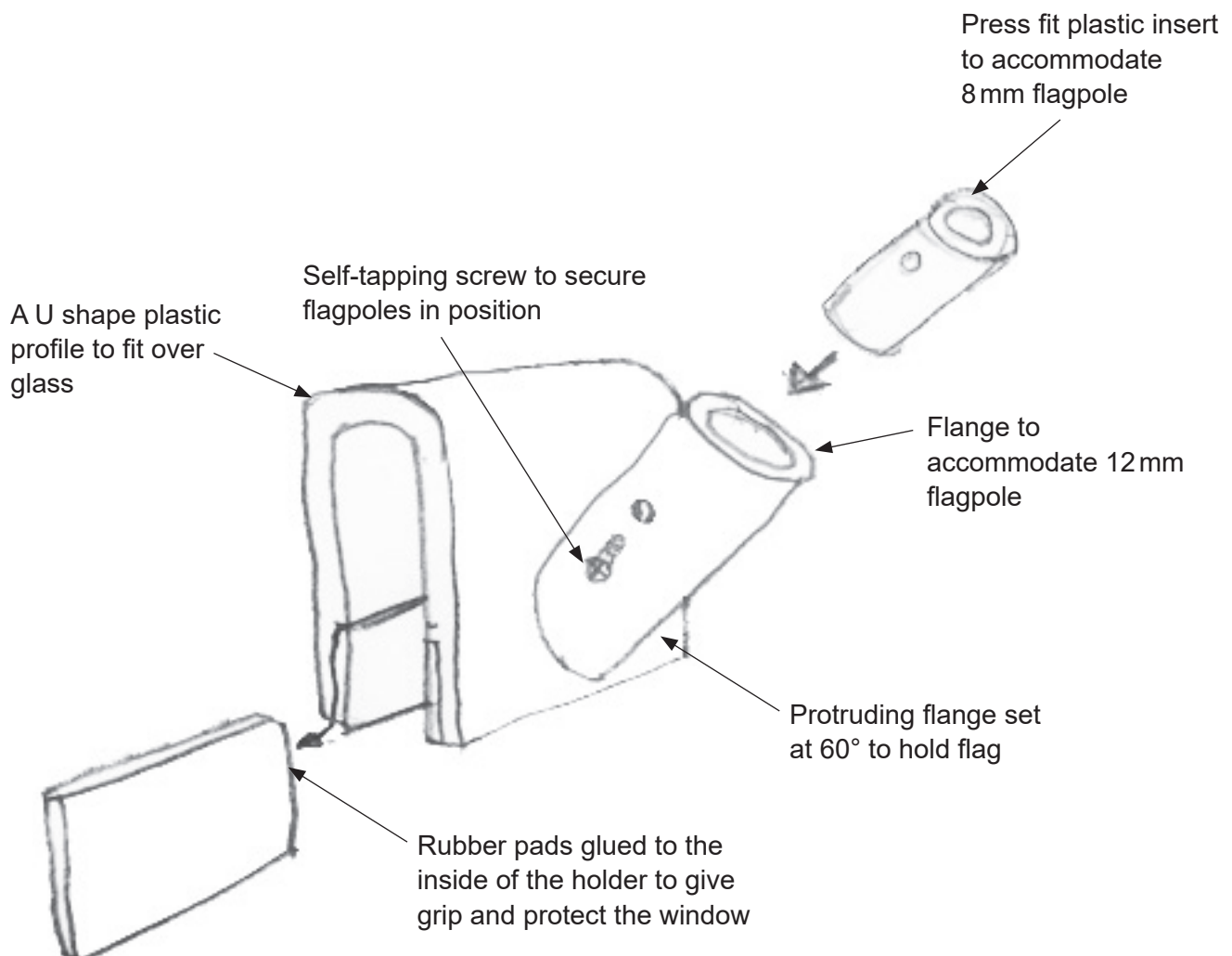
- (ii) A social change has been a general shift to exercise more and explore the great outdoors more. [1] This has given rise to the design of bicycles for a very wide range of environments and terrains, activities and functions. To meet these challenges designers have encompassed new technologies, developed the use of new materials and processes. [1]

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

**Correct alternative responses will be given full credit.**

- (g) An appropriate design for a car window flag holder which will securely hold a small flag at an angle of  $60^\circ$  and will be safely secured to the window of the car.

Sample annotated sketch of a holder



AVAILABLE  
MARKS

Description	Marks awarded
Detailed annotated sketches representing an appropriate design of a car window flag holder which will securely hold either an 8 mm diameter flagpole or a 12 mm diameter flagpole at a 60° angle and will be safely secured to the window of the car.	[4]
Both the sketches and annotation are good. The design may be limited in terms of its appropriateness as a car window flag holder which will securely hold either an 8 mm diameter flagpole or a 12 mm diameter flagpole at a 60° angle and will be safely secured to the window of the car.	[2]–[3]
Limited sketches lacking detail and appropriate annotation. Difficulties in determining if the design is suitable as a car window flag holder which will securely hold either an 8 mm diameter flagpole or a 12 mm diameter flagpole at a 60° angle and will be safely secured to the window of the car.	[1]
Level of response not worthy of credit	[0]

[4]

**Correct alternative responses will be given full credit.**

**Section C**

AVAILABLE MARKS
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