



*Rewarding Learning*

**ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2019**

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## **Technology and Design**

**Assessment Unit AS 1**

*assessing*

**Systems and Control or Product Design**

**[STE12]**

**THURSDAY 16 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

Electronic and Microelectronic Control Systems

AVAILABLE MARKS

1 (a) (i) combined value for  $R_2, R_3 = 60\Omega$  [1] =  $R_2 \times R_3 / R_2 + R_3$   
 $100 \times R_3 = 6000 + 60 \times R_3$   
 $R_3 = 6000/40$  [1]  
 value for  $R_3 = 150$  Ohms [1] [3]

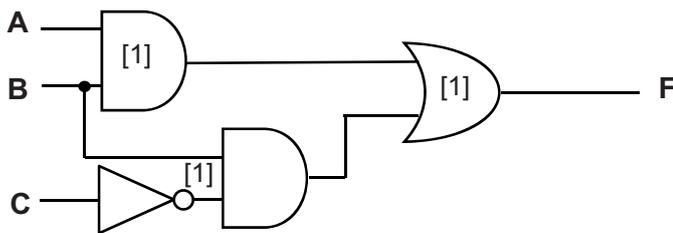
(ii) Min. value for  $R_1, R_2$  and  $R_3$  with  $-10\% = 160 - 16 = 144$  [1]  
 Using  $I \times V$  where  $I = V/R$  for min. value of  $R$   
 $(6 - 2) / 144 \times (6 - 2)$  [1]  
 Maximum power dissipated = 111 mW [1] [3]

(b) (i)

| Input A | Input B | Input C | output F |
|---------|---------|---------|----------|
| 0       | 1       | 0       | 1        |
| 1       | 1       | 0       | 1        |
| 1       | 1       | 1       | 1        |

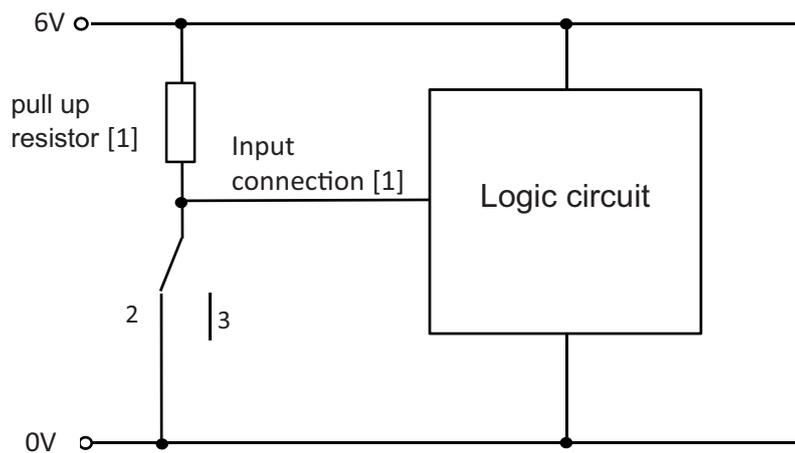
[3]

(ii) Sample answer



[3]

(iii) Sample answer



[2]

(c) (i)  $h_{fe} = I_c/I_b$  [1]

(ii)  $I_c$  (max) is the maximum current that can safely flow from collector to emitter without causing permanent damage to the transistor.

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

(iii)  $I_c = 12/25 = 0.48$  A [1]  
 $h_{fe} = 0.48/0.002 = 240$  [1]

Gain required = 240 [2]

Chosen transistor type = Type C [1]

AVAILABLE  
MARKS

20

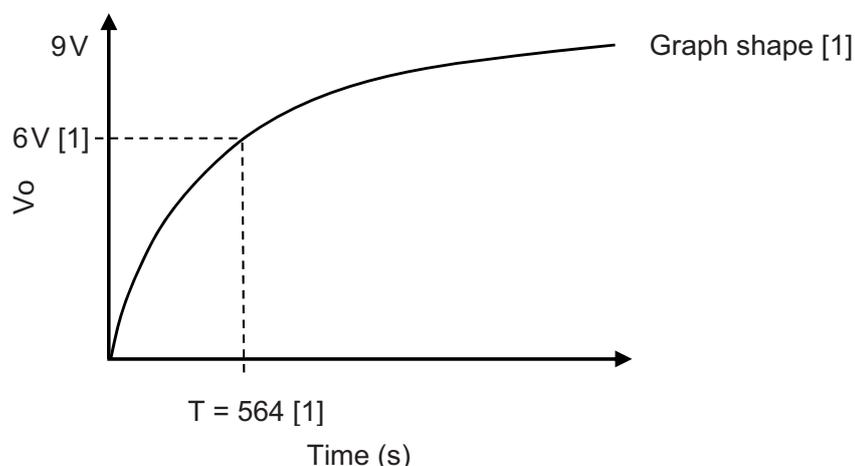
2 (a) (i) Electrolytic capacitors tend to have a high tolerance.  
**Correct alternative responses will be given full credit.** [1]

(ii) The term 'negative temperature coefficient' refers to the relationship between temperature and resistance specifically when temperature increases the resistance decreases.

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

(iii)  $T = C \times R$   
 $= 0.0047 \times 120\,000$  [1]  
 $= 564$  [1]

Time constant = 564 seconds [2]

(iv)  Graph shape [1]

9V  
6V [1]  
 $V_o$

$T = 564$  [1]

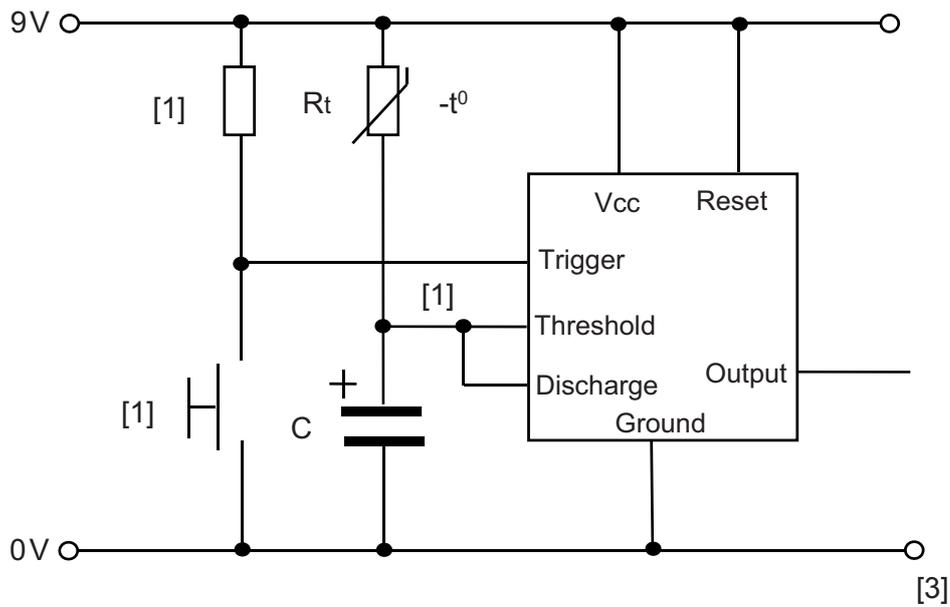
Time (s)

[3]

(b) (i) The discharge pin on a 555 timer internally 'grounds' the external capacitor therefore allowing the timer to reset before beginning another time period.

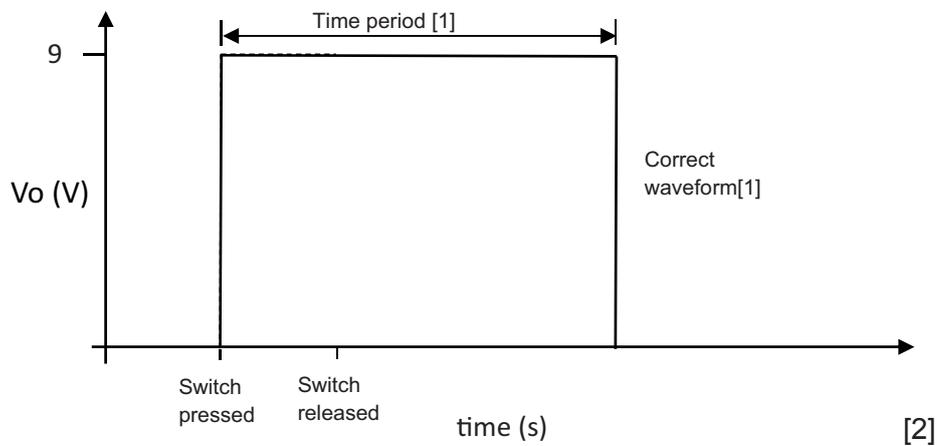
Award [2] for a full explanation and [1] for a limited explanation. [2]

(ii) sample answer



(iii)  $T = 1.1 \times C \times R$   
 $7.48 = 1.1 \times 0.0001 \times R$  [1]  
 $R = 7.48 / 1.1 \times 0.0001$  [1]  
 $R = 68000$  [1]  
 $R_t = 68000$  ohms [3]

(iv) sample answer



(v) Sample answer  
 Safety issue – Burns from overheating components [1]  
 Procedure – Check power ratings of components [1]

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

**Total**

20

**40**

| AVAILABLE MARKS |
|-----------------|
|                 |
| <b>40</b>       |

Section B

Mechanical and Pneumatic Control Systems

AVAILABLE  
MARKS

- 3 (a) Diaphragm [1]
- (b) Jockey wheel [1]  
 Annotation [1]  
 Spring loading [1]
- (c) Flow control valve [1]  
 Reservoir [1]  
 Piping to 5PV [1]  
 Slowly – FCV [1]
- Correct alternative responses will be given full credit.**
- (d) Appropriate piping to B [1]  
 Appropriate piping to C [1]  
 Appropriate piping to D [1]  
 Appropriate piping to E [1]  
 Piping to 5PV [1]
- (e) Key [1]  
 Keyways [1]  
 Annotation of key and keyways with shaft [1]
- (f) Please assume  $\pi = 3.14$ .  
 $F = P \times A$
- $100 - 74.88 = 25.12$  [1]  
 $25.12/0.5 = 50.24 \text{ mm}^2$  [1]  
 $50.24 \text{ mm}^2/3.14 = 16$   
 $4 \times 4 = 16$  [1]  
 Radius = 4 mm [1]

20

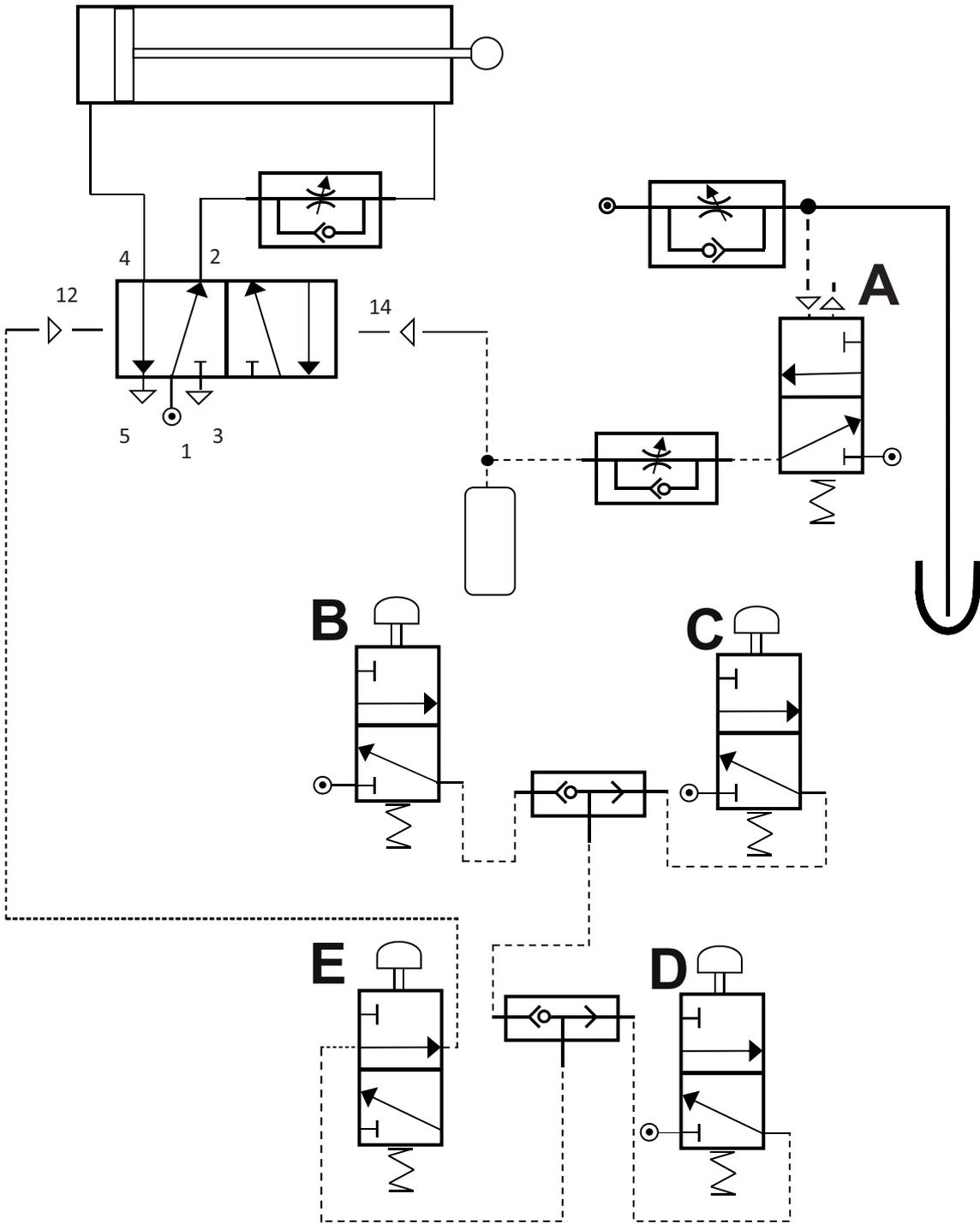


Fig. 10

- 4 (a) Wormwheel [1]
- (b) A–G [1]  
 A–B  $75/150 = 0.5$  [1]  
 C–E  $160/160 = 1$  [1]  
 F–G  $35/70 = 0.5$  [1]  
 $0.5 \times 1 \times 0.5 = 0.25$  [1]
- (c) VR F–G  $35/70 = 0.5$   
 OS = IS/VR OS =  $144/0.5 = 288\text{rev/min}$  at G [1]  
 G and worm same VR [1]  
 OS = IS/VR – 8 =  $288/\text{VR} - \text{VR} = 36$   
 Worm Z =  $36 = 36/1$  Z = 36Teeth [1]

(d)

| A sample answer could involve the use of a pulley connected to <b>X</b> which, via a belt, transmits motion to another pulley connected to a cam or crank and slider. The crank and slider or cam could be positioned to rise and activate the 3PV <b>Y</b> with a suitable activation method. The pulleys would be sized to ensure that <b>Y</b> is activated once for every four rotations of <b>X</b> . | Marks awarded |
|--|---------------|
| Detailed annotated sketch. The design is complete and effective, enabling <b>Y</b> with a suitable activation method to be activated once for every four rotations of shaft <b>X</b> .   | [5]–[6]       |
| Annotated sketch lacks some important information. The design with some further supporting information/amplification could enable <b>Y</b> to be activated. However, not activated once for every four rotations of <b>X</b> .   | [3]–[4]       |
| Sketch with little or no annotation. Most aspects of the design are unclear with only a little evidence that the desired function can be achieved.   | [1]–[2]       |
| Level of response not worthy of credit   | [0]           |

[6]

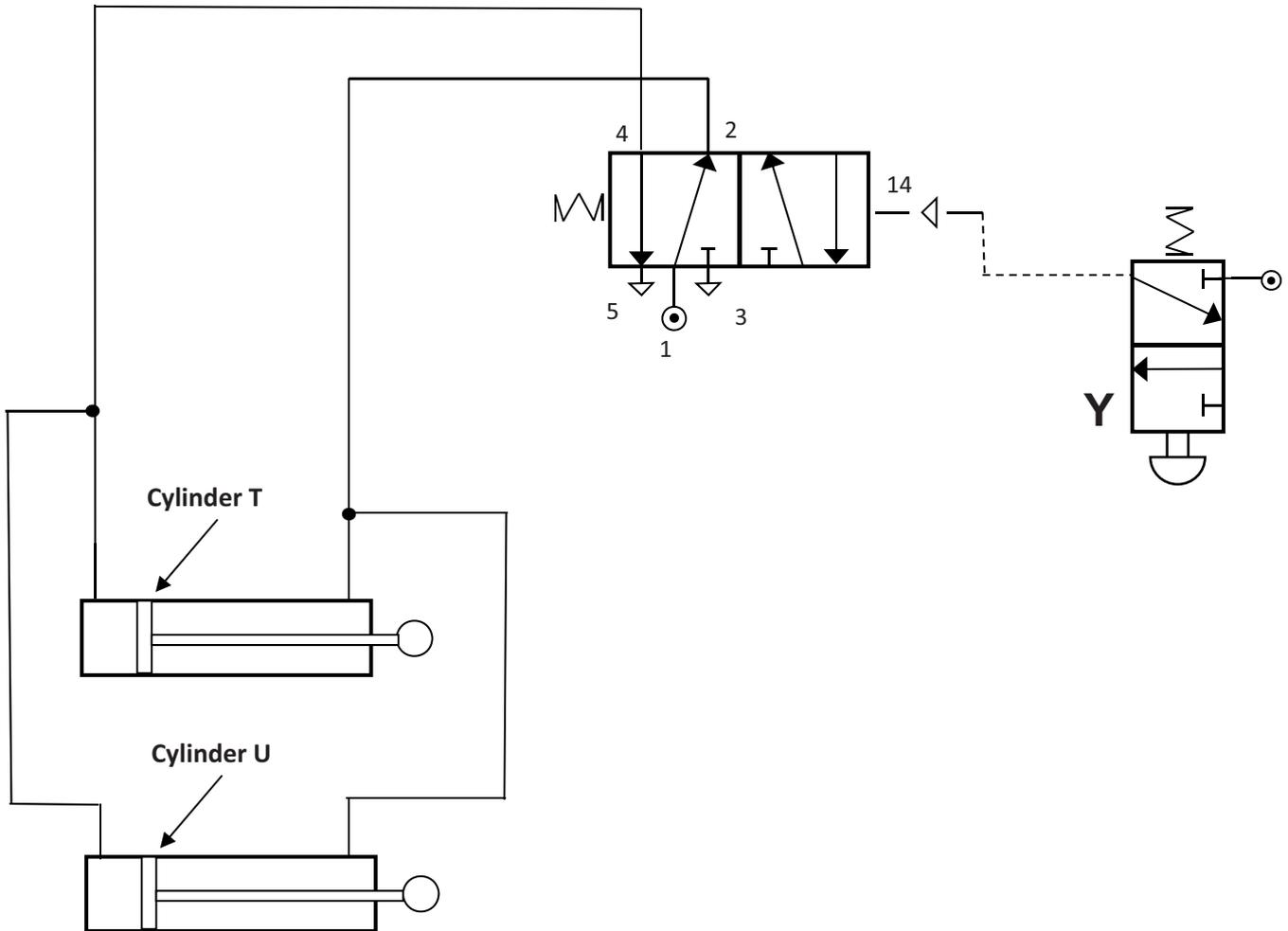
AVAILABLE  
MARKS

- (e) Piping from Y to 5PV
- Spring activation of 5PV
- Outstroke of U
- Outstroke of T
- Instroke of U
- Instroke of T

- [1]
- [1]
- [1]
- [1]
- [1]
- [1]

| AVAILABLE MARKS |
|-----------------|
|                 |

Correct alternative responses will be given full credit.



Sample Answer 4(e)

|              |           |
|--------------|-----------|
|              | 20        |
| <b>Total</b> | <b>40</b> |
|              |           |

Section C

AVAILABLE  
MARKS

- 5 (a) Any **two** specific characteristics associated with thought showers for example:
- Mainly carried out with a group of people.
  - No restrictions placed on the design outcomes – just ideas which come into your head.
  - Limited to a set time.
- (2 × [1]) [2]

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

- (b) (i) Any **two** specific properties associated with (CFRP) which would make it suitable for the holder for example:
- Excellent strength-to-weight ratio.
  - Excellent rigidity.
  - Corrosion resistant.
- (2 × [1]) [2]

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

- (ii) Any **one** main specific reason why (CFRP) may not be a suitable material for the holder for example:
- High cost.
  - Difficulty to dispose at the end of the life span.
- [1]

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

- (c) Employee safety is concerned with the safety of personnel mainly during the manufacturing stage of a product, whereas consumer safety is concerned that the product is safe for the person to use under normal conditions.
- Award [2] for a full explanation and [1] for a limited explanation. [2]

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

- (d) Any **two** main characteristics associated with mass production for example:
- Involves the manufacture of 1000's of products.
  - Only small or little variation to meet client requirements can be achieved.
  - Cheaper unit cost compared to one-off and batch production.
- (2 × [1]) [2]

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

- (e) Any **three** specific characteristics associated with a registered design for example:
- Gives you the right to stop anyone copying or using your design in the UK
  - It is active for up to 25 years.
  - Registered designs must have individual characteristics.
  - It should not remind any informed person of an existing design.
- (3 × [1]) [3]

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

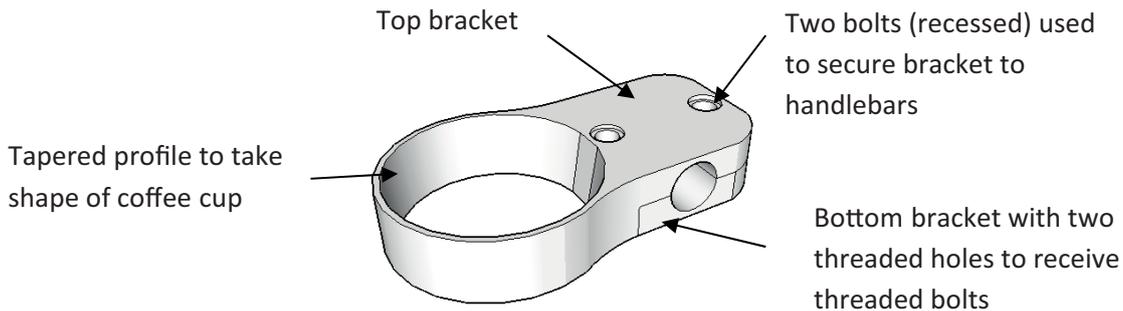
- (f) A product review refers to an evaluation of a product by the user who has sufficient experience to comment on reliability and whether or not the product delivers on its promises.

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

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

- (g) A labelled isometric projection drawing of an appropriate low cost design of a coffee cup holder that is easy and quick to secure to the handlebars.

Sample bracket



| Description  | Marks awarded |
|--|---------------|
| A detailed and appropriate low cost design of a coffee cup holder that will allow the user to easily and quickly secure to the handlebars. Detailed annotation is provided.  | [4]           |
| The design of the coffee cup holder represents a possible solution. It may be limited in terms of its appropriateness or it being a low cost design or if it will allow the user to easily and quickly secure it to the handlebars. Good annotation is provided. | [2]–[3]       |
| Difficulties in determining if the design of the coffee cup holder is appropriate, low cost and will allow the user to easily and quickly secure it to the handlebars. Limited annotation is provided.   | [1]           |
| Level of response not worthy of credit   | [0]           |

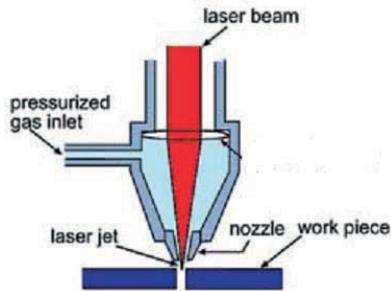
for a limited drawing in isometric. [1]  
 for a good isometric sketch. [2] [6]

20

- 6 (a) Any **two** specific criteria that the designer would need to include in a manufacturing specification for the housing of the lighter for example:
- How the housing is to be manufactured.
  - The specific materials to be used to manufacture the housing.
  - Description of the system used to check the quality of the housing.
- (2 × [1]) [2]

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

(b)



An annotated sketch of laser cutting process to include:  
 The work piece is set onto the plate of the laser cutter, door closed and with the extraction on the laser head enters from the side of the sheet and cuts through the axis depending on the profile to be cut. The laser either melts, burns or vaporises away the material. After a short period of time the material can be removed from the plate.

| Description  | Marks awarded |
|--|---------------|
| A detailed annotated sketch. The explanation covers the main aspects of the laser cutting process.                               | [5]           |
| Both the sketch and annotation are good. The explanation covers some of the main aspects of the laser cutting process.           | [3]–[4]       |
| Limited sketch and appropriate annotation. Explanation is limited with regards to the main aspects of the laser cutting process. | [1]–[2]       |
| Level of response not worthy of credit   | [0]           |

[5]

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

- (c) A work order is usually a specific task or job that can be scheduled to a person within the company. [1]

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

- (d) Any **two** main requirements of the Trades Description Act that the company would need to comply with when deciding upon the information for the packaging for example:
- Ensure that the consumer is informed of the country of origin.
  - The product must be correctly described on or in its packaging.
  - Ensure that the product performs as advertised on the packaging.
- (2 × [1]) [2]

- (e) (i) Example product – Bicycle  
 Social change – There has been a general shift in the need to exercise more or explore the great outdoors or possibly make more use of our leisure time by engaging with a range of sporting activities. [1]

Explanation

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 and created new shapes and profiles

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

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

- (ii) Example product – Television  
 Cultural change – The cultural change has been to be more inclusive and reflect the cultural diversity which exists in our society. [1]

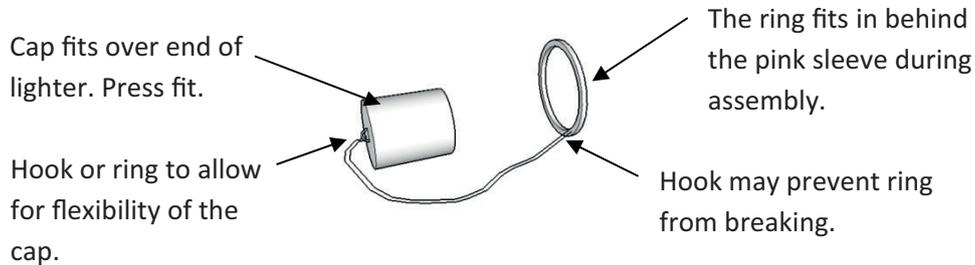
Explanation

The range of programmes on our television for viewing can appeal to and reflect our multicultural society. Televisions can be programmed to meet the needs of specific languages. The design of satellite television provides the capability of providing a greater array of material for a multicultural society.

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

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

- (f) A secure plastic cover for the end of the gas lighter.  
 Additional sketches must show details of component parts.



| Description  | Marks awarded |
|--|---------------|
| Detailed annotated sketches representing an appropriate design of a secure plastic cover that can be quickly attached or removed and has a means of preventing it from getting lost.                                     | [4]           |
| Both the sketches and annotation are good. The ideas represent improvements but lack the finesse appropriate for the product.  | [2]–[3]       |
| Limited sketches lacking detail and appropriate annotation. Difficulties in determining if the design of the secure plastic cover can be quickly attached or removed and has a means of preventing it from getting lost. | [1]           |
| Level of response not worthy of credit   | [0]           |

[4]

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

**Total**

20

**40**