



Rewarding Learning

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

Technology and Design

Assessment Unit AS 1

assessing

Product Design and Systems and Control

[AV111]

THURSDAY 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.

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

Section A

		AVAILABLE MARKS
1	<p>(i) Any characteristic of a material that distinguishes it from other materials. [1]</p> <p>(ii) • The degree of stability can influence the constructional method and the long term rigidity of the product • Degree of stability can influence the appearance of the product. [2]</p> <p>(iii) A suitable metal for the bolts, e.g. Stainless steel [1]</p>	4
2	<p>(i) Any one from the following: • Plywood is much stronger than hardboard • Plywood is suitable for outdoor applications, hardboard is not. [1]</p> <p>(ii) Any two from the following: • Stronger material • Better quality surface finish • More suitable for securing fitting to [2]</p> <p>(iii) Any one specific application for plywood : • Building applications • General construction [1]</p> <p>Any one specific application for MDF: • Furniture • Skirting boards, sill boards and door architraves [1]</p>	5
3	<p>(i) Any two from the following: • Round, square and flat Bar • Pipe • Sheet or strip • Angle, channel I or H section [2]</p> <p>(ii) Copper – Any one from the following: • Good conductor of electricity • Corrosive resistant [1]</p> <p>High carbon steel – Any one from the following: • Very hard • Good metal wear resistance [1]</p> <p>Aluminium – Any one from the following: • High strength to weight ratio • Good resistance to corrosion [1]</p>	5

			AVAILABLE MARKS
4	<p>(i) Any one from the following:</p> <ul style="list-style-type: none"> • PVC • Polythene • Nylon 	[1]	6
	<p>(ii) Any one from the following:</p> <ul style="list-style-type: none"> • Suitable process for long hollow products • Relatively quick one stage process • One stage process produces a high quality finish. 	[1]	
	<p>(iii) Suitable sketch of the extrusion process to include the hopper, heated chamber and screw, die and cooling chamber. Description.</p>	[2] [2]	
5	<p>(i) Composites are made up of two or more different materials combined by bonding.</p>	[1]	
	<p>(ii) Alloys are formed by mixing two or more metals.</p>	[1]	
	<p>(iii) Example: Piezoelectric sensor in an airbag for a car.</p> <p>One main characteristic:</p> <ul style="list-style-type: none"> • Material senses the force of an impact triggering an electric charge activating the airbag. 	[2]	
6	<p>(i) Any one main characteristic from the following:</p> <ul style="list-style-type: none"> • Production of a product uninterrupted, e.g. chemical industry • Used to manufacture products that are going to be produced over a long period of time 	[1]	5
	<p>(ii) Any two main characteristics from the following:</p> <ul style="list-style-type: none"> • Operates as separate units within a large manufacturing plant • Individual cell has responsibility for every aspect of the production of the component • Essential all members of the cell work as a team • Numbers of people in cells can vary. 	[2]	
	<p>(iii) Any two main characteristics from the following:</p> <ul style="list-style-type: none"> • Only buy materials and components as and when you need them • JIT removes the need for stockpiles of resources • Saves on money and space 	[2]	

- 7 (i) Wasting is the removal of material by hand tools, manual or CNC machine tools.

[1]

- (ii) Example:

Manufacturing processes	Risk Association	Methods of minimising risk
Using the polisher to polish the edges of acrylic	(1) fragments getting into your eyes (2) revolving parts	(1) wear goggles (2) appropriate clothing/tie hair back

[4]

- 8 (i) Example: Car – Fashion changes to have small, compact economical, environmentally friendly vehicle. The fashion changes have also resulted in shape, colour and profile changes together with availability of internal gadgets

[2]

- (ii) Example: Mobile phone – The social change has resulted in the way we communicate with the introduction of the mobile phone. The mobile phone has changed dramatically in shape, style, size and range of functions to meet the demands of all the users.

[2]

Quality of written communication:

For a response not worthy of credit	[0]
Limited explanation using English grammar	[1]
Clear and coherent explanation using good English grammar	[2]

[2]

Section A**AVAILABLE MARKS**

5

6

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Section B

9 (a) (i) Exclusive OR

[1]

(ii)

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

[4]

(iii) The advantage of using a PIC for the logic circuit would be the requirement for only one IC. Two logic ICs would be necessary but only one PIC thus reducing the potential size of the final circuit. A disadvantage of using a programmable system for the logic circuit would be the speed of operation of the PIC compared to a dedicated logic IC. This is because the execution cycle for the program would add a delay to time taken for the logic function to be performed.

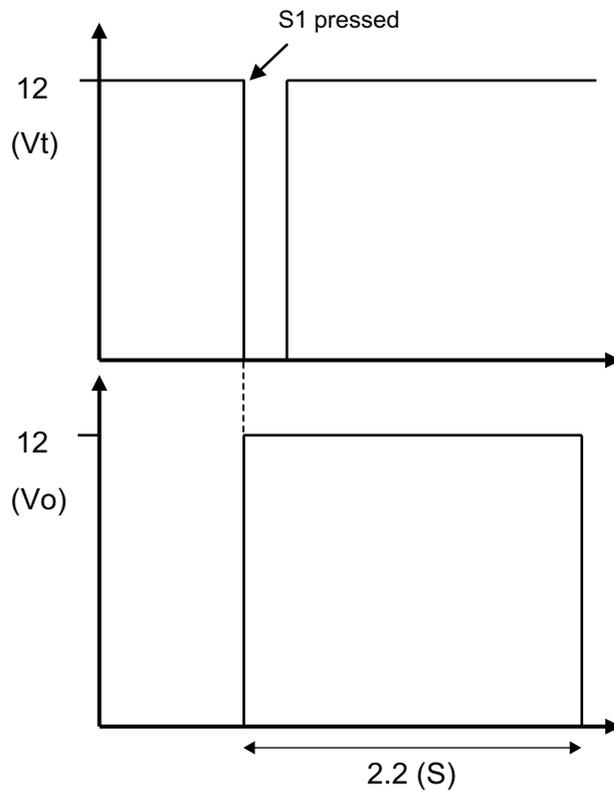
[2]

Quality of written communication

[1]

AVAILABLE
MARKS

(b) (i)



Axes [1]

S1 pressed released Vt [2]

Vo [1]

[4]

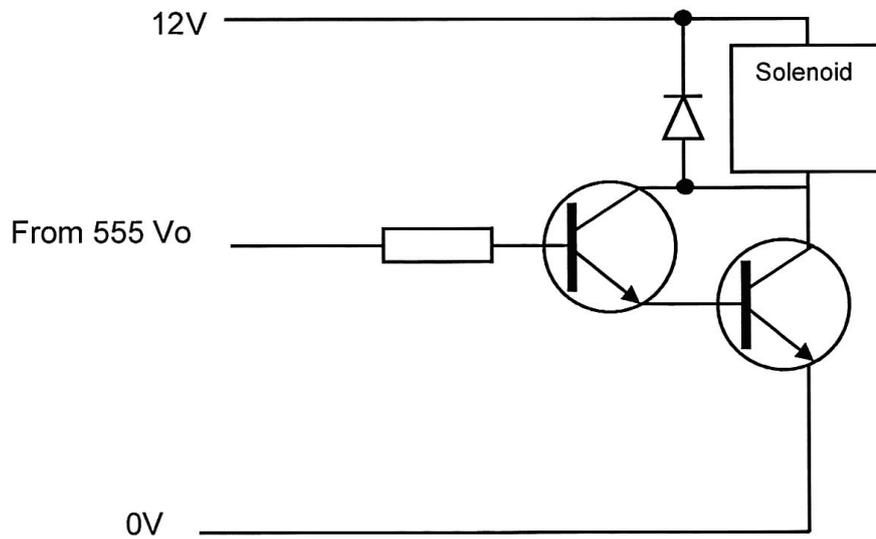
(ii) For 2.2 seconds $R2 = 200\text{ k}$

[2]

For 5.7 seconds $R3 = 518\text{ k}$

[2]

(iii)



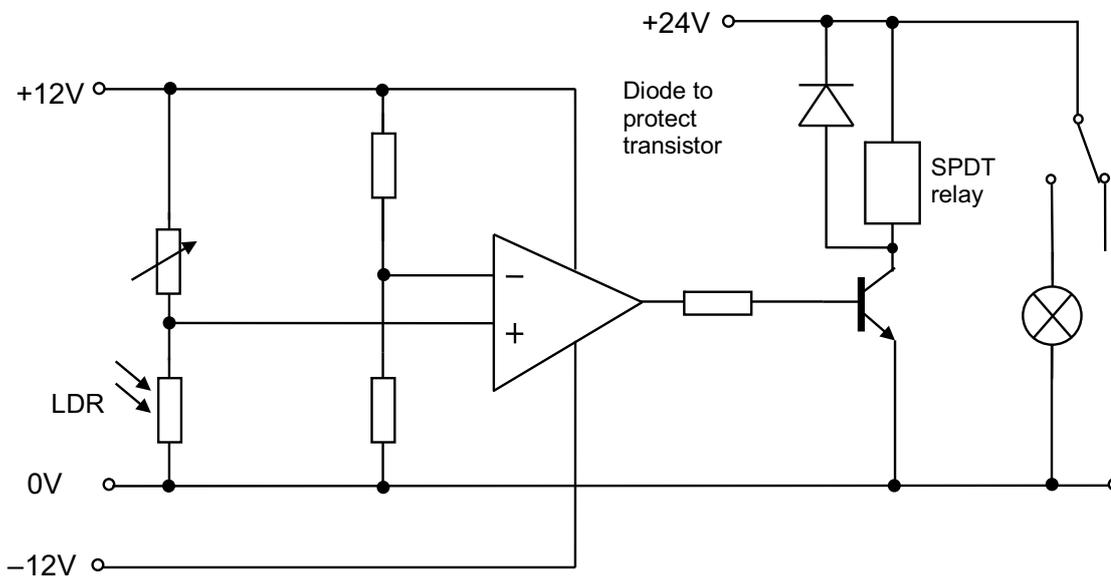
high gain
capacity to switch high collector current

circuit [2]
reasons [2]

[4]

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- 10 (a) (i) As light intensity increases the resistance of the LDR decreases. [1]
- (ii) When conditions darken the resistance of the LDR will increase. This will cause the voltage V_o to increase. [2]
- (iii) To adjust the 'sensitivity' of the circuit [1]
- (iv) Tolerance refers to the operational accuracy of the resistor and is usually stated in percentage terms. For example $1\text{ k}\Omega$ resistor with a stated tolerance of $\pm 5\%$ could vary between $950\text{--}1050$ ohms. [2]
- Quality of written communication [1]
- (v) V_o range $0.19\text{V--}7.5\text{V}$ [4]
- (b) 4.17A [2]
- (c)



- Op amp [2]
 Transistor [1]
 Relay [1]
 Diode [1]
 Annotation [2]

[7]

Section B

AVAILABLE MARKS

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Section C

		AVAILABLE MARKS
11	(a) (i) Clockwise	[1]
	(ii) OS = IS/VR 162/2 = 81 revs/min D–E and F–G share same shafts Therefore no VR increase/decrease Output speed at G = 81 revs/min	[1] [1]
	(iii) A–B 150/50 = 3 C–D 72/108 = 2/3 Tot VR = $3 \times \frac{2}{3} = 2$	[1] [1] [1]
	(iv) X–H 75/50 = 1.5 VR between I–J = 0.625 I = 80T and J = 50T sharing c/shafts with no influence on VR	[1] [1] [1] [1]
	(b) (i) Annotated sketch of cotter pin Securing method Showing housing/location	[1] [1] [1]
	(ii) Grub screw	[1]
	(c) (i) Round belt. It can twist to join shafts/pulleys which are at right angles to each other	[2]
	(ii) Annotated sketch outlining main features of jockey wheel including: <ul style="list-style-type: none"> • Pulley • Spring loading method • How features/elements are combined <p>Explanation and why it may be required:</p> <ul style="list-style-type: none"> • Removal of slack on belt which causes pulley slippage • Torque transmitted will be reduced if belt is slack • Positioning to run against the side of the pulley • Spring loading used to self-adjust to correct tension • Self-adjusting jockey wheel mechanism secured, e.g. to rigid frame/casing 	[3]
	Quality of written communication	[1]

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		AVAILABLE MARKS
12 (a) (i)	Main air supply	[1]
	(ii) Push button	[1]
	(iii) Solenoid	[1]
(b)	Appropriate operation of A	[1]
	Appropriate operation of B	[1]
	Appropriate operation of C	[1]
	Appropriate operation of D	[1]
	Appropriate operation of system with cylinder. (See sample answer)	[1]
(c)	Appropriate connections and piping. (See sample answer)	[2]
(d)	3PV with suitable activation method.	[2]
	Time delay	[1]
	Signal at 5PV	[1]
	Or other suitable answer (See sample answer)	
(e)	The unidirectional flow control valve is adjusted to only allow a small trickle of air to flow to the tee connector. At the tee connector some air escapes preventing a build-up of force on the diaphragm which would enable it to activate. When the air is prevented from escaping at the air bleed pressure builds up on the diaphragm and the three port valve is activated.	[2]
	Quality of written communication	[1]
(f)	$6 \times 6 \times 3.14 = 113.04$ $113.04 \times 0.5 = 56.52 \text{ N}$ $320 - 56.52 = 263.48 \text{ N}$	[3]
Section C		40

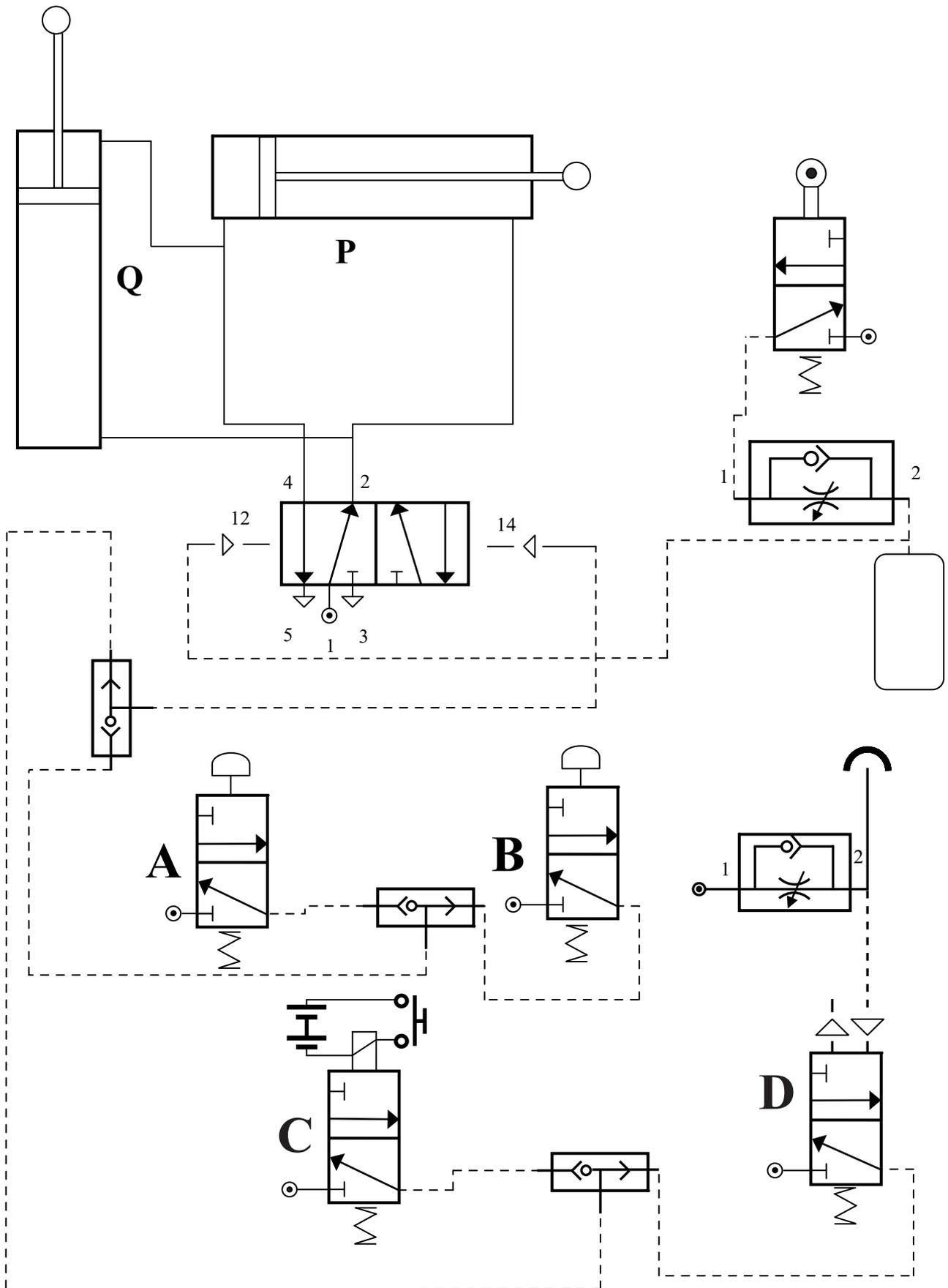
Section D

AVAILABLE
MARKS

- 13 (a) (i)** Any **two** from the following:
- Overall dimensions length, height and width
 - Stipulate material requirements
 - Acceptable tolerances
 - Surface finish
- [2]
- (ii)** Any **one** suitable material from the following:
- Thermoplastic elastomers
 - Polythene
- Any **two** main reasons from the following:
- Can be injection moulded
 - Good heat insulator
 - Stiff and tough and available in a range of colours
- [3]
- (iii)** Any **two** from the following:
- Domestic use not commercial use
 - Restricted to predetermined slice sizes
 - Restricted by 13 amp plug for electrical supply.
- [2]
- (iv)** Any **two** from the following:
- Rounded profile for corners
 - Insulated body – heat and electrical
 - Plug covering to prevent accidents.
- [2]
- (v)** Any **two** from the following:
- Form or shape can arrive out of the function of the product or be dictated by manufacturing processes
 - The toaster shown is a simple geometrical three-dimensional box shape with a function to heat a slice of bread. This function may well have influenced the shape
 - Costs and the availability to produce large numbers by injection moulding may have contributed.
- [2]
- Quality of written communication [1]
- (b) (i)** An appropriate design of a pictogram for the side of the toaster to remind the user to switch off the appliance at the wall socket after use (**Fig. 13(c)**).

Level of response not worthy of credit	[0]
A vague sketch lacking detail and appropriate annotation. Difficulty in deciding 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]–[3]
Detailed annotated sketch representing an appropriate improvement to the overall design.	[4]

[4]



- (ii) A low cost ergonomically designed utensil which minimises the use of materials while assisting the user to lift the warm toast out of the toaster (**Fig. 13(d)**).

Level of response not worthy of credit	[0]
A vague sketch lacking detail and appropriate annotation. Difficulty in deciding if the idea is appropriate and represents improvements. Little or no reference is made to cost and how ergonomics has been considered.	[1]
Both the sketch and annotation are limited. The idea represents an improvement but lacks the finesse appropriate for the product. Some reference is made to cost and how ergonomics has been considered.	[2]–[3]
Detailed annotated sketch representing an appropriate improvement to the overall design. Other appropriate reference is made to cost and how ergonomics has been considered.	[4]

[4]

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- 14 (a) (i)** Annotated sketch showing container/vessel producing steam, framed housing showing a jigs/template for the required profile or shape. Finally a clamping mechanism to ensure the material forms into the required profile. [3]
- (ii)** Any **two** from the following:
- Available in a range of colours and sizes
 - Relative low cost and easily applied
 - Durable and suitable for outdoor conditions. [2]
- (iii)** Any **two** from the following:
- Forms the basis of Health and Safety law
 - Employers have a duty to ensure so far as it is possible that employees and other visitors are protected at work
 - Employers are required to keep everyone involved informed of health and safety issues. [2]
- (b)** Any **two** from the following:
- Mainly carried out with a group of people
 - No restrictions placed on the designs outcomes – just ideas which come into your head
 - Limited to a set time [2]
- Quality of written communication [1]
- (c)** Any **two** from the following:
- High resistance to impact
 - Very good strength to weight ratio
 - Good resistance to abrasion [2]

(d) (i)	Level of response not worthy of credit	[0]	[4]
	A vague sketch lacking detail and appropriate annotation. Difficulty in deciding 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]–[3]	
	Detailed annotated sketch representing an appropriate improvement to the overall design.	[4]	

(ii)	Level of response not worthy of credit	[0]	[4]
	A vague sketch lacking detail and appropriate annotation. Difficulty in deciding 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]–[3]	
	Detailed annotated sketch representing an appropriate improvement to the overall design.	[4]	

Section D**Total****AVAILABLE
MARKS**

20

40**80**