



Rewarding Learning

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

Technology and Design

Assessment Unit AS 1

assessing

Product Design and Systems and Control

[AV111]

FRIDAY 10 JANUARY, MORNING

**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.

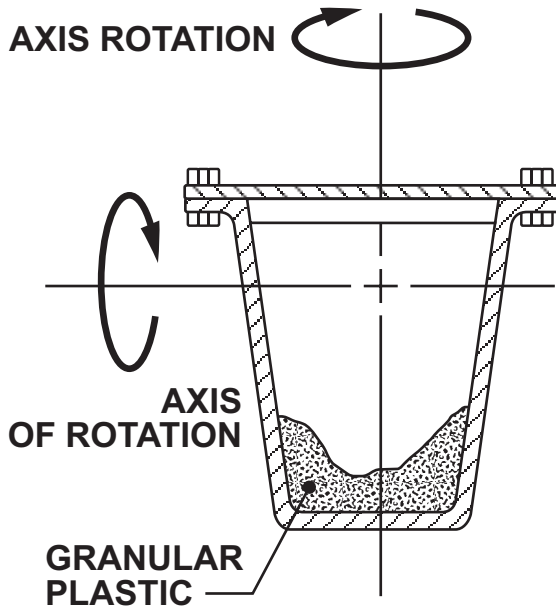
In all cases, correct alternative responses will be given full credit.

AVAILABLE
MARKS

Section A

- | | | |
|---|--|---|
| 1 | <p>(i) The difference between physical properties and mechanical properties – Mechanical properties refers to how a material reacts when subjected to forces (e.g. strength, hardness, etc.). Physical properties refers to the characteristics displayed by the material in relation to non-mechanical influences, e.g. density, electrical and thermal conductivity. [2]</p> <p>(ii) Toughness – this is the measure of how much energy is required to break a material. [1]</p> <p>(iii) Hardness – this is the measure of a material’s ability to withstand being scratched, cut or dented. [1]</p> | 4 |
| 2 | <p>(i) Hardwoods – from deciduous trees grown in the warmer temperate regions. Softwoods – from conifers grown in the cooler regions. [2]</p> <p>(ii) Beech – Any one main property from the following:</p> <ul style="list-style-type: none"> • It is very tough. • It is quite hard. • It has no taste. <p>Any one main working characteristic from the following:</p> <ul style="list-style-type: none"> • It is not prone to splitting. • Suitable for machining. • Good stability. [2] <p>(iii) Any one main property associated with mahogany from the following:</p> <ul style="list-style-type: none"> • Quite strong. • Aesthetically pleasing. [1] <p>Application for the use of mahogany, e.g.</p> <ul style="list-style-type: none"> • High quality furniture. [1] [2] | 6 |
| 3 | <p>(i) Polythene: e.g. bags and bottles.</p> <p>ABS: e.g. drain waste and vent piping systems. [2]</p> <p>(ii) Any one main reason why polystyrene is used for packaging from the following:</p> <ul style="list-style-type: none"> • Good at absorbing shock. • Easily processed at low cost. <p>Any one main reason why melamine formaldehyde is used for table tops from the following:</p> <ul style="list-style-type: none"> • Heat resistant. • High toughness and scratch resistant. [2] | 4 |

Rotational Moulding



Description:
 • Plastic heated.
 • Molten plastic takes up shape of mould due to rotational forces
 [2]

[2] [4]

4

5 (i) Permanent methods include welding or adhesives. Semi-permanent would include self-tapping screws or nuts and bolts. [2]

(ii) Any **two**:
 • Higher melting point required around 600–900 degrees C well above soldering.
 • Produces a stronger joint than soldering.
 • Used to joint thicker profiles of materials than soldering. [2]

(iii) e.g. MIG. The materials are joined by melting them and allowing the molten material to mingle and then cool to become a solid. The molten material is protected by gas (to prevent impurities being absorbed) produced by the vaporisation of a powdered coating around the welding rod. [2]

6

6 (i) Any **two**:
 • Batches of items produced at one time.
 • Good flexibility in order to meet individual client requirements.
 • Semi-skilled labour required. [2]

(ii) Any **two**:
 • Based on flexible workforce and flexible machinery.
 • People are semi-skilled – ability to perform a variety of tasks.
 • Works best with batch production – flexibility essential. [2]

(iii) Any **two**:
 • Stages of the design process can overlap.
 • Good communication essential between all stages.
 • Aim is to design/manufacture with maximum efficiency. [2]

6

AVAILABLE MARKS	
4	4
6	6
6	6

- 7 (i) To ensure that the glass is capable of doing what it was designed to do. [1]
- (ii) Any **one**:
- To avoid expensive recalls.
 - Ensure consistency/quality of product manufacture.
 - To avoid bad publicity. [1]
- (iii) Any **one**:
- Thickness of the glass to ensure that it fits within the PVC frame.
 - Width/height of the glass to ensure that it is not too large/small for the frame. [2]
- 8 (i) 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. [2]
- (ii) Any **two**:
- Ensure that the consumer is informed of the country of origin.
 - Protects the consumer by making it an offence for a trader to wrongly describe goods or services. [2]

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**

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6

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Section B

AVAILABLE MARKS

9 (a) (i) Nand gate

[1]

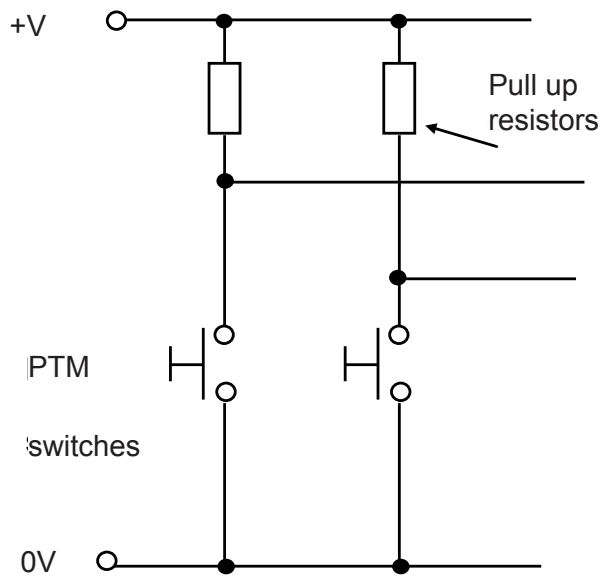
(ii)

A	B	C	D	E	Q
0	0	1	1	1	1
1	0	1	0	1	0
0	1	1	1	0	0
1	1	0	1	1	1

[1] for each correct row

[4]

(iii)



[3]

(b) (i) AND logic [1]

(ii) When both switches have been closed a voltage at the base of the transistor will cause the collector/base junction of the transistor to conduct. This in turn will cause the LEDs to illuminate. When either of the switches is opened the transistor will cease to conduct and the LEDs will turn off. [2]

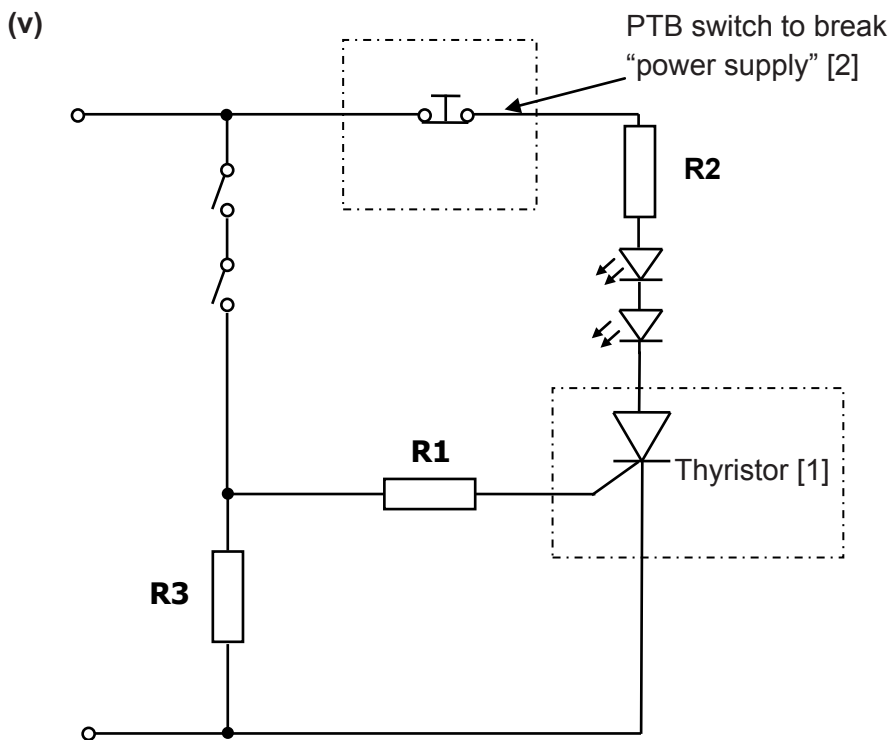
For a response not worthy of credit	[0]
Clear and coherent explanation using good English grammar.	[1]

Quality of written communication [1]

(iii) $I_b = 20 \text{ mA} / 120 = 0.17 \text{ mA}$ [1]
 $R_1 = (6 \text{ V} - 0.6 \text{ V}) / 0.17 \text{ mA} = 31.8 \text{ k}\Omega$ [1]

(iv) $R_2 = 6 \text{ V} - (2 \times 2.2 \text{ V}) / 20 \text{ mA}$
 $= 80 \Omega$ [2]

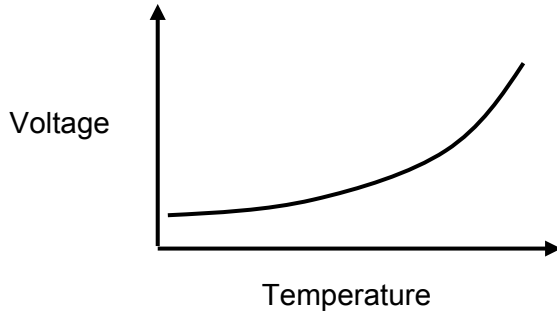
Power = $1.6 \text{ V} \times 20 \text{ mA}$
 $= 32 \text{ mW}$ [1] [3]



[3]

20

10 (a) (i)



[2]

Voltage V_o increases as temperature increases.

[1]

[3]

(ii) $5.6k/8.4k \times 9V = 6$ volts.

[2]

(b) (i) It can be considered as on/off. [1] Because of the high gain of the comparator in this mode it effectively 'switches' from the inverting state to the non-inverting state with no in-between state. [1]

[2]

(ii) In order to allow adjustment of the reference threshold temperature.

[2]

(iii) With RV in mid-position $V_1 = 10k/15k \times 9V = 6$ volts

[2]

(iv) Above 0° resistance of thermistor decreases therefore voltage at inverting input will increase. Output will be $-ve$ therefore LED will switch on.
Below 0° centigrade resistance of thermistor increases therefore voltage at inverting input will decrease. Output will be $+ve$ therefore buzzer will switch on.

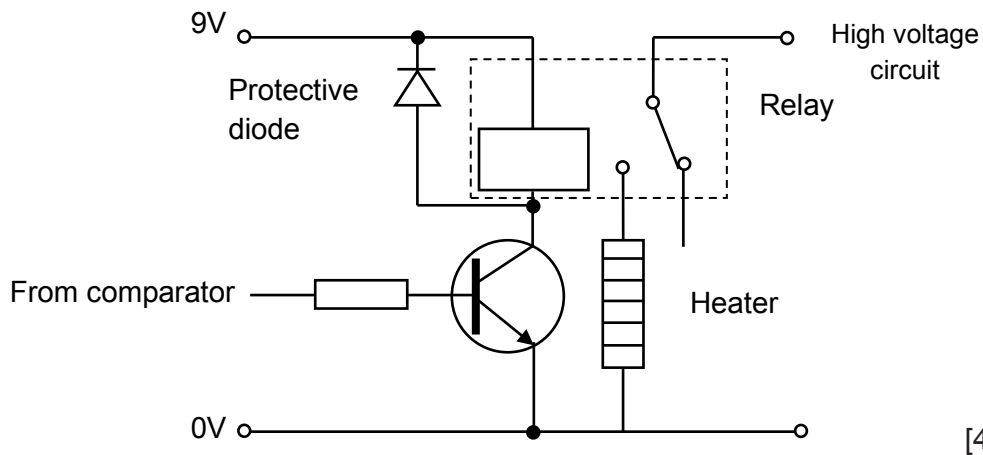
[4]

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

Quality of written communication

[1]

(c)



[4]

Section B

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Section C

**AVAILABLE
MARKS**

- 11 (a) (i)** H-I VR = $60/60 = 1$ [1]
- (ii)** H-I = $60/60 = 1$
 J Worm = $60/1 = 60$
 K-L = $100/50 = 2$
 $1 \times 60 \times 2 = 120$
 OS = IS/VR
 OS = $240/120 = 2$ rev/min [3]
- (iii)** A-C = $50/100 = 0.5$ [1]
 D-E = $60/120 = 0.5$ [1]
 F-G = $60/60 = 1$
 I-H = $60/60 = 1$
 Wormwheel = 60 [1]
 K-L = $100/50 = 2$
 Tot VR $0.5 \times 0.5 \times 1 \times 1 \times 60 \times 2 = 30$ [1] [4]
- (iv)** Crank and slider. [1]
- (v)** Knife-edged follower can follow intricate cam profiles.
 For example the dip in the heart shaped cam can be accurately followed by the narrow knife edge.
 The roller follower reduces the amount of friction generated between the cam and follower. This follower will not wear down as quickly as the narrow knife-edged follower.

 Or other suitable answer [4]
- | | |
|--|-----|
| For a response not worthy of credit | [0] |
| Clear and coherent explanation using good English grammar. | [1] |
- Quality of written communication [1]
- (b) (i)** Viable working solution incorporating a rack and pinion.
 Rack attached to beam. [1]
 Pinion attached to pivot. [1]
 Integration of system with seesaw. [1] [3]
 Or other suitable answer.
- (ii)** A viable answer should include the following:
 Suitable bell crank linkage incorporated in the solution.
 Linkage attached to rope. [1]
 Linkage attached to swing knocker. [1]
 Viable/working solution. [1] [3]
 Or other suitable answer (must be a suitable linkage).

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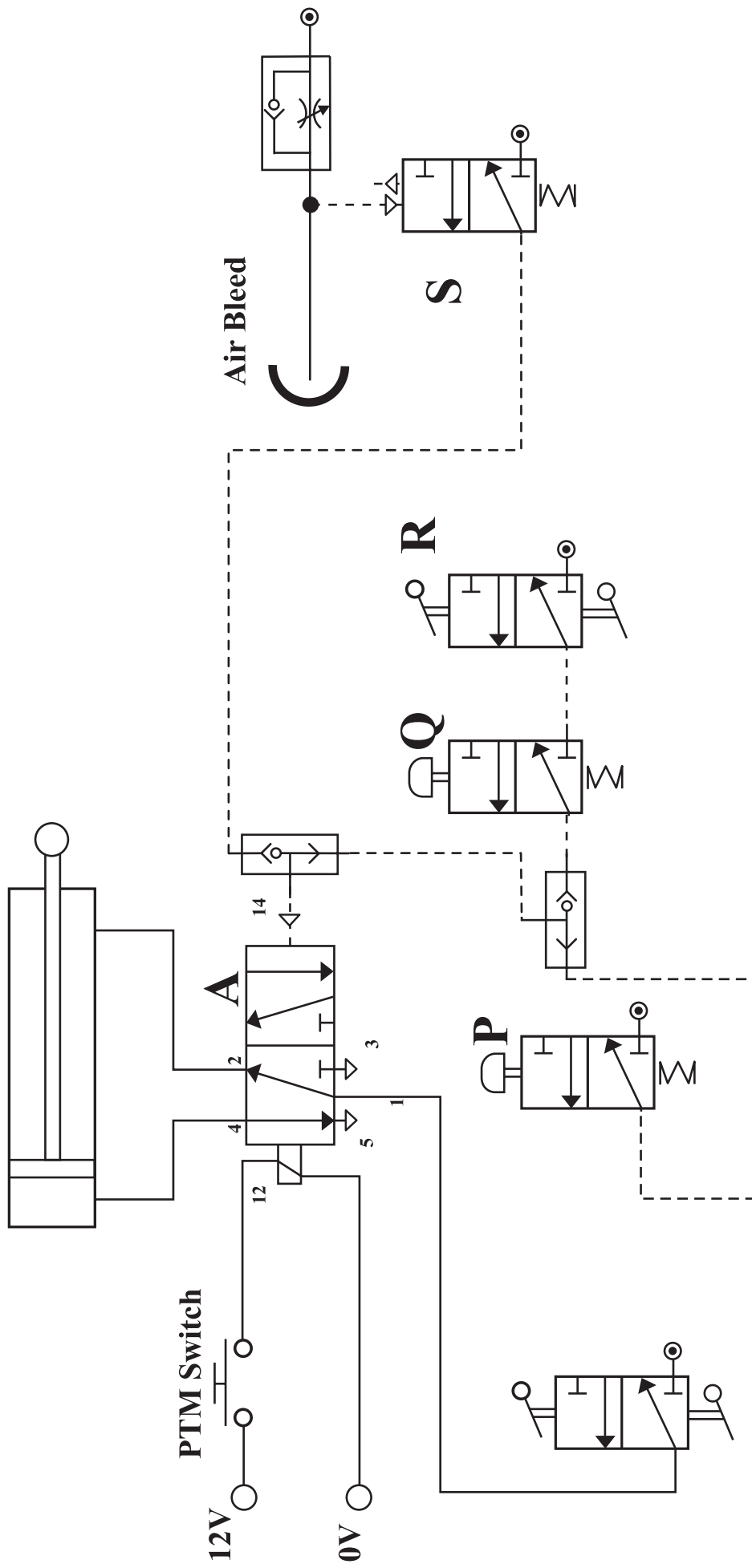
- 12 (a) (i)** Suitable answer incorporating flow control valve and tee connector. [2]
See sample answer.
- (ii)** Solenoid activation method employed. [2]
Wiring to power, switch and solenoid.
See sample answer.
- (iii)** Appropriate operation of P. [1]
Appropriate operation of Q. [1]
Appropriate operation of R. [1]
Appropriate operation of S. [1]
Appropriate operation of system with cylinder. [1]
Shuttle valves. [1] [6]
See sample answer.
- (iv)** Incorporation of lever activation. [1]
Suitable/viable method which disengages the main air supply. [2] [3]
- (b) (i)** The air enters the unidirectional flow control valve and is blocked from passing through the free flow area. This forces the air through the restrictor which reduces the rate at which the air is flowing. The air then flowing at a reduced rate slowly starts to fill up the reservoir. Once the air has filled the reservoir it is then able to proceed to the next section of the circuit. The time taken to fill the reservoir determines the overall time delay. The adjustable setting on the flow control valve can be varied to increase or decrease the flow of air passing through it and the speed it can fill the reservoir. [3]
- | | |
|--|-----|
| For a response not worthy of credit | [0] |
| Clear and coherent explanation using good English grammar. | [1] |
- Quality of written communication [1]
- (ii)** $325.12 - 300 = 25.12$ [1]
 $25.12/0.5 = 50.24$ [1]
 $50.24/3.14 = 16$
 $\sqrt{16} = 4 \text{ mm}$ [1] [3]

**AVAILABLE
MARKS**

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Section C

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Answer Q12

Section D

**AVAILABLE
MARKS**

- 13 (a) (i)** Two performance criteria:
- Robust and reliable to withstand normal service life.
 - To maintain an appropriate speed and power for a number of cleans. [2]
- (ii)**
- Use of colour (dark blue, teardrop light blue and white in body) male colours.
 - Simple design and use of colour – no-nonsense profile appropriate for target audience.
 - Use of bulky, chunky body, which may make it suitable for teenage male. [2]
- | | |
|--|-----|
| For a response not worthy of credit | [0] |
| Clear and coherent explanation using good English grammar. | [1] |
- Quality of written communication [1]
- (iii) Any two:**
- Suitability of material to the working environment/conditions.
 - Suitability of material to be injection moulded.
 - Relatively low cost material and specific properties of the material, e.g. electrical insulator. [2]
- (iv)** Suitable manufacturing process – injection moulding [1]
- Any **one:**
- High quality finish of housing produced in one process with very good dimensional accuracy achieved.
 - Cost effective method by producing large numbers at relatively low unit costs. [1] [2]
- (v) Any one:**
- Grip diameter to determine barrel size.
 - Thumb size for switch. [1]
- (vi) One positive environmental issue:**
- Plastics used are recyclable. [1]
- One negative environmental issue:**
- Product has to be larger to house the electrical components than would otherwise be necessary with a conventional toothbrush. [1] [2]

- (b) (i) Solution could be based on molars (innovative design) for holding the electric toothbrush and the bracket suitable for wall mounting

Level of response not worthy of credit	[0]
A vague sketch lacking detail and appropriate annotation. The design may not be appropriate.	[1]
Both the sketch and annotation are limited. The design lacks the finesse appropriate for the product.	[2] or [3]
Detailed annotated sketch representing an appropriate innovative design.	[4]

[4]

- (ii)

Level of response not worthy of credit	[0]
A bar chart lacking the appropriate criteria. The bar chart may not be suitable for printing.	[1]
A limited bar chart illustrating some of the criteria which may be suitable for printing.	[2] or [3]
A detailed bar chart illustrating all of the criteria which is suitable for printing.	[4]

[4]

AVAILABLE
MARKS

20

14 (a) (i) Primary research is research that is created for the first time (questionnaires) whereas secondary research is research that already exists or is available from books, Internet or other sources. [2]

- (ii) Any **two**:
- It is used to identify and distinguish its products from those of others.
 - A name, logo, slogan, shape, word, song or symbol can be registered as a trademark.
 - It must be distinctive, not deceptive, and morally acceptable
 - It must be renewed every 10 years. [2]

- (b) e.g.:
- Engrave logo.
 - Round corners.
 - Grooves, slots etc. [3]

- (c) (i) Any **two**:
- Good strength and versatility.
 - Can be recycled and is relatively cheap.
 - Can insulate against sound, temperature and vibration. [2]

- (ii) Any **two**:
- Can provide security (special tamper-evident holograms can be used to prevent access to boxes).
 - Brand protection – The use of holograms on labels can mark the genuineness of the product.
 - Advertising – Holograms can provide eye-catching pictures which add appeal and generate more interest. [2]

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

Quality of written communication [1]

(d) (i)

Level of response not worthy of credit	[0]
Vague sketches which attempt to explain the requirements with little or no rendering.	[1]
Limited sketches which convey some or all of the requirements with some rendering.	[2] or [3]
Detailed sketches which convey all requirements with good quality rendering.	[4]

(ii) Solution based on a small two-part cylindrical unit which allows the top half to rotate freely while being supported by the bottom half.

Level of response not worthy of credit	[0]
A vague sketch lacking detail and appropriate annotation. The design may not be appropriate.	[1]
Both the sketch and annotation are limited. The design lacks the finesse appropriate for the product.	[2] or [3]
Detailed annotated sketch representing an appropriate overall design.	[4]

[4]

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Section D

40

Total

80

**AVAILABLE
MARKS**