



*Rewarding Learning*

**ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2013**

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## **Technology and Design**

**Assessment Unit AS 1**

*assessing*

**Product Design and  
Systems and Control**

**[AV111]**

**TUESDAY 4 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.

### Section A

|   |       |  | AVAILABLE MARKS |   |
|---|-------|--|-----------------|---|
| 1 | •     | Strength – this is the measure of how good a material is at resisting being mis-shaped, or deformed when acted upon by a force   | [1]             | 4 |
|   | •     | Durability – the ability of a material to resist wear and tear   | [1]             |   |
|   | •     | Brittleness – a material that fractures with little or no deformation  | [1]             |   |
|   | •     | Plasticity – a material’s ability to change shape permanently when subjected to force without cracking or breaking   | [1]             |   |
| 2 | (i)   | Any <b>two</b> from: <ul style="list-style-type: none"> <li>• Protects against wear, dirt and corrosion</li> <li>• Changes the appearance of the product</li> <li>• Enable easy maintenance by washing or polishing</li> </ul> | [2]             | 4 |
|   | (ii)  | Metal parts are preheated, dipped into the fluidised bath. The plastic melts and coats the surface. When the part is removed the residual heat fuses the coating and creates a smooth surface.                                 | [2]             |   |
| 3 | (i)   | Thermoplastic can be heated and returned to a workable plastic. Thermosetting cannot be reshaped.  | [2]             | 6 |
|   | (ii)  | Any <b>two</b> from: <ul style="list-style-type: none"> <li>• Self lubricating</li> <li>• Hard, tough material</li> <li>• Wear resistant</li> </ul>  | [2]             |   |
|   | (iii) | Any <b>two</b> from: <ul style="list-style-type: none"> <li>• Non-toxic</li> <li>• Strong, easily cleaned</li> <li>• Maintains its shape well and is resistant to scratching</li> </ul>  | [2]             |   |
| 4 | (i)   | Any <b>one</b> from: <ul style="list-style-type: none"> <li>• quick method</li> <li>• capable of producing complex shapes</li> <li>• suitable process for high melting point metals</li> </ul>                                 | [1]             | 5 |
|   | (ii)  | Sand Casting – Annotated sketch showing split mould, sand with profile, runner and riser.<br>Description   | [3]<br>[1]      |   |

- 5 (i) Factor of safety – reference to the safety margin (factor) that the designer has allowed for in the design above that which the product or component would normally be expected to withstand. [2]
- (ii) Any **one** from:
- To ensure that testing was fair and consistent without having to test every individual product.
  - Recognised method accepted by professional bodies. [1]
- (iii) Any **one** from:
- Attract and assure customers that the product is safe and fit for purpose.
  - Helps the company to continue to develop and maintain best practice. [1]
- 6 (i) Computer-integrated manufacture [1]
- (ii) Manufacturing – To use computers in an integrated way in order to initiate and monitor the manufacturing of components or product levels and make changes based on feedback. [2]
- (iii) Assembly – To use computers in an integrated way to help select, move and position components for final assembly. In addition they can process feedback and help prevent continued mistakes by initiating corrective steps throughout the assembly stage. [2]
- 7 (i) Aesthetics are the qualities which make a design attractive to look or pleasing to experience. Ergonomics is the study of the design of objects and their interaction with people. [2]
- (ii) • **Form** – the parts of the suitcase are aesthetically pleasing as they take a standard geometrical shape. The form is also derived from the function. [1]
- **Texture** – smooth texture giving a feeling of quality. [1]
  - **Colour** – the two contrasting colours used in the design complement each other. [1]

|  |     |
|--|-----|
| 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]

AVAILABLE  
MARKS

4

5

7

8 (i) The creation of products that meet the needs of the present generation without compromising the ability of future generations to meet their own needs.

[2]

(ii) • Reduce – the electric kettle is designed so that it can minimise the amount of water and energy used when boiling water. This will help reduce the energy needed

• Reuse – of paper bags as a result cutting down on material/process use

• Recycle – of aluminium cans as a result reducing the use of materials

[3]

**Section A**

**AVAILABLE MARKS**

5

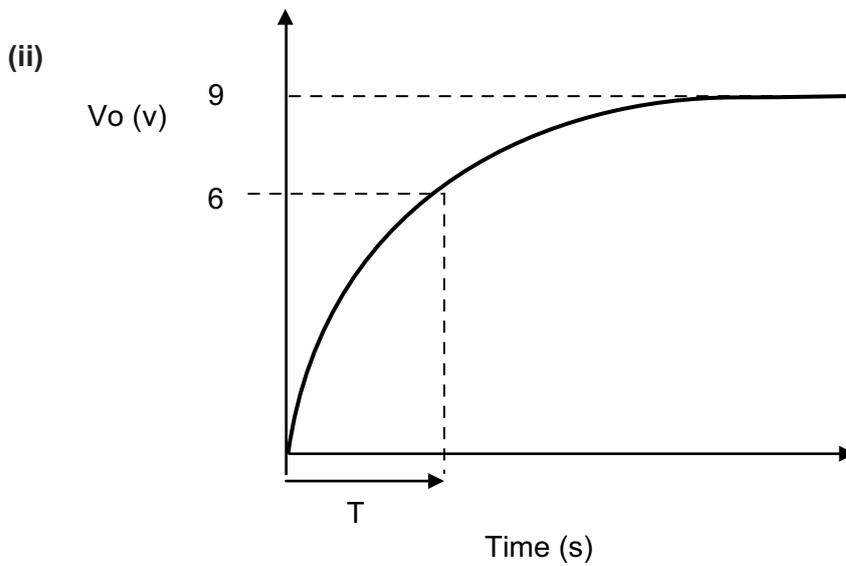
**40**

Section B

AVAILABLE MARKS

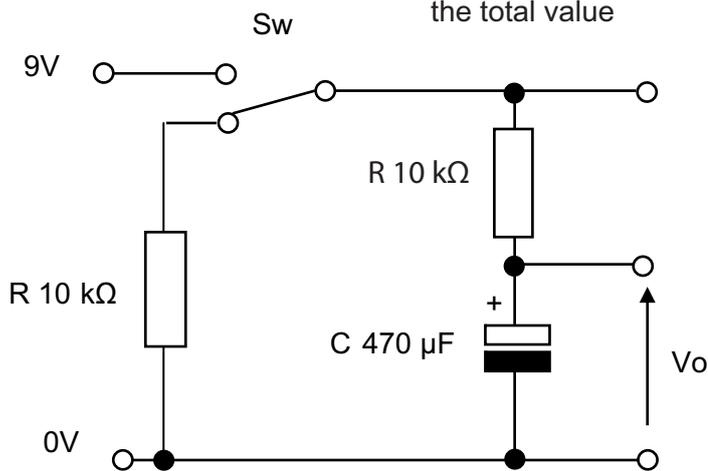
9 (a) (i)  $T = CR$   $T = 4.7$  seconds

[2]



[2]

(iii) Capicator will discharge through a resistor of twice the total value



[3]

(b) (i)  $I_c = 9/20 = 0.45A$   
 $I_c/I_b = 0.45/0.005 = 90$

[3]

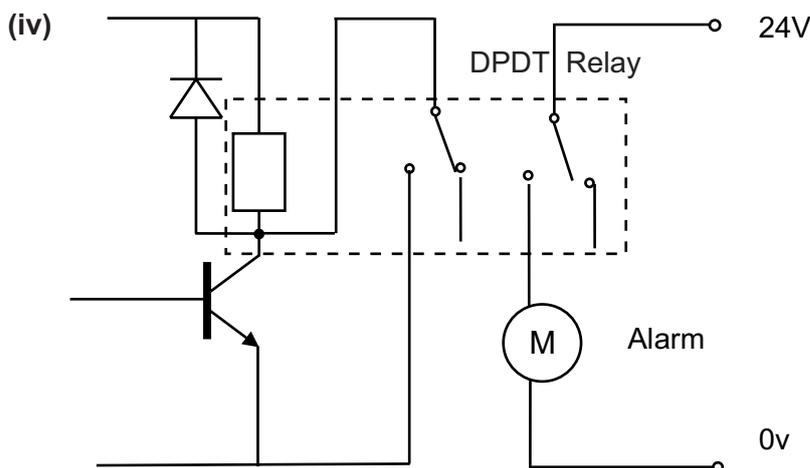
(ii) Labelled diagram showing a diode (reverse biased) in parallel with the relay coil.

[2]

- (iii) When sw 1 is closed the capacitor C will charge through the resistor R1. When the voltage at the base of the transistor reaches somewhere in the region of 0.6V the transistor will switch on. The coil in the relay will close the contacts and the motor will switch on. [3]

|  |     |
|--|-----|
| Level of response not worthy of credit.                    | [0] |
| Clear and coherent explanation using good English grammar. | [1] |

Quality of written communication [1]



When the transistor switches on, one side of the DPDT will act as a latch by bypassing the transistor. [4]

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- 10 (a) (i) SR flip flop [1]

(ii)

| A | B | Q |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

[2]

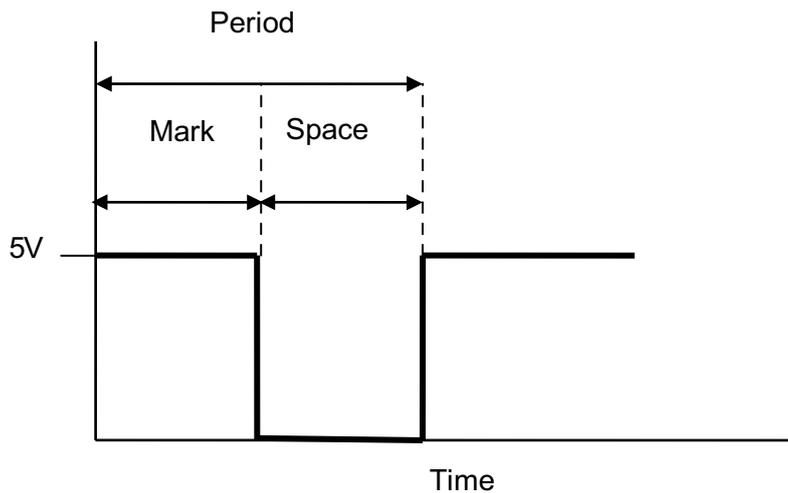
- (iii) Pull up when the PTM switches are open the inputs to the gates are connected to the positive rail via these resistors. Hence they are pulled up. [2]

- (b)  $S = 0$   $R = 1$   $Q = 1$   $\bar{Q} = 0$   
 $S = 1$   $R = 1$   $Q = 1$   $\bar{Q} = 0$   
 $S = 1$   $R = 0$   $Q = 0$   $\bar{Q} = 1$  [3]

(c) (i) No programming software required.

[1]

(ii)



[3]

(d) (i)  $5 - 1.8 = 3.2 / 0.015 = 213$  ohms

[2]

(ii) 220 ohms is the nearest higher value ensuring that the LED current is limited to less than 15 mA.

[2]

|  |     |
|--|-----|
| Level of response not worthy of credit.                    | [0] |
| Clear and coherent explanation using good English grammar. | [1] |

Quality of written communication

[1]

$$\begin{aligned}
 \text{(iii)} \quad F &= \frac{1.44}{(R_1 + 2R_2)C} \\
 \therefore C &= \frac{1.44}{(R_1 + 2R_2) \times F} \\
 &= \frac{1.44}{(3.9 \times 10^3 + 68 \times 10^3) \times 2} \\
 &= 10 \mu\text{F}
 \end{aligned}$$

[3]

**Section B**

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## Section C

AVAILABLE  
MARKS

- 11 (a) (i)** Ans = Anticlockwise [1]
- (ii)** Ans = A–C =  $150/150 = 1$   
D–E =  $40/80 = 0.5$   
Wormwheel 40 [2]  
Tot VR =  $1 \times 0.5 \times 40 = 20$  [1]
- (iii)** Ans = VR A–D =  $150/150 = 1$   
VR A–E =  $1 \times 0.5 = 0.5$  [1]  
OS = IS/VR  
OS at D = 500  
OS at E = 1000 [1]  
Diff = 500 rev/min [1]
- (iv)** Ans = OS = IS/VR  
? =  $500/20 = 25$  [2]  
25 rev/min [1]
- (v)** Ans = Existing VR =  $1 \times 0.5 \times 40 = 20$   
VR needed to obtain speed of 50 rev/min = 10 [1]  
Wormwheel needs to be  
 $1 \times 0.5 \times ? = 10$  [1]  
VR = 20  
Wormwheel teeth = 20 [1]
- (vi)** The mechanical system involves a number of moving parts which are rotating in different directions. Clothing or fingers could get caught or trapped in the moving parts. Safety signs should be displayed to alert operators of this hazard.
- The moving parts are rotating at considerable rotational velocities and there is a danger of flying debris being released. A safety guard could be installed to prevent danger to the user. Users would need to follow the procedure of ensuring that the guard is in place when in the mechanical system is in use.
- Or other suitable answer. [2]
- |  |     |
|--|-----|
| Level of response not worthy of credit.                    | [0] |
| Clear and coherent explanation using good English grammar. | [1] |
- Quality of written communication [1]
- (b) (i)** Sketch outlining the eccentric cam. [1]  
Sketch outlining Roller Follower [1]  
Annotation [1]
- (ii)** The difference between the highest and lowest points that the follower will move.  
Or other suitable answer [1]

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- 12 (a)** The filter removes dust particles from the compressed air.  
The lubricator adds a fine mist of oil to the compressed air.  
Or other suitable answer [2]
- (b) (i)** Roller Trip [1]
- (ii)** Plunger [1]
- (iii)** Push button [1]
- (iv)** Appropriate operation of A [1]  
Appropriate operation of B [1]  
Appropriate operation of C [1]  
Appropriate operation of D [2]  
See sample answer.
- (v)** Suitable method of activation [1]  
Suitable component used with correct piping on default [1]  
Integration with main air supply [1]  
See sample answer.
- (vi)** The air enters the automatic return system at the Tee connector when the DAC goes positive.  
The air is forced to go through the restricted element of the uni-directional flow control valve.  
Air gradually builds up in the reservoir until it reaches a sufficient level to activate the five port valve at the 12 air activation port.  
  
Or other suitable answer [3]
- |  |     |
|--|-----|
| Level of response not worthy of credit.                    | [0] |
| Clear and coherent explanation using good English grammar. | [1] |
- Quality of written communication [1]
- (vii)**  $90 - 64.88 = 25.12$  [1]  
 $25.12/0.5 = 50.24 \text{ mm}^2$  [1]  
 $50.24 \text{ mm}^2/3.14 = 16$   
 $4 \times 4 = 16$   
Radius = 4 mm [1]

Section C

AVAILABLE  
MARKS

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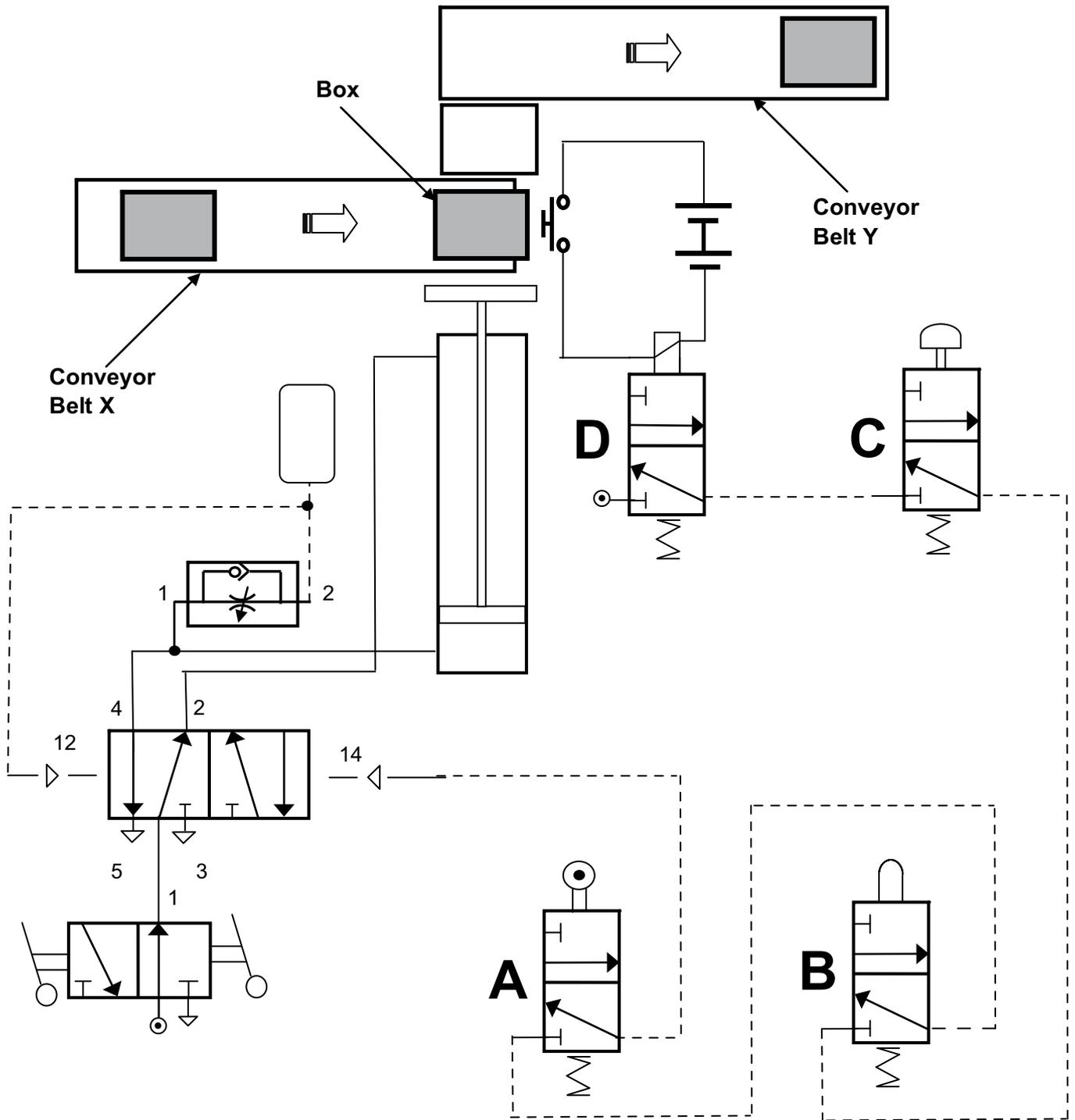


Fig. 12

## Section D

AVAILABLE  
MARKS

- 13 (a) (i) Any **two** from:
- Creche facilities
  - Target audience of parents/guardians wanting a more stylish/modern product.
  - Restaurants [2]
- (ii) Any **two** from:
- Stability of the high chair with splayed legs
  - Harness for securing child in seat
  - Smooth, soft edges ensuring no potential harm
  - No small components easily removed and materials non-toxic [2]
- (iii) Any **one** from:
- Take less time to break down after being discarded
  - Biodegradable plastics are completely safe and do not have any chemicals or toxins [1]
- (iv) Any **two** from:
- Standard materials used for the product
  - Little assembly required by the manufacturer
  - Processes suitable for high volume, low unit cost production
  - Cost effective materials [2]
- (v) Any **two** from:
- Shape of the seat to suit child profile
  - Foot support with additional embossed grip pattern
  - Inclusion of a space (hand grip) for lifting the chair
  - Straps which have adjustments to suit individual child [2]

|  |     |
|--|-----|
| Level of response not worthy of credit.                    | [0] |
| Clear and coherent explanation using good English grammar. | [1] |

Quality of written communication [1]

- (vi) Any **two** from:
- They are suitable for injection moulding
  - Easily coloured with dyes
  - Can be recycled [2]

(b) (i)

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

[4]

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

[4]

AVAILABLE  
MARKS

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14 (a) (i) A design brief is a statement which describes a design task or a problem to be solved whereas a design specification is a list of requirements which need to be considered when designing the product. [2]

(ii) Formative evaluation is ongoing and occurs every time you make a decision or judgement regarding your work. Summative evaluation occurs at the end of the project. It specifically judges how well the final manufactured product meets the specification. [2]

(b) (i) Any **two** from:

- Gives you the right to stop anyone copying or using your design in the UK
- It is active for up to 25 years
- Registered design must be new
- Registered design must have individual character and it should not remind any informed person of an existing design [2]

(ii) **Two** from the following:

- protects the materials from being used by another company
- renewal periodically
- covers a wide range of documentation from unauthorised reproduction
- an international dimension [2]

(c) Any **three** from:

- Outline guidance on the safe handling, use and storage of hazardous substances in the workplace.
- Series of regulations that every business/company must follow to protect workers, customers and the general public from the effects of hazardous substances.
- COSHH set out eight basic measurements that should be taken into account to assess and control exposure of hazardous substances. [3]

|  |     |
|--|-----|
| Level of 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]        | <b>AVAILABLE<br/>MARKS</b> |
|         | A vague sketch lacking detail and appropriate annotation. Difficulty in disseminating if the idea communicates the required information to the user. | [1]        |                            |
|         | Both the sketch and annotation are limited. The idea is appropriate and communicates the required information to the user.                           | [2] or [3] |                            |
|         | Detailed annotated sketch. The idea is very appropriate and clearly communicates the required information to the user.                               | [4]        |                            |

[4]

|      |   |            |                            |
|------|---|------------|----------------------------|
| (ii) | Level of response not worthy of credit.   | [0]        | <b>AVAILABLE<br/>MARKS</b> |
|      | A vague sketch lacking detail and appropriate annotation. Difficulty in disseminating if the idea is appropriate and represents improvements. | [1]        |                            |
|      | Both the sketch and annotation are limited. The idea represents an improvement but lacks the finesse appropriate for the product.             | [2] or [3] |                            |
|      | Detailed annotated sketch representing an appropriate improvement to the overall design.  | [4]        |                            |

[4]

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**Section D****40****Total****80**