Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2017

Technology and Design

Assessment Unit AS 1

assessing

Product Design and Systems and Control

[AV111]

MONDAY 22 MAY, 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 **(i)** The term common form and sizes of materials refers to the common form in which the material is widely available (e.g. metal sheet, plate, bar, etc.) [1] and sizes refers to the standard stock size that the material is manufactured in. [1] [2]

(ii) **Two** main properties of MDF for example:
- MDF is fairly strong.
- MDF is durable.
- MDF can be fire resistant. [2]

One main working characteristic of MDF for example:
- MDF can be easily drilled, cut and shaped.
- MDF allows for paint to be applied without the need for an undercoat or primer. [1] 5

2 **(i)** **Two** main reasons why polystyrene is used for fast food packaging for example:
- Good heat insulation properties.
- Lightweight.
- Hygienic with food. [2]

(ii) **Two** main reasons why ABS is used for children's toys for example:
- Bright shiny colours can be achieved in ABS.
- ABS has good resistance to scratching.
- ABS is a non-toxic material. [2] 4

3 **(i)** A composite is made up of two or more different materials combined by bonding [1] and an alloy is formed by mixing two or more metals [1]. [2]

(ii) **One** main characteristic associated with light-emitting polymers for example:
- Converts electrical energy into visible light.
- By engineering the chemical structure of the LEP all emission colours can be obtained.

One specific application for example:
- Thin and lightweight displays for portable electronics. [2] 4

4 **(i)** **Two** main reasons why the vacuum forming process may be used for example:
- It is an efficient process.
- Vacuum forming produces shapes with good definition.
- Low cost when produced in large numbers. [2]

(ii) Vacuum forming – Annotated sketch showing sheet clamped, sheet heated, mould and vacuum [2]

Description [2] 6
Sheet clamped and heated [1]
Plastic forms around mould and vacuum created [1]

			AVAILABLE MARKS
5	(i)	CIM could be used effectively for stock control of the pots by recording stock levels and providing feedback when levels are too low or too high which will help guide production. [1] In addition this information can be used for forward ordering of materials or distribution of stock. [1] [2]	
	(ii)	**Two** main characteristics associated with the Trade Descriptions Act for example: • Ensure that the consumer is informed of the country of origin. • If a company or person sells a product that does not perform as advertised then that company or person can be held liable. • Protects the consumer by making it an offence for a trader to wrongly describe goods or services. [2]	4
6	(i)	Rolling is a process where a pair of metal rolls, which are rotating in the opposite direction to one another [1], allow a piece of metal to be reduced in cross-sectional area or shaped through deformation. [1] [2]	
	(ii)	The process of welding involves permanently joining metals by the use of heat, causing the two main pieces of metal to become molten [1] and using a joining material to mix them before they solidify. [1] [2]	
	(iii)	**Two** main reasons for inspecting the play park climbing frames and slides before installation would be for example: • Ensure consistency of the materials. • Ensuring that the manufacture is to the required standard. • To avoid bad publicity. [2]	6
7	(i)	**Two** main specific properties of mild steel which would make it suitable for the play park climbing frame for example: • Good strength to weight ratio. • Can be processed into relatively complex shapes. • Tough material. [2]	
	(ii)	The process of plastic coating involves degreasing the metal, heating it before fluidisation. [1] The metal object is submerged into the powder for a few seconds, before being removed [1] and returned to the oven to allow the plastic coat to fuse. [1] [3]	5
8	(i)	**One** main social change and the influence this has had on the design of the product, e.g. Mobile phone – The social change has resulted in the way we communicate with the introduction of the mobile phone. [1] The mobile phone has changed dramatically in shape, style, size and range of functions to meet the demands of all the users. [1] [2]	
	(ii)	Specific product explanation of any one of the 3R's influence on the design, e.g. Reduce – Breakfast cereal [1] manufacturers have reduced their packaging by designing it based on the level of protection needed. [1] Reuse – The reuse of glass bottles [1] often requires them to be designed to be more robust for repeated use. [1] Recycle – Use of polystyrene cups [1] can be used for the design of a pencil. [1] [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
6
40

Section B

AVAILABLE MARKS

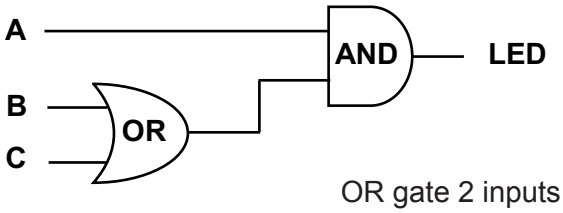
9 **(a)** **(i)** Single pole single throw. [1]

(ii)

A	B	C	LED
1	0	1	1
1	1	0	1
1	1	1	1

3 rows correct [3]

(iii)

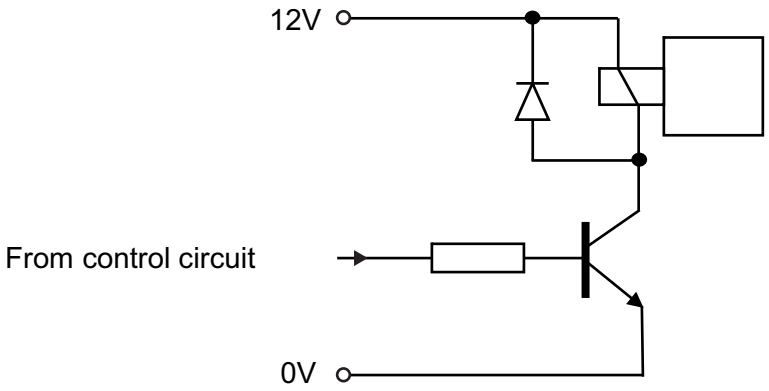


OR gate 2 inputs [1]
AND gate 1 input [1]
connections [1] [3]

(iv) R = 6 – 1.8/0.030 [1] = 140 ohms [1] [2]

(v) P = 4.2 × 0.030 = 0.126 W [1] – select 0.25W [1] [2]

(b) **(i)**



12V connection to solenoid [1]
Resistor and transistor connection to [1]
Addition of flywheel diode [1] [3]

(ii) Sample answer

- The advantage is that the coil consumes power only momentarily while the relay is being switched. [1]
- A latching relay has a magnetic core that retains the contacts in the operated position by the remanent magnetism in the core [1]. This type requires a current pulse of opposite polarity to release the contacts [1]. [2]

Quality of written communication [1]

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

(iii) Any **two** advantages for example:
Thyristors, unlike relays, have no moving parts or mechanical contacts and are likely to be more reliable in the longer term.
Thyristors are usually smaller than relays therefore making them more space efficient on circuit boards. [2]

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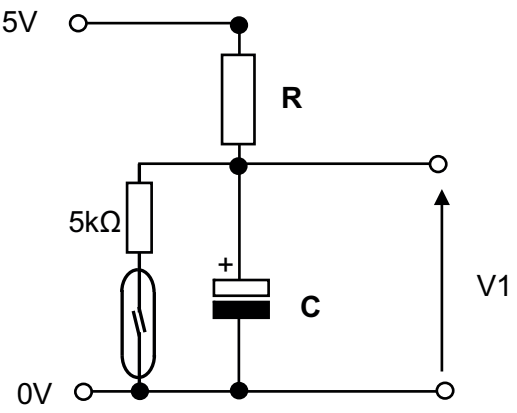
AVAILABLE MARKS

10 **(a)** **(i)** V1 will drop to zero volts. [1]

(ii) C = 3/10 000 = 300 μF. [2]

(iii)



[1] for resistor position, [1] for resistor value [2]

(b) **(i)** Minimum position = 0 ohms therefore V2 = 0 volts. [1]

(ii) V2 = 5 × 20/30 = 3.33 volts. [2]

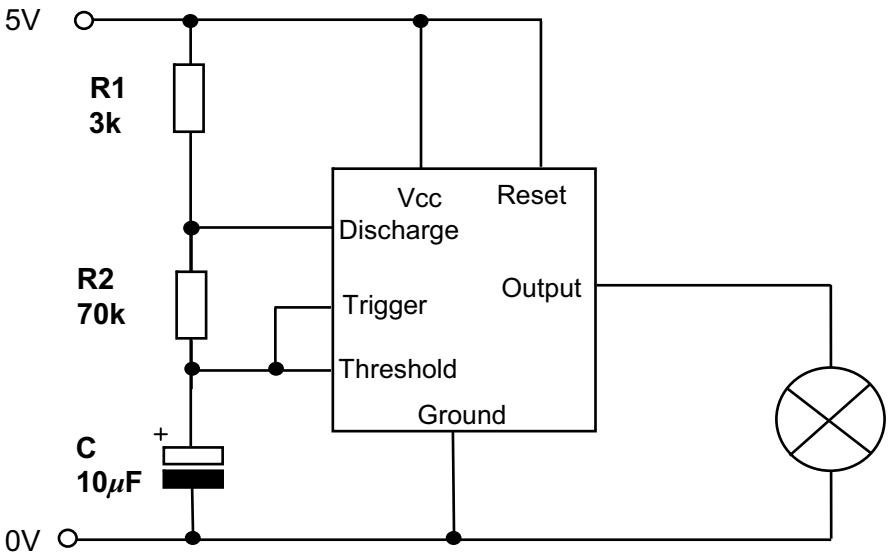
(iii) When the reed switch is closed the voltage V1 will be zero and V2 will be fixed at 3 volts therefore the output voltage will be negative with respect to zero. [1] When the reed switch is opened the voltage V1 will start to increase from zero volts [1]. After a time delay V1 will exceed V2 and the output voltage will be positive. [1] [3]

Quality of written communication [1]

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

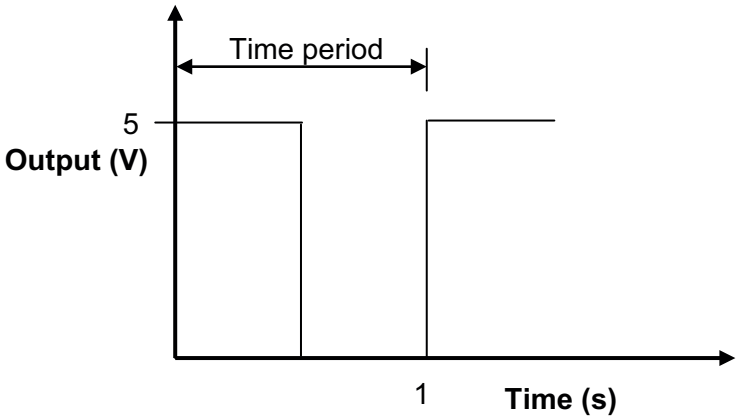
(c) **(i)** $C = \frac{1.44}{(R1 + 2R2)C} = \frac{1.44}{(3\,k + 140\,k)} = 10\mu F.$ [2]

(ii)



[3] for correct connection of components [3]

(iii)



Labelled axes [1]
Graph [1]
Time period [1]

[3]

AVAILABLE MARKS
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Section B | **40**

Section C

AVAILABLE MARKS

11 (a) Efficiency = MA/VR × 100%
95 =?/4 × 100 [1]
95 = 3.8/4 × 100 [1]
MA = L/E
3.8 = 190/? [1]
3.8 = 190/50
Ans = 50N [1]

(b) (i) Keys and keyways provide a more secure fixing method than a grub screw [1]. Grub screws are used when relatively small forces are involved. [1] [2]

Quality of written communication [1]

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

(ii) VR A–B = 28/56 = 0.5 [1]
C–D = 96/48 = 2 [1]
E–F = 48/24 = 2 [1]
Total VR A–F = 0.5 × 2 × 2 = 2
Ans = 2 [1]

(iii) VR required (VR= IS/OS) = 60/5=12 [1]
VR I–K = 50/25 = 2 [1]
VR needs to be 6 (12/2 = 6) [1]
VR = 60/10 Ans = 10 [1]

(c) A sample answer could include the following:

Parts A and B could have racks attached which are operated by a single pinion wheel. As the pinion wheel turns it could mesh with both racks raising one and lowering the other at the same time. Shaft Z could provide the rotary motion for the pinion wheel to operate via a pulley/gear system.

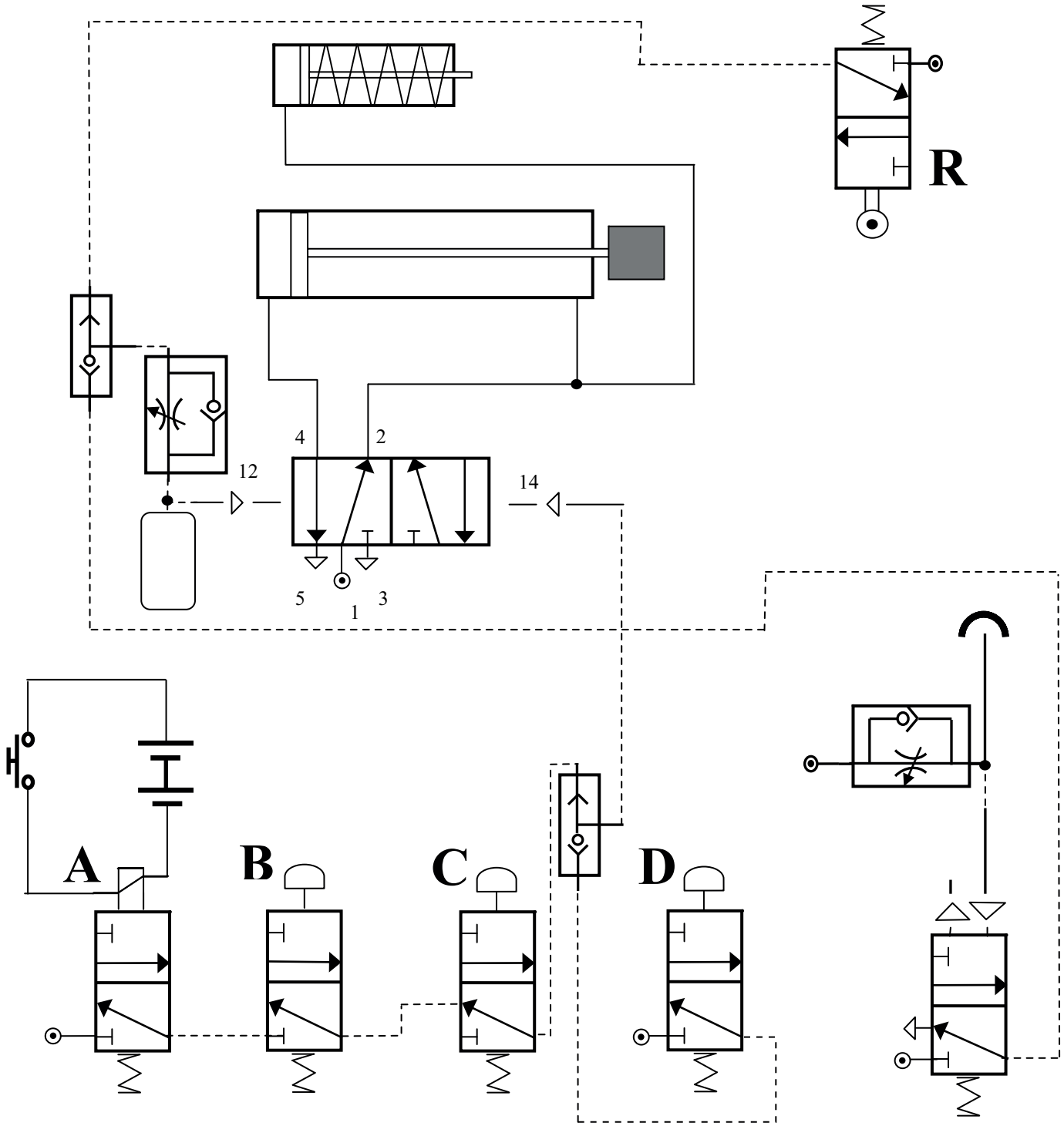
Alternatively, answers involving cam and followers or crank and sliders could be used.

Other suitable answers could be used which perform the desired function.
A and B move in opposite directions [1]
Method of connecting motion from shaft Z to solution [3]
Annotation [1] 20

			AVAILABLE MARKS
12	**(a)**	The activation method at **L** – signal air. [1]	
	(b)	Low air pressure is being supplied through the flow control valve and takes the easy route passing out through the air bleed end into the outside air. [1]	
		Once the air bleed end is blocked the air has to go to the low pressure air activation end on the three port valve. [1]	
		Quality of written communication [1]	

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

	(c)	Tee connector connected at exhaust air-line leading to five port valve and piping [1]	
		Integration of single acting cylinder [1]	
	(d)	Activation of A [1] And function [1] Not function [1] Or function [1]	
		Connection to 5PV [1] See sample solution Or other suitable solution	
	(e)	Arrangement of valve **R** [1] 'Or' – integration with air bleed. [1] Integration of time delay to the 5PV [2] Arrangement of airbleed [1] See sample solution Or other suitable solution	
	(f)	$F = P \times A$ SAC $3.14 \times 30 \times 30 = 2826\,mm^2$ $2826 \times 0.5 = 1413$ N [1]	
		DAC $3.14 \times 40 \times 40 = 5024\,mm^2$ $3.14 \times 4 \times 4 = 50.24\,mm^2$ [1] $5024 – 50.24 = 4973.76\,mm^2$ $4973.58 \times 0.5 = 2486.88$N [1]	
		Difference is $2486.88 – 1413 = 1073.88$ N [1]	20
		Section C	**40**



Answer Fig. 12

AVAILABLE MARKS

Section D

Product Design

13 (a) (i) Any **one** main aspect in support of the view that this a low cost product for example:
- Use of standard components.
- Use of common form and sizes of materials. [1]

(ii) Any **two** specific performance criteria that a designer would need to include in a specification for example:
- To support the weight of the user.
- Must perform its function in outdoor environments.
- Must be capable of being folded and unfolded a large number of times. [2]

(iii) Any **two** main criteria that would influence the selection of the material to be used for the legs for example:
- A material with good strength to weight ratio.
- Suitability for outdoor environments.
- Cost of material. [2]

(b) Formative evaluation takes place during the design of the product and has a strong influence on the development of the product. [1] Summative evaluation is a review that takes place following the completion of the product. [1] [2]

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

Quality of written communication [1]

(c) (i) Any **two** main properties of GRP which make it suitable for the centre support bracket for example:
- Very good strength to weight ratio.
- Good resistance to corrosion.
- It can be moulded into a range of complex shapes. [2]

(ii) A hologram is a flat surface that, under proper illumination appears to contain a three dimensional image. [1]

A main reason why the company may want to use this modern material is that it may well serve as a selling point for the product. [1] [2]

AVAILABLE MARKS

(d) **(i)** A design to enable the user to quickly extend the length of each of the legs – this could be based on a ball and spring mechanism used on a crutch.

Level of response not worthy of credit.	[0]
Poor sketches with little or no annotation. Difficulties in determining if the design is appropriate for the camping stool.	[1]
Annotated sketches are limited. The design allows the user to extend the length of each of the supports of the camping stool.	[2] or [3]
Detailed annotated sketches. The design is suitable and allows the user to quickly extend the length of each of the supports of the camping stool.	[4]

[4]

(ii) A bar chart to represent the information on each of the three camping stools.

Maximum loading [1]
Frame type [1]
Seat fabric colours [1]
Maximum vertical height [1] [4]

20

AVAILABLE MARKS

14 **(a)** The purpose of a design brief is to put the problem in context and indicate the requirements. [1]

(b) **(i)** Any **two** main characteristics associated with thought showers for example:
- No criticism of any idea is allowed.
- All ideas are welcome no matter how bizarre.
- The emphasis is to produce a large number of ideas. [2]

(ii) Any **two** main specific characteristics associated with a patent for example:
- A monopoly allowing you to exclude others from making, using, selling or importing your invention for 20 years.
- Must have an inventive step that is not obvious to someone with knowledge and experience in the subject.
- Protects the technical and functional aspects of the product.

Any **one** main reason why it would be beneficial for the company to have a patent for example:
- It would prevent other companies laying claim to their design.
- The company could license the patent and receive revenue. [3]

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

Quality of written communication [1]

(c) **(i)** Any **two** main characteristics associated with solid white board which make it suitable for packaging for example:
- Cost effective.
- Suitable for printing on.
- Can be folded or creased to create desired profile. [2]

(ii) The process of die cutting.

Suitable sketch of die cutting process to include the card in position, die/sharp knife. [2]
Description of the process to include clamping the material before the knife presses down and cuts through. [1] [3]

AVAILABLE MARKS

(d) (i) A solution could be based on an injection moulded lipped bracket to house the mobile phone. The bracket would have a slot on the base for the charger connection and may slot into one of the three adapters.

Level of response not worthy of credit.	[0]
A vague sketch lacking detail and appropriate annotation. Difficulty in determining if the design is appropriate, if a mobile phone can be securely held or if the design can be attached to the three way adapter.	[1]
Both the sketch and annotation are limited. Some aspects of the design are appropriate, a mobile phone can be held and the design has a form of attachment to the three way adapter.	[2] or [3]
Detailed annotated sketch. The design is appropriate, a mobile phone can be securely held and the design can be attached to the three way adapter.	[4]

[4]

(ii) A solution could be based on an ergonomically shaped ring to allow people to insert two/three fingers and grip the cover to assist removal.

Level of response not worthy of credit.	[0]
A vague sketch lacking detail and appropriate annotation. Difficulty in determining if the design is appropriate and would enable people with limited finger mobility to remove the safety plug cover. Little or no explanation on how the design would be suitable for people with limited finger mobility.	[1]
Both the sketch and annotation are limited. Some aspects of the design are appropriate and would enable people with limited finger mobility to remove the safety plug cover. Limited explanation on how the design would be suitable for people with limited finger mobility.	[2] or [3]
Detailed annotated sketch. The design is appropriate and would enable people with limited finger mobility to remove the safety plug cover. Appropriate explanation on how the design would be suitable for people with limited finger mobility.	[4]

[4] 20

Section D **40**

Total **80**