



*Rewarding Learning*

**ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
January 2012**

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## **Technology and Design**

**Assessment Unit AS 1**

*assessing*

**Product Design and Systems and Control**

**[AV111]**

**TUESDAY 17 JANUARY, 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

#### Product Design and Practice

			AVAILABLE MARKS
1	• <b>Density</b> – The amount of matter in a material.	[1]	4
	• <b>Strength</b> – is the measure of how good a material is at resisting being mis-shaped, or deformed, when acted upon by a force.	[1]	
	• <b>Electrical conductivity</b> – Electrical conductivity relates to how well electrons travel, or are conducted through a material.	[1]	
	• <b>Thermal conductivity</b> – Thermal conductivity relates to how well heat travels, or is conducted through a material.	[1]	
2	(i) Ferrous metals contain iron, non-ferrous metals do not.	[1]	5
	(ii) Any <b>two</b> main properties from the following: <ul style="list-style-type: none"> <li>• The oxide film prevents rusting</li> <li>• Shiny attractive metal</li> <li>• Good ductility/tensile strength</li> <li>• Suitability for use in dishwasher.</li> </ul>	[2]	
	(iii) Galvanised steel dustbin or corrugated roof	[1]	
	Any <b>one</b> main reason from the following: <ul style="list-style-type: none"> <li>• Resistant to atmospheric corrosion</li> <li>• Low melting point.</li> </ul>	[1]	
3	(i) Any <b>two</b> main reasons from the following: <ul style="list-style-type: none"> <li>• Weather resistant and resistant to chemical cleaners</li> <li>• Good mechanical properties</li> <li>• Suitable for the extrusion process</li> <li>• Can be provided in a range of colours.</li> </ul>	[2]	4
	(ii) Any <b>two</b> main reasons from the following: <ul style="list-style-type: none"> <li>• Good transparency levels for rear lights</li> <li>• A lightweight material</li> <li>• Resistant to cleaning products.</li> </ul>	[2]	
4	(i) Mild steel is malleable.	[1]	5
	(ii) Suitable sketch of the press forming process to include the <b>punch, die and hydraulic press or form of pressure.</b> Description.	[3] [1]	
5	(i) Permanent joining methods (e.g. welding) are used with the expectation that the components will not be disassembled during their life cycle. Semi-permanent joining methods (e.g. nuts and bolts) facilitate disassembly during life cycle.	[2]	
	(ii) Any <b>two</b> specific characteristics from the following: <ul style="list-style-type: none"> <li>• Low melting point required, around 230 °C</li> <li>• Used for joining thin metals</li> <li>• Produces relatively weak joint.</li> </ul>	[2]	

		AVAILABLE MARKS
(iii)	Any <b>two</b> specific characteristics from the following: <ul style="list-style-type: none"> <li>• Very high melting point required, around 3000–3600 °C</li> <li>• Produces a very strong joint</li> <li>• Used for joining wide thicknesses of metal.</li> </ul>	[2]
6	(i) Any <b>two</b> main advantages from the following: <ul style="list-style-type: none"> <li>• Objects are drawn accurately, they can be scaled, rotated, etc.</li> <li>• Drawings can be created in 3D and viewed from any angle</li> <li>• Can simulate how a produce can perform.</li> </ul>	[2]
	(ii) Any <b>two</b> main advantages from the following: <ul style="list-style-type: none"> <li>• Continuous or very large number of items produced</li> <li>• Assembly line production used</li> <li>• Only small or little variation to meet client requirements can be achieved</li> <li>• Cheaper unit cost compared to the other two methods</li> <li>• Less skilled labour required.</li> </ul>	[2]
	A response which is not worthy of any credit	[0]
	Poor selection and use of a writing form and style appropriate to the content. The content is poorly organised and little use is made of appropriate technological vocabulary. The writing is barely legible and the spelling, grammar and punctuation is inaccurate.	[1]
	Good selection and use of a writing form and style appropriate to the content. The content is organised and use is made of appropriate technological vocabulary. The writing is legible and the spelling, grammar and punctuation is accurate.	[2]
	Quality of written communication	[2]
7	(i) Employee safety is concerned with the safety of personnel mainly during the manufacturing stage, whereas consumer safety is concerned that the product is safe for the person to use under normal working conditions.	[2]
	(ii) The British Standards is the national Standards for the UK which is an agreed technical specification or other precise information for a product.	[2]
	(iii) Any <b>two</b> specific characteristics, e.g. <ul style="list-style-type: none"> <li>• Ensure that the consumer is informed of the country of origin</li> <li>• Protects the consumer by making it an offence for a trader to wrongly describe goods or services.</li> </ul>	[2]
8	(i) Sustainability: The ability to maintain our quality of life at its present level. From this comes the idea that the current generation of people should not damage the environment in ways which will threaten the quality of life and the environment for future generations.	[2]
	(ii) Life cycle analysis: The assessment of a product's energy consumption, use of raw materials, waste, emissions and by-products from its conception through manufacture, distribution and use, to its recycling or disposal.	[2]
<b>Section A</b>		<b>40</b>

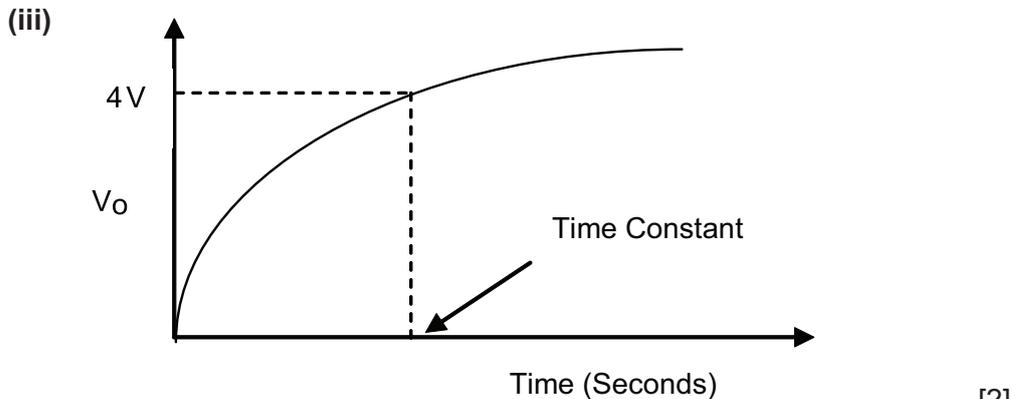
## Section B

## Electronic and Microelectronic Control Systems

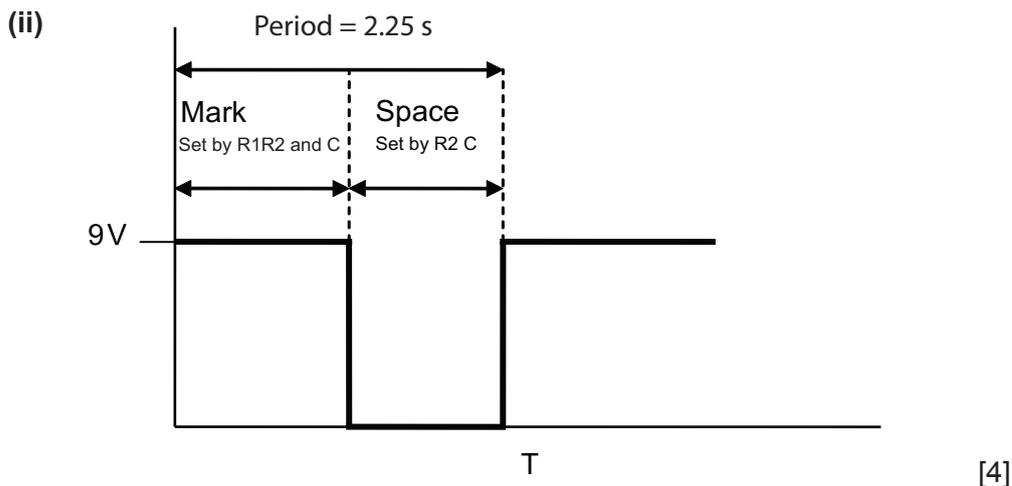
AVAILABLE  
MARKS

9 (a) (i) The tolerance is the **precision** of the resistor and it is given as a percentage. [1]

(ii)  $T = RC$   
 $R = 5/100 \times 10^{-6} = 50 \text{ k}\Omega$  [2]



(b) (i) 0.44 Hz [2]



(iii) When Sw is closed the trigger pin will initially be low which means the output pin will be high. The output will remain high until the voltage at the threshold pin reaches  $2/3$  the supply voltage. The time taken to reach this voltage is determined by the  $R_1$ ,  $R_2$  and C. (charging) The output pin will then go low and remain low until the voltage at the trigger pin falls below  $1/3$  supply voltage. The time taken to reach this voltage is determined by the time taken to discharge C through  $R_2$ . When the voltage at the trigger pin falls below  $1/3$  supply voltage the output pin will go high again. The cycle repeats until the switch Sw is opened. [4]

Poor explanation using inaccurate English grammar. [0]

Clear and coherent explanation using good English grammar. [1]

(iv)  $9 - 1.4 = 7.6 \text{ V}$   
 Total current =  $12 \text{ mA} \times 3 = 36 \text{ mA}$   
 Therefore  $R = 7.6/36 \times 10^{-3} = 211 \text{ ohms}$  [2]

(v) 220 ohms since it is the nearest higher value which will allow LEDs to operate safely. [2]

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10 (a) (i) NOR gate [1]

(ii)

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	0

[3]

(iii) EXOR gate or exclusive OR gate



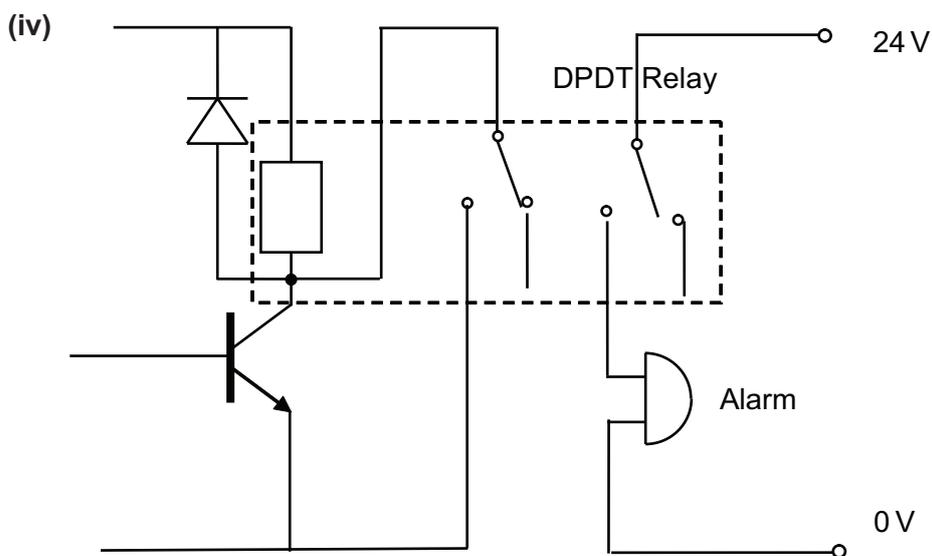
[2]

(b) (i)  $h_{FE} = I_c/I_b$  [1]

(ii)  $I_c = 6 \text{ V}/30 \Omega = 0.2 \text{ amps}$   
 If gain = 80 then  $I_b = 0.2/80 = 2.5 \text{ mA}$

Therefore  $R_b = 6 - 0.6/0.0025 = 2160 \Omega$  [4]

(iii) The electromagnetic coil in the relay circuit will generate a back emf which could damage the transistor. The diode is inserted in parallel with the coil with the cathode facing the positive rail and will effectively short circuit any back emf [2]



[4]

- (c) Answer likely to refer to shock/fire/burn issues. [2]
- Poor explanation using inaccurate English grammar. [0]
- Clear and coherent explanation using good English grammar. [1]

**Section B**

AVAILABLE MARKS
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<b>40</b>

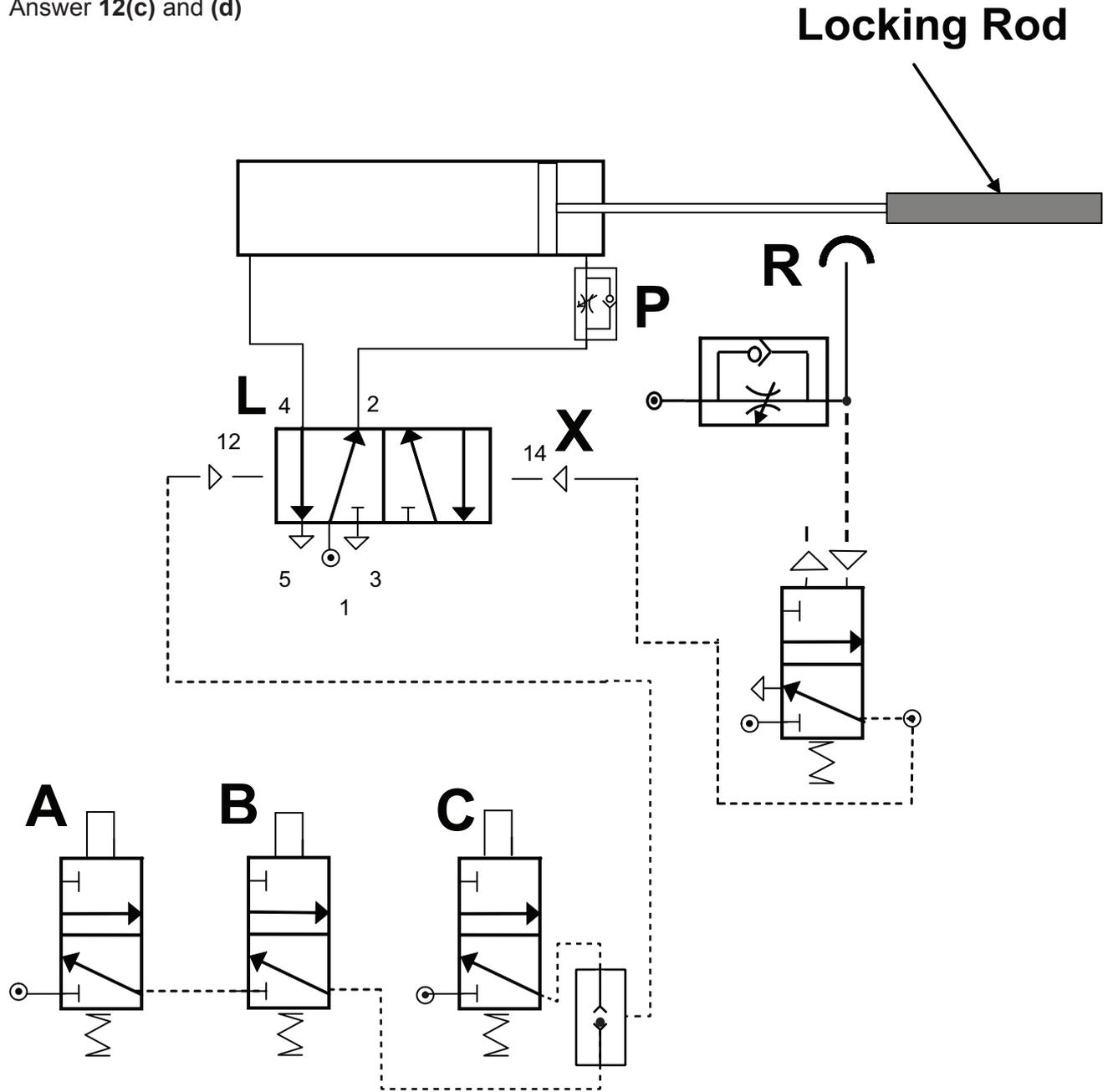
## Section C

## Mechanical and Pneumatic Control Systems

			AVAILABLE MARKS
11	(a)	(i) Toothed pulley	[1]
		(ii) Mechanical advantage = load/effort $48/40 = 1.2$ Effort is 40 N	[2]
		(iii) VR = Distance moved by effort/distance moved by load $2 = 0.8/?$ Distance moved by load is 0.4 m	[2]
		(iv) Efficiency = MA/VR $\times$ 100% $1.8/2 = 0.9$ $0.9 \times 100 = 90\%$	[1] [1]
	(b)	(i) Anticlockwise	[1]
		(ii) No T Driven/No T Driver $A-B = 18/36 = 0.5$ $C-E = 55/55 = 1$ E-F = Sharing shaft VR = 1 $0.5 \times 1 \times 1 = 0.5$	[3]
		(iii) VR C-F = 1 $60 \times 3 = 180$	[1] [2]
		(iv) Bevel gear Annotated sketch of bevel gearing system.	[1] [2]
		(v) Any <b>two</b> safety issues that should be considered when working with mechanical systems <ul style="list-style-type: none"> <li>Heat produced by friction</li> <li>Flying debris from moving parts</li> <li>Trapped finger.</li> </ul>	[2]
		Poor explanation using inaccurate English grammar.	[0]
		Clear and coherent explanation using good English grammar	[1]
12	(a)	(i) Roller Trip	[1]
		(ii) Signal/pilot air	[1]
	(b)	(i) Adds a fine mist of oil to the compressed air to ensure the components operate smoothly.	[1]
		(ii) Maintains the air pressure at a constant rate during use.	[1]
		(iii) The filter removes any dust or dirt particles from the compressed air before it is released into the circuit.	[1]

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Answer 12(c) and (d)



- (c) Main air supply [1]
- Connection A-B [1]
- Connection to include C [1]
- Signal to L [1]

- (d) Connection to R [1]
- Main air supply [1]
- Flow control valve [1]
- Tee connection [1]
- Diaphragm 3PV [1]
- Correct piping [1]

AVAILABLE MARKS

- (e) The uni-directional flow control valve restricts the exhaust air flowing from the double acting cylinder as it is outstroking. The speed of the outstroke can easily be controlled using the manual screw type adjustment. The uni-directional flow control valve allows air to flow freely through it allowing the double acting cylinder to instroke freely. The exhaust air flow would not be restricted if it was positioned the wrong way round. As the exhaust air would not be restricted the outstroke speed of the double acting cylinder would not be controlled.

Or other suitable answer. [2]

Poor explanation using inaccurate English grammar. [0]

Clear and coherent explanation using good English grammar. [1]

- (f) (i)  $4 \times 4 = 16$   
 $16 \times 3.14 = 50.24 \text{ mm}^2$  [1]  
 $0.5 \times 50.24 = 25.12 \text{ N}$  [2]

**Section C**

**AVAILABLE  
MARKS**

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**40**

## Section D

## Product Design

AVAILABLE  
MARKS

- 13 (a) (i)** A young male – teenager given the size of the bicycle. This person is also into riding bicycles and trying tricks. Target audience is related to people who can afford the bicycle and teenagers who are not restricted by a physical handicap [2]
- Poor explanation using inaccurate English grammar. [0]
- Clear and coherent explanation using good English grammar. [1]
- (ii)** Any **two** from the following:
- Colour – the use of black which contrasts with the blue grips.
  - Form – bulky shape from the low profile, thick tyres and solid frame profile.
  - Style – geometrical shape of the frame and very 'bare' look [2]
- (iii)** Any **two** from the following:
- Sourcing cheaper materials or using substitute materials
  - Using cheaper processes
  - Redesign to minimise materials/processes/components [2]
- (iv)** Any **two** from the following:
- The most important property of natural rubber is its elasticity
  - High tensile strength and
  - High abrasion resistant [2]
- (v)** Any **one** from the following:
- Comes from a renewable source
  - Low environmental impact
  - Natural rubber can be recycled. [1]
- (vi)** Any **two** from the following:
- Very good strength to weight ratio
  - Good resistance to corrosion
  - It can be moulded into a range of complex shapes [2]
- (b) (i)**
- |  |         |
|--|---------|
| Level of response not worthy of credit   | [0]     |
| Vague sketches lacking detail and appropriate annotation. Difficulties in disseminating if the ideas are appropriate and represent improvements. | [1]     |
| Both the sketches and annotation are limited. The ideas represent improvements but lack the finesse appropriate for the product.                 | [2]–[3] |
| Detailed annotated sketches representing an appropriate improvement to the overall design.   | [4]     |
- [4]

(ii)	Level of response not worthy of credit	[0]
	Vague sketches lacking detail and appropriate annotation. Difficulties in disseminating if the ideas are appropriate and represent improvements.	[1]
	Both the sketches and annotation are limited. The ideas represent improvements but lack the finesse appropriate for the product.	[2]–[3]
	Detailed annotated sketches representing an appropriate improvement to the overall design.	[4]

[4]

AVAILABLE  
MARKS

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- 14 (a)** Any **one** from the following:
- The change of colour of material due to changing temperatures
  - Available in inks, pigments
  - Two types – liquid crystal and leucodyes. [1]
- (b)** A design specification contains detailed information of a product's requirements, characteristics, all the processes, materials and other information needed to design the product. [2]  
A manufacturing specification contains clear and detailed information and instructions for the manufacture of the product.
- Poor explanation using inaccurate English grammar. [0]
- Clear and coherent explanation using good English grammar. [1]
- (c)** Gives the designer the right to prevent others making, using or selling the invention of the thermochromic cup without permission. [2]
- (d) (i)** Any **two** from the following:
- Strong and rigid suitable for packaging
  - Suitable for printing on
  - Clean look and attractive appearance. [2]
- (ii)** Suitable sketch of die cutting process to include the card in position, die/sharp knife. [2]  
Description of the process to include the knife pressing down and cutting through the material. Material clamped. [2]
- (e)** Sketches showing the shape of the packaging that will provide protection for the cup while minimising the use of materials.

Level of response not worthy of credit	[0]
Vague sketches lacking detail and appropriate annotation. Difficulties in disseminating if the ideas are appropriate and represent improvements.	[1]
Both the sketches and annotation are limited. The ideas represent improvements but lack the finesse appropriate for the product.	[2]–[3]
Detailed annotated sketches representing an appropriate improvement to the overall design.	[4]

[4]

An explanation of how you have considered environmental issues;

Example: The use of recycled cardboard – minimising the number of processes for the packaging and the material needed – maximising the number of packages that can be manufactured from a single sheet – sourcing materials which are locally produced.

[2]

An explanation of how the safety of the user has been considered.

Example: The removal or using a radius on corners. Ensuring the packaging is easily removed by the user when purchased. Selecting materials which cause no harm to young children.

[2]

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**Section D****40****Total****80**AVAILABLE  
MARKS