Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2024

Technology and Design

Assessment Unit AS 1

assessing

Systems and Control or Product Design

[STE12]

MONDAY 13 MAY, AFTERNOON

MARK SCHEME

General Marking Instructions

Introduction

The main purpose of the mark scheme is to ensure that examinations are marked accurately, consistently and fairly. The mark scheme provides examiners with an indication of the nature and range of candidates' responses likely to be worthy of credit. It also sets out the criteria which they should apply in allocating marks to candidates' responses.

Assessment objectives
Below are the assessment objectives for GCE Technology and Design.

Candidates should be able to:

AO1 Demonstrate specific knowledge and understanding, be able to apply that knowledge and understanding in combination with appropriate skills in their designing, communicate ideas and outcomes, and demonstrate strategies for evaluation.

AO2 Apply skills, knowledge and understanding of relevant materials to produce suitable and appropriate outcomes; communicate ideas and outcomes, and demonstrate strategies for evaluation.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality of response reflecting the level of maturity which may reasonably be expected of a 17- or 18-year-old which is the age at which the majority of candidates sit their GCE examinations.

Flexibility in marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses 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.

Positive marking
Examiners are encouraged to be positive in their marking, giving appropriate credit for what candidates know, understand and can do 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 of a 17- or 18-year-old GCE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Marking Calculations
In marking answers involving calculations, examiners should apply the 'own figure rule' so that candidates are not penalised more than once for a computational error. To avoid a candidate being penalised, marks can be awarded where correct conclusions or inferences are made from their incorrect calculations.

Types of mark schemes
Mark schemes for tasks or questions which require 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.

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.

Levels of response
In deciding which level of response to award, examiners should look for the 'best fit' bearing in mind that weakness in one area may be compensated for by strength in another. In deciding which mark within a particular level to award to 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.

Section A

Electronic and Microelectronic Control Systems

Answer **both** questions in this section.

AVAILABLE MARKS

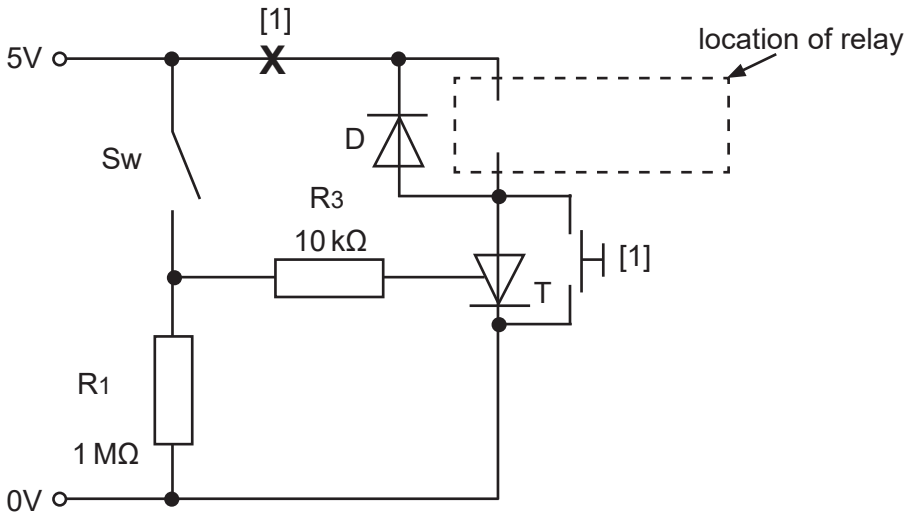
1 (a) (i) Micro switch actuators [1] are sensitive to small physical movements [1]

All relevant, valid responses will be given credit. [2]

(ii) When a sufficient current is applied to the gate terminal, [1] it triggers the thyristor into a conducting state with current flowing from anode to cathode [1] and will continue to do so, even when the gate signal is removed. [1] [3]

All relevant, valid responses will be given credit.

(iii) Sample answer.



Source: CCEA

All relevant, valid responses will be given credit. [2]

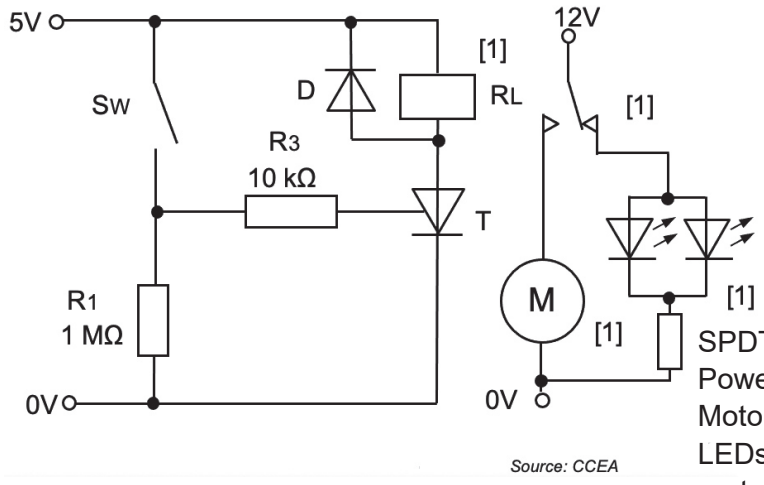
(iv) When current stops flowing in the relay coil the diode will short circuit [1] any back emf induced by the collapsing electromagnetic field. [1]

All relevant, valid responses will be given credit. [2]

(b) (i) P = 12 × 0.35 [1]
= 4.2 W [1] [2]

(ii) $R = \frac{(12 \square 2.5)}{(2 \times 0.022)}$ [2]
= 216 Ω [1] [3]

(c) (i)



Source: CCEA

SPDT relay [1]
Power supply [1]
Motor connected [1]
LEDs connected with protective resistor [1]

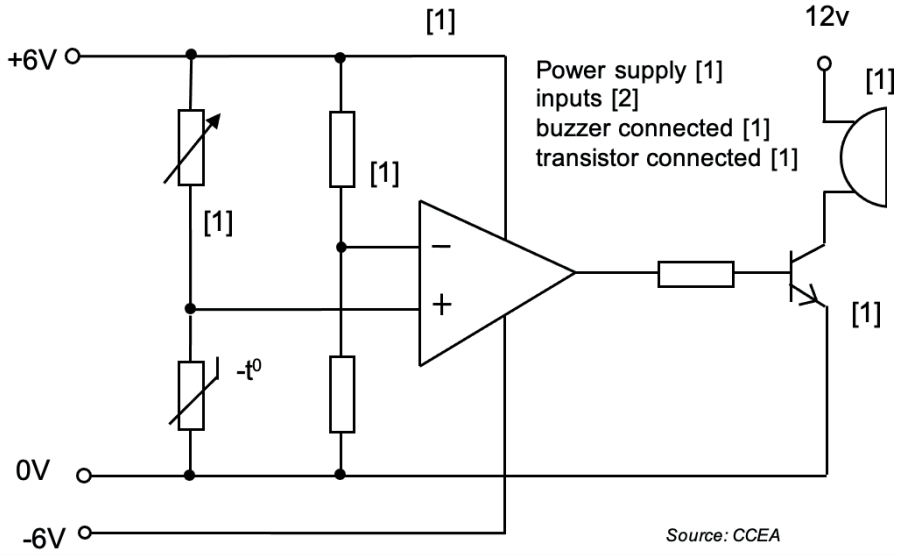
All relevant, valid responses will be given credit. [4]

(ii) Power supply to the circuit should be turned off [1] to prevent the risk of electrical shock when touching or moving components [1]

All relevant, valid responses will be given credit. [2]

20

AVAILABLE MARKS

				AVAILABLE MARKS
2	(a)	(i)	The output voltage Vo can be adjusted [1] to a specific value for a given temperature which may be useful in setting a 'threshold' value. [1]	
			All relevant, valid responses will be given credit. [2]	
		(ii)	At 15 °C Rth = 4KΩ [1]	
			$2.5 = 6 \times \left(\frac{4}{4} + Rv\right)$ [1]	
			Rv = 9.6 – 4	
			= 5.6 kΩ [1]	
			All relevant, valid responses will be given credit. [3]	
		(iii)	The output voltage Vo will increase [1] as the temperature increases. [1]	
			All relevant, valid responses will be given credit. [2]	
	(b)	(i)	Comparators have a high gain [1] enabling small voltage changes at one input to be detected. [1]	
			All relevant, valid responses will be given credit. [2]	
		(ii)		
			All relevant, valid responses will be given credit. [5]	
	(c)	(i)	On/off [1] The system has two output states [1] determined by the timer where the buzzer is either sounding or not sounding. [1]	
			All relevant, valid responses will be given credit. [3]	
		(ii)	$2 = \frac{1.44}{(18k \square 54k)} \times C$ [1]	
			$0.72 = (72k) \times C$ [1]	
			$C = \frac{0.72}{72k}$ [1]	
			Answer = 10 μF [3]	20
			Section A	**40**

Section B

Mechanical and Pneumatic Control Systems

AVAILABLE MARKS

3 **(a)** Pear shaped cam
(1 × [1]) [1]

(b) Parallel motion linkage or parallel linkage.
(1 × [1]) [1]

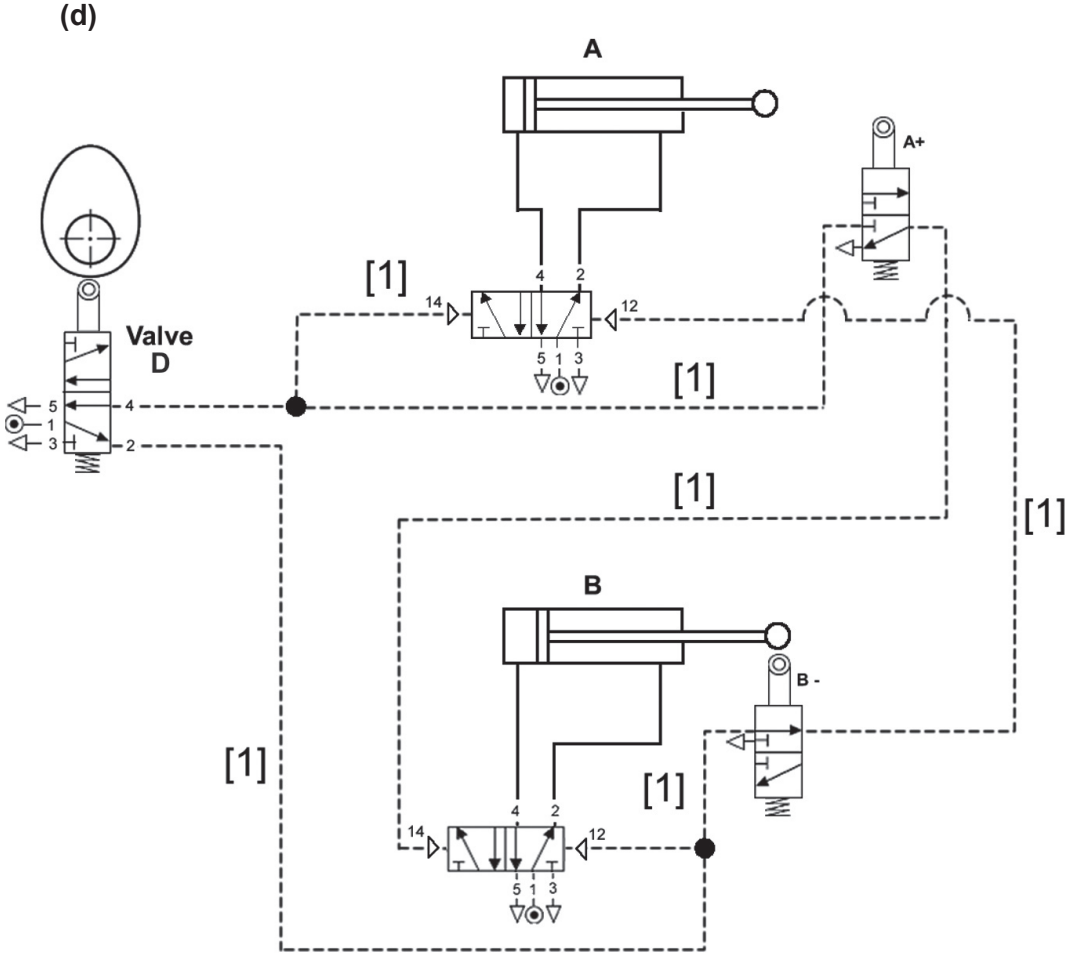
(c) **Filtration** to remove water, solid particles and oil [1] by using mechanical filters [1]

Pressure Regulation is installed to maintain a constant pressure [1] so that the system runs at maximum efficiency [1]

Lubrication the moving parts of the system are lubricated by spraying a fine mist of oil into the clean air [1] to maintain and protect the moving parts in the system [1]

All relevant, valid responses will be given credit. [6]

(d)



All relevant, valid responses will be given credit. [6]

(e)

driven driver	$\frac{75}{1}$	×	$\frac{300}{75}$	×	$\frac{300}{150}$	×	$\frac{400}{200}$		
	75	×	4	×	2	×	2	=	VR 1200
	[1]		[1]		[1]		[1]		[1]

(5 × [1]) [5]

(f) $\frac{3000}{1200}$ = 2.5 RPM

(1 × [1]) [1]

AVAILABLE MARKS

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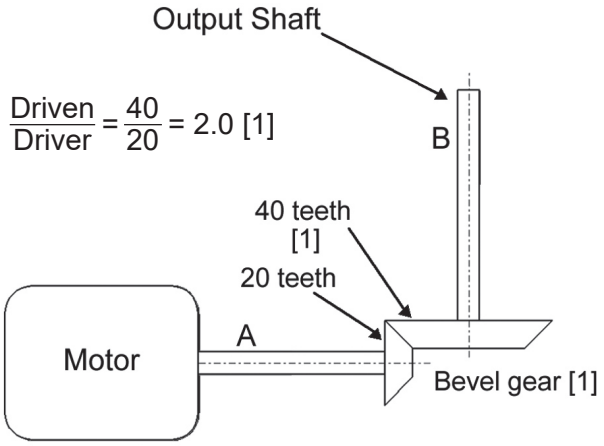
4 **(a)** **(i)** 3.14 × 20 × 20 [1] = 1256 mm^2 [1]
1256 × 0.2 [1] = 251.2 N [1]
(4 × [1]) [4]

(ii) Third class lever
(1 × [1]) [1]

(iii) Area D = 19 × 19 × 3.14 = 1133.54 mm^2 [1]
Area d = 3.14 × 5 × 5 = 78.5 mm^2 [1]
D area – d area = 1055.04 mm^2 [1]
1055.04 × 0.2 = 211 N [1]
(4 × [1]) [4]

(iv) $\frac{100\text{ mm}}{250\text{ mm}}$ = MA 0.4
(1 × [1]) [1]

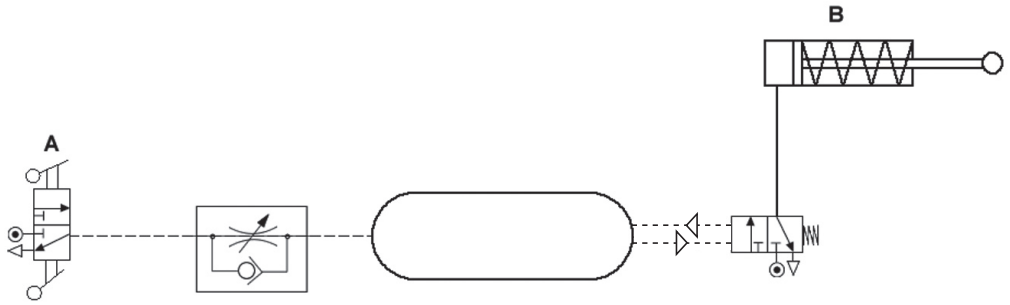
(b)



Sketch of bevel gear [1]
appropriate ratio of teeth on the gears [1]
appropriate annotation [1]
(3 × [1]) [3]

All relevant, valid responses will be given credit.

(c)



Unidirectional flow restrictor in appropriate position. [1]
Reservoir in appropriate position. [1]
Piping in appropriate position. [1]
(3 × [1]) [3]

All relevant, valid responses will be given credit.

(d) Any **one** safety consideration when working with pneumatic and mechanical systems for example:

Pneumatics

- Always turn air off before altering the circuit,[1] piping can whip and cause injury. [1]
- Don't turn the main air supply on until the circuit is connected up, [1] check connections are tight before supplying pressurised air. [1]

(2 × [1]) [2]

Mechanical

- Operate equipment only when guards are in place [1] and properly adjusted and moving parts have been enclosed. [1]

- Do not wear loose clothing, jewellery, or long hair around machines,[1] as these increase the risk of being caught in the machinery. [1]

(2 × [1]) [2]

All relevant, valid responses will be given credit.

Section B

AVAILABLE MARKS
20
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Section C

Product Design

AVAILABLE MARKS

5 **(a)** A survey is when people are asked a question or series of questions [1] in order to gather information or data about what most people think about a product. [1] [2]

All relevant, valid responses will be given credit.

(b) **(i)** Any **two** characteristics associated with British Standards for example:

- A standard which allows companies to ensure their products meet a recognised standard in safety and therefore ensure fitness for purpose.
- Companies which meet the standards are awarded the BSI Kitemark for use on its products.
- It is an independent organisation which is not government or industry owned so that it can be impartial and fair.

(2 × [1]) [2]

All relevant, valid responses will be given credit.

(ii) Employee safety is concerned with the safety of all personnel in the company but mainly during the manufacturing stage of a product. [1] In comparison, consumer safety is concerned that the product is safe for the person to use under normal conditions. [1] [2]

All relevant, valid responses will be given credit.

(c) Any **two** specific characteristics associated with a flow process chart for example:

- The order of assembly of the parts or components will be set out.
- All the tools, equipment and processes required will be listed.
- Quality control checks will be specified.

(2 × [1]) [2]

All relevant, valid responses will be given credit.

(d) Any **two** specific characteristics associated with QRM for example:

- QRM focuses on the entire business, from purchasing through to product delivery.
- QRM focuses on the relentless pursuit of reducing lead times.
- By using QRM, a company can reduce customer waiting time.

(2 × [1]) [2]

All relevant, valid responses will be given credit.

(e) Laminating involves building up the curved portion of the guitar with veneer layers. [1] The layers are glued and sandwiched between the faces of a jig (profile of the guitar) using cramp pressure. [1] [2]

All relevant, valid responses will be given credit.

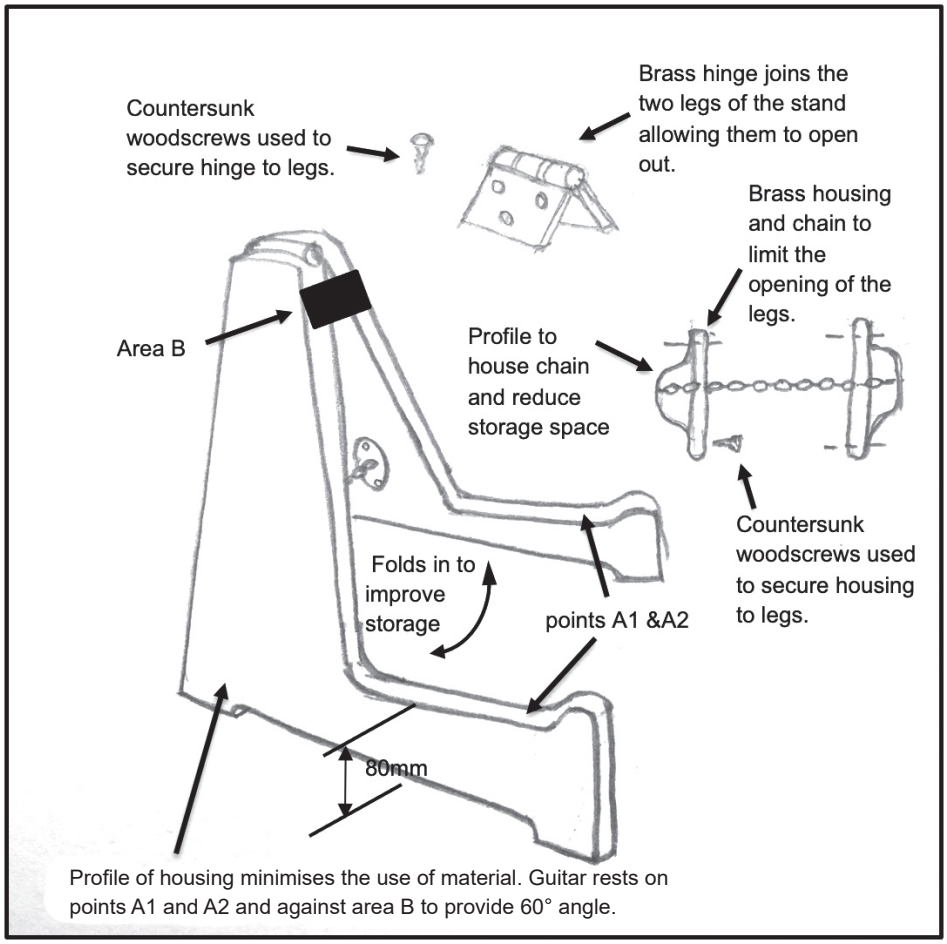
(f) Formative evaluation is ongoing and occurs every time a decision or judgement is made regarding your work.[1] Summative evaluation occurs at the end of the project. It specifically judges how well the final manufactured product meets the specification. [1] [2]

All relevant, valid responses will be given credit.

AVAILABLE MARKS

(g) Sample answer.

AVAILABLE MARKS



Description	Marks awarded
Excellent detailed annotated sketches of a compact design for a stand which will hold the guitar at approximately 80 mm at 60°. The design can be quickly and easily folded and unfolded for use and minimises the use of materials and storage space.	[5]–[6]
Good, annotated sketches of a compact design for a stand. The design represents a possible solution, but it may be limited in terms of its appropriateness to hold the guitar at 80 mm at 60°. It may also be limited in its ability to be quickly and easily folded and unfolded for use and if it minimises the use of materials and storage space.	[3]–[4]
Basic sketches and annotation of a design for a stand. Difficulties in determining if the design of the stand is compact and could hold the guitar at 80 mm at 60°. Difficulties in determining if the design could be quickly and easily folded and unfolded for use and if it minimises the use of materials and storage space.	[1]–[2]
Level of response not worthy of credit	[0]

All relevant, valid responses will be given credit. [6]

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AVAILABLE MARKS

6 **(a)** Continuous improvement is a company culture that encourages all employees to look for ways to enhance the business's operations. [1] This includes suggesting ideas to improve efficiencies, evaluating current processes and finding opportunities to cut unproductive work. [1] [2]

Any **one** reason why the company would want to adopt this approach for example:

- Reducing the company's costs. [1]
- Can help to improve the company's productivity. [1] [1]

All relevant, valid responses will be given credit.

(b) Attribute analysis could be used to help generate ideas for the garden vacuum by taking key elements of the product for example, method of power, vacuum tube shape and size, bag storage, materials, colours and type of finish, etc. [1] Identify a range of options for the key elements and combine each element to create new ideas. [1] [2]

All relevant, valid responses will be given credit.

(c) A work order outlines a sequence of actions which must be followed [1] to complete a job or task satisfactorily in a specific time frame. [1] [2]

All relevant, valid responses will be given credit.

(d) **(i)** Any **two** main properties associated with carbon fibre reinforced plastic (CFRP) for example:

- Excellent strength-to-weight ratio for the vacuum tube.
- Excellent rigidity given the design of the vacuum tube.
- Good corrosion resistance making it suitable for a range of environments.

(2 × [1]) [2]

All relevant, valid responses will be given credit.

(ii) Any **one** reason why (CFRP) may be considered as an unsuitable material for the vacuum tube, for example:

- High cost may make it unsuitable for the product.
- Difficulty of disposing this material at the end of its life span. [1]

All relevant, valid responses will be given credit.

(e) An annotated sketch of the water jet cutting process to include high pressure water supply, nozzle with narrow kerf width, abrasive powder or grit and material.

AVAILABLE MARKS

Description	Marks awarded
The annotated sketch is excellent and covers the main elements of the water jet cutting process.	[4]
The annotated sketch is good and covers some of the main elements of the water jet process.	[2]–[3]
The annotation sketch is basic with only a few of the main elements of the water jet process.	[1]
Level of response not worthy of credit.	[0]

[4]

All relevant, valid responses will be given credit.

(f) Any **two** specific characteristics associated with a registered design for example:

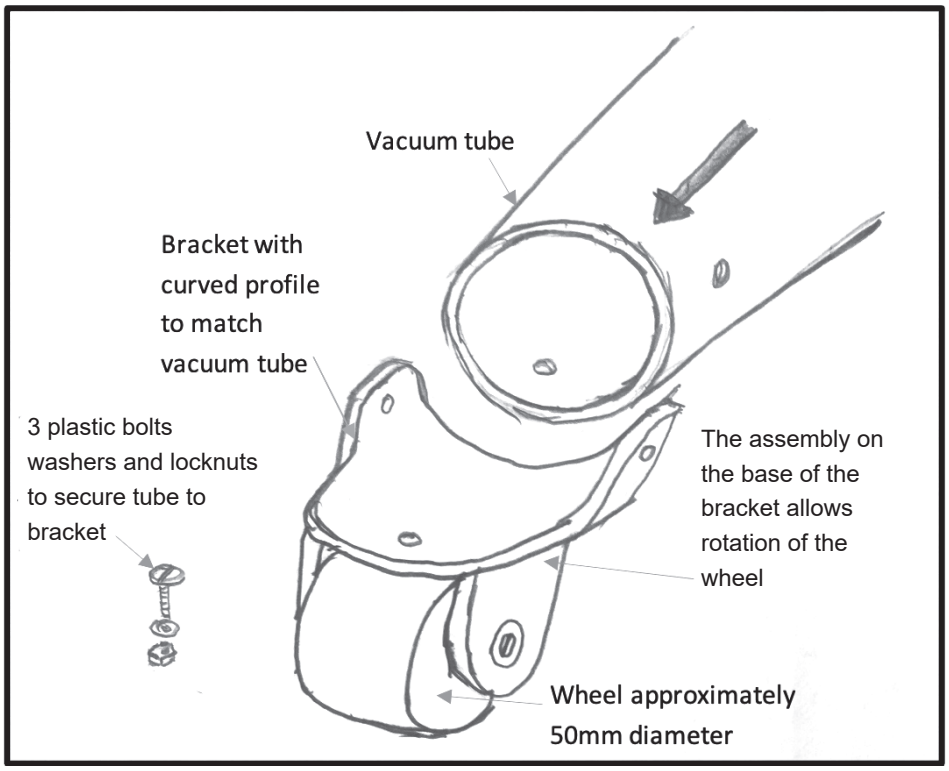
- Gives you the right to stop anyone copying or using your design in the UK.
- It is active for up to 25 years.
- Registered designs must have individual characteristics and it should not remind any informed person of an existing design.

(2 × [1]) [2]

All relevant, valid responses will be given credit.

(g) Sample Answer.

AVAILABLE MARKS



Description	Marks awarded
Excellent detailed annotated sketches of a design that can be attached to the bottom of the vacuum tube and will ensure that the tube will remain at least 50 mm off the ground during use whilst maintaining the manoeuvrability of the product.	[4]
Good, annotated sketches of a design. The design represents a possible solution, but it may be limited in terms of its appropriateness to be attached to the bottom of the vacuum tube. It may also be limited in its ability to ensure it remains at least 50 mm off the ground whilst maintaining the manoeuvrability of the product.	[2]–[3]
Basic sketches and annotation of a design. Difficulties in determining if the design could be attached to the bottom of the vacuum tube. Difficulties in determining if the design would remain at least 50 mm off the ground and if it would maintain the manoeuvrability of the product.	[1]
Level of response not worthy of credit	[0]

[4] 20

All relevant, valid responses will be given credit.

Section C **40**