

Sample Assessment Material (SAM)

...day ... Month Year – Morning/Afternoon

OCR Level 1/Level 2 Cambridge Nationals in Engineering Design

R038: Principles of engineering design

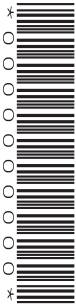
Time allowed: 1 hour 15 minutes

You must have:

- a ruler

You can use:

- a calculator



Write clearly in black ink. **Do not write in the barcodes.**

Centre number

--	--	--	--	--

Candidate number

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First name(s) _____

Last name _____

INSTRUCTIONS

- Use black ink.
- Write your answer to each question in the space provided. You can use extra paper if you need to, but you must clearly show your candidate number, the centre number and the question numbers.
- Answer **all** the questions.

INFORMATION

- The total mark for this paper is **70**.
- The marks for each question are shown in brackets [].
- Dimensions are in millimeters unless the question says something different.
- This document has **20** pages.

ADVICE

- Read each question carefully before you start your answer.

Section A

Put a tick (✓) in the box next to the **one** correct answer for each question.

- 1** On an engineering drawing what is represented by the line in **Fig. 1**?



Fig. 1

- (a) Centre line
(b) Hidden detail
(c) Leader line
(d) Projection

[1]

- 2** Which product would typically use 'one-off' as a scale of production?

- (a) Car
(b) Road bridge
(c) Shampoo bottle
(d) Smart phone

[1]

3 Which type of drawing is shown in **Fig. 2**?

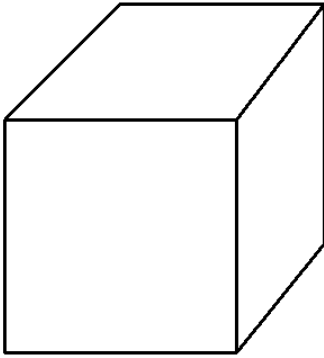


Fig. 2

- (a) Assembly
- (b) Isometric
- (c) Oblique
- (d) Orthographic

[1]

4 Which of these is an example of inclusive design?

- (a) Including a wind-up charger on a radio
- (b) Producing a computer-gaming chair in multiple colours
- (c) Providing a ramp for wheelchair access to a building
- (d) Putting a company logo on a remote control

[1]

5 Which of these statements best describe planned obsolescence?

- (a) A product created to last indefinitely
- (b) A product that can be repaired
- (c) A product that is created to last a limited time
- (d) A product that is recyclable

[1]

Turn over

- 6 On an engineering drawing which of the following mechanical features is shown in Fig. 3?

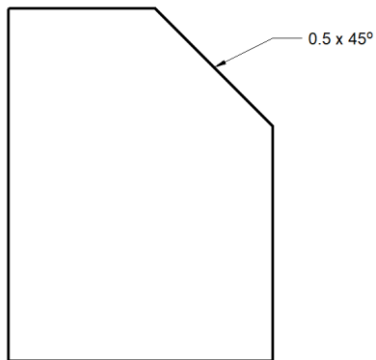


Fig. 3

- (a) Chamfer
(b) Countersink
(c) Hole
(d) Thread

[1]

- 7 Which of these modelling methods is typically used for electronic circuits?

- (a) Block
(b) Breadboarding
(c) Card
(d) 3D printing

[1]

8 What does the letter **M** mean in the product analysis tool ACCESS FM?

- (a) Materials
- (b) Mechanical
- (c) Modelling
- (d) Motor

[1]

9 Which **type** of manufacturing process involves removing material by machining to create a product?

- (a) Assembly
- (b) Finishing
- (c) Shaping
- (d) Wasting

[1]

10 A dimension is $10 \pm 0.2\text{mm}$. Which of these would be within tolerance?

- (a) 9.8mm
- (b) 10.3mm
- (c) 10.4mm
- (d) 9.5mm

[1]

Turn over

Section B

11 (a) A design brief sets out what is required by a user. State **two** types of information that may be included in a design brief.

1

2

[2]

(b) State **two** aesthetic factors that can influence a user's opinion of a product.

1

2

[2]

(c) State the meaning of 'market pull'.

.....

[1]

(d) Explain **one** way in which ergonomic design could improve the use of a computer mouse.

.....

[2]

(e) Fig. 4 shows the initial stages of a linear design process. Complete the flowchart by inserting the missing stages.

Missing stages:	Test prototype
	Production plan
	Generate ideas
	Research the problem

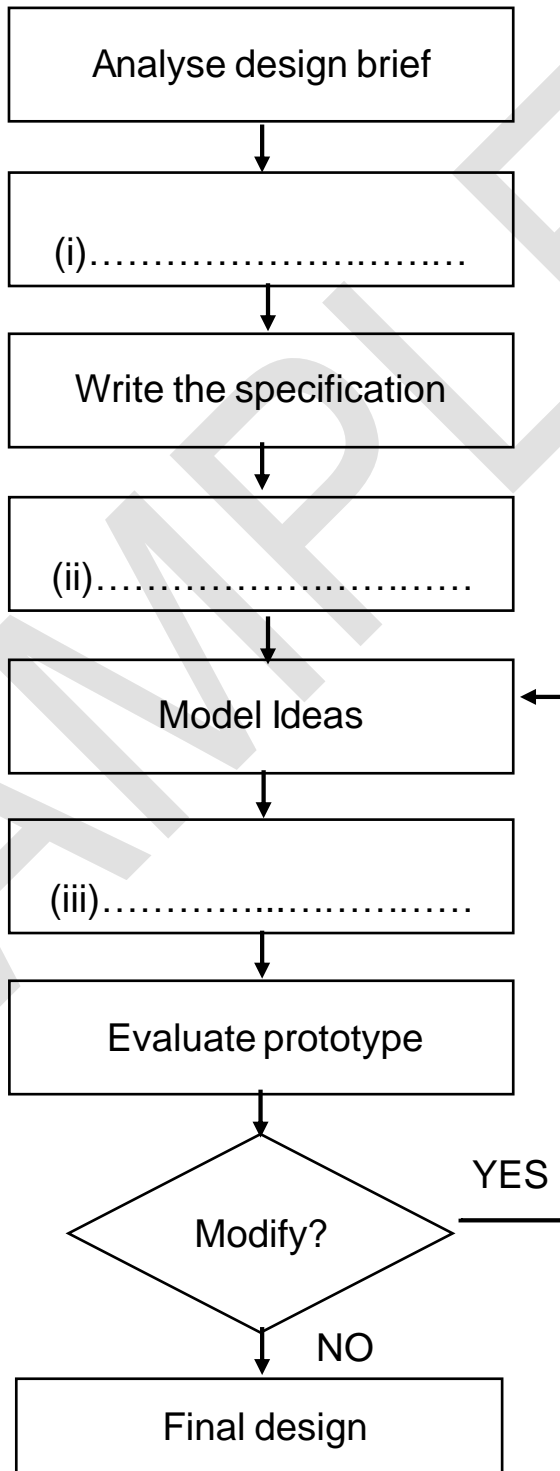


Fig. 4

[3]

- 12 (a) State what the symbol in **Fig. 5** represents in an orthographic drawing.

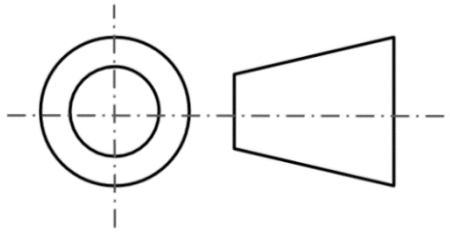


Fig. 5

.....
..... [1]

- (b) A component has a length of 150 mm. Complete the drawing in **Fig.6**, using standard conventions, placing the following items in the correct location:

- Leader lines
- Arrows
- Dimension



Fig. 6

[4]

- (c) A component has a drilled hole with a diameter of 30 mm. Show this on the drawing using standard conventions in **Fig. 7**.

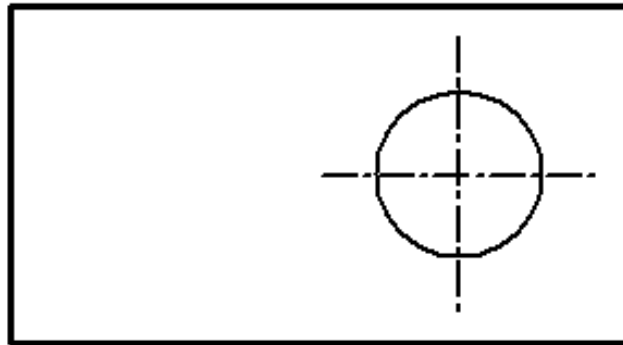


Fig. 7

[2]

- (d) State the name of each mechanical feature used in engineering drawings. Write your answer in **Table 1**.

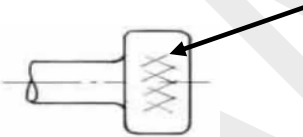
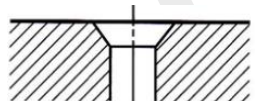
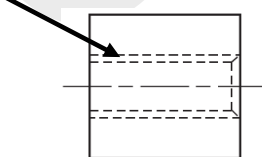
Mechanical feature	Name
(i) 	(i).....
(ii) 	(ii).....
(iii) 	(iii).....

Table 1

[3]

Turn over

- 13 **Fig. 8** shows a group of electric scooters (e-scooters). Many cities around the world provide rentable e-scooters to decrease traffic pollution. The e-scooters are made from a variety of metals and plastics, are powered by rechargeable batteries and users must be over 16 years of age.



Fig. 8

- (a) Explain how the following requirements could influence the design of an e-scooter as shown in **Fig. 8**.

(i) Aesthetics

.....
.....
.....
..... [2]

(ii) Ergonomics

.....
.....
.....
..... [2]

(iii) Sustainability

.....
.....
.....
..... [2]

- (b) An engineering design specification (EDS) for an e-scooter could contain information about the aesthetics, cost and the environment.

State **two** other items of information that would normally be given in an EDS for an e-scooter, giving a reason for each.

1

.....

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2

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[4]

SAMPLE

Turn over

(b) Explain **one** advantage and **one** disadvantage of using 3D printers.

Advantage

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Disadvantage

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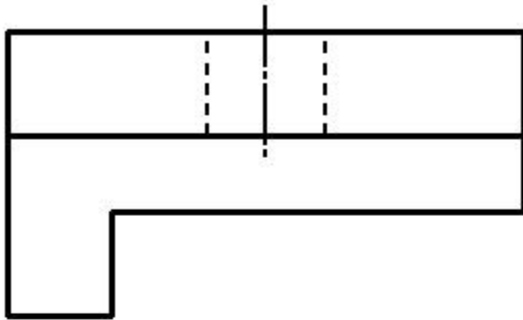
[4]

SAMPLE

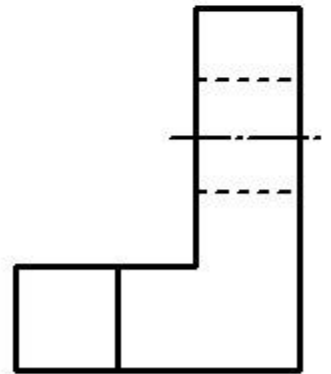
Turn over

- 15 (a) Fig. 10 is a drawing of a shelf bracket.

In the space provided complete the third angle orthographic projection by adding a **front view**.



PLAN VIEW



SIDE VIEW

FRONT VIEW



[2]

Fig.10

(b) State the meaning of the following abbreviations used on engineering drawings.

(i) DIA.....[1]

(ii) MATL.....[1]

(c) State **one** purpose of isometric drawings.

.....[1]

(d) Recycle and Repair are two of the 6Rs of sustainable design.

State **three** of the other 6Rs of sustainable design.

1

2

3

[3]

(e) Give **one** reason why an engineering company might implement relevant British Standard for its products.

.....

.....

.....

.....[2]

Turn over

16 (a) Describe **one** method of evaluating a design idea, other than making a model.

.....
.....
.....
..... [2]

(b) Describe **one** method of measuring the linear dimensions of a completed product.

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..... [2]

(c) An engineering company is proposing to move from manually creating drawings of products to producing all drawings using CAD software.
Discuss the advantages and disadvantages of this change.

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..... [6]

END OF QUESTION PAPER

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Sample Assessment Material (SAM)

Cambridge Nationals in Engineering Design
R038: Principles of engineering design

MARK SCHEME
DRAFT

Duration: 1 hour 15 minutes

MAXIMUM MARK 70

Version: 2
Last updated: 15/07/21
(FOR OFFICE USE ONLY)

This document consists of 11 pages

Crossed Out Responses

If a student has crossed out a response and written a clear alternative response, then the crossed out response is not marked. If no alternative is given, examiners will give students the benefit of the doubt and mark the crossed out response if it is legible.

Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a student gives two responses (even if one of these responses is correct), no mark will be awarded, as it is not possible to determine which was the first response selected.

Contradictory Responses

When a student provides contradictory responses, no mark will be awarded, even if one of the answers is correct.

Short Answer Questions (usually worth only **one mark per response**)

If a student needs to give a set number of short answer responses, but gives more, only the set number of responses will be marked. The response space will be marked from left to right on each line and then line by line until the required number of responses have been marked. The remaining responses will not be marked.

Short Answer Questions (worth **two or more marks**)

If a student is required to provide a description of, say, three items or factors and four items or factors are provided, then marking will be similar to the above example (but downwards).

Longer Answer Questions

If a student provides two (or more) responses to a medium or high tariff question which only needs a single (developed) response, and does not cross out the first response, the first response will be marked.

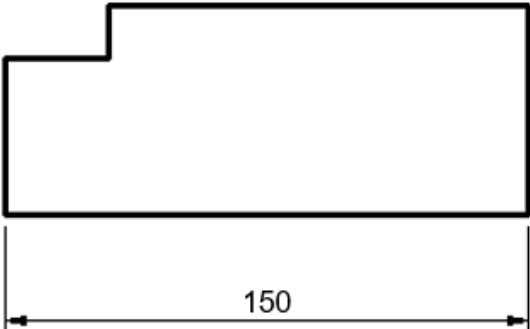
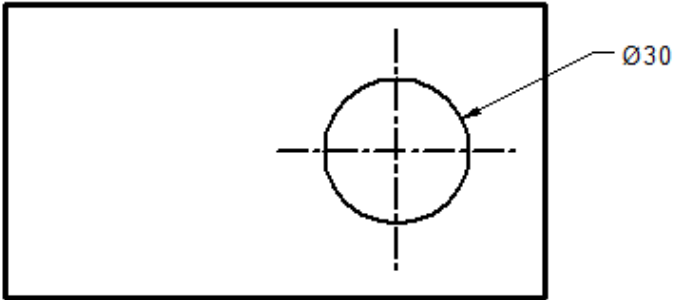
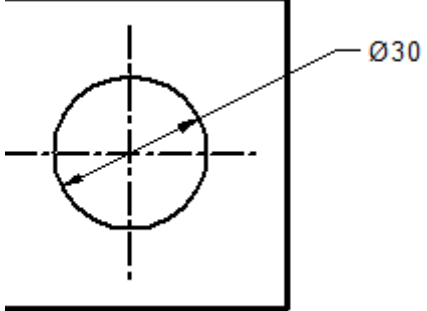
Levels of response marking

- a. **To determine the level** – examiners will start at the highest level and work down until they reach the level that matches the answer
- b. **To determine the mark within the level**, they will consider the following:

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

Question		Answer	Mark	Guidance
1		(a) Centre line	1	Correct answer only
2		(b) Road bridge	1	Correct answer only
3		(c) Oblique	1	Correct answer only
4		(c) Providing a ramp for wheelchair access to a building	1	Correct answer only
5		(c) A product that is created to last a limited time	1	Correct answer only
6		(a) Chamfer	1	Correct answer only
7		(b) Breadboarding	1	Correct answer only
8		(a) Materials	1	Correct answer only
9		(d) Wasting	1	Correct answer only
10		(a) 9.8mm	1	Correct answer only

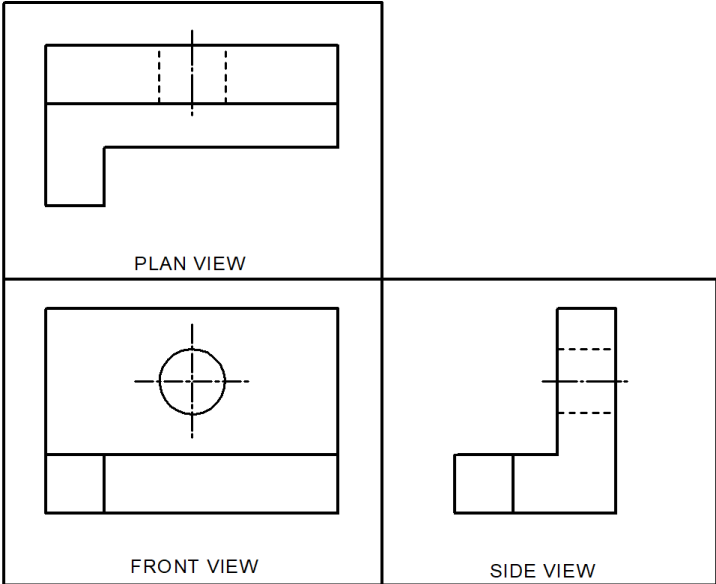
Question		Answer	Mark	Guidance
11	(a)	<p>Any two from:</p> <ul style="list-style-type: none"> • Aesthetics (1) • Function (1) • Materials (1) • Target market (1) • Environmental issues (1) <p>Award credit for any other appropriate response.</p>	2	
11	(b)	<p>Any two from:</p> <ul style="list-style-type: none"> • Colour (1) • Sound (1) • Form (1) • Texture (1) <p>Any other reasonable answer.</p>	2	
11	(c)	<p>One mark for any of the following answers:</p> <ul style="list-style-type: none"> • New products/technologies made due to requirements of the marketplace / customers / market research. 	1	
11	(d)	<p>Two marks for:</p> <ul style="list-style-type: none"> • Designed to fit the hand (1) • Keeps hand/elbows/wrists/arms in a comfortable position (1) • Reduce fatigue (1) • Prevents conditions like RSI (1) <p>Award credit for any other appropriate response.</p>	2	
11	(e)	<p>Missing stages are sequenced as follows:</p> <ol style="list-style-type: none"> i. Research the problem (1) ii. Generate ideas (1) iii. Test prototype (1) <p>No mark for production plan or risk assessment.</p>	3	One mark for each correct stage

Question		Answer	Mark	Guidance
12	(a)	3 rd angle orthographic projection (1)	1	
	(b)	<p>The dimension should be central (1) and above the dimension line (1) leader lines should not touch the component (1) arrows should have solid heads (1) arrows touch the inside of projection lines (1)</p> 	4	
12	(c)	<p>Any two from:</p> <p>The leader line arrow should touch the outside of the circle and lead out of the square (1). The value Ø30 should be at the start of the leader line (1)</p> 	2	<p>Award 1 mark for use of D30 instead of Ø30.</p> <p>Award 1 mark if the leader line arrows touch in the inside of the circle.</p> 
12	(d)	<ul style="list-style-type: none"> i) Knurl (1) ii) Countersink (1) iii) Thread (1) 	3	One mark for each correct answer

Question			Answer	Mark	Guidance
13	(a)	(i)	<p>Any appropriate aesthetic point relating to the design of an e-scooter.</p> <p>e.g.</p> <ul style="list-style-type: none"> • The body of the e-scooter will be an attractive colour (1) to make it stand out and be seen when used (1) • The colour of the mud guards could match or complement the colour of the main body (1) • The design of the shape of the body will be appealing (1) accept example for second mark – e.g. sleek/modern/eye-catching (1) • The foot plate of the e-scooter will be made from a material which makes it attractive (1) accept relevant example for second mark – e.g. gloss finish/matt finish/shiny/textured/smooth (1) <p>Award credit for any other appropriate response.</p>	2	Simple answer 1 mark, justified answer 2 marks.
13	(a)	(ii)	<p>Any appropriate ergonomic point relating to the design of an e-scooter.</p> <p>e.g.</p> <ul style="list-style-type: none"> • The e-scooter steering column will feature an adjustable height (1) to allow a range of users (1) • The e-scooter will be as lightweight as possible (1) so that it is easy to carry and operate (1) • The handlebar grips are easy to grip (1) to make them comfortable (1) to use and control the e-scooter (1) • The foot plate is as wide as possible (1) to allow a range of users to stand safely on it (1) <p>Award credit for any other appropriate response.</p>	2	Simple answer 1 mark, justified answer 2 marks.

Question			Answer	Mark	Guidance
13	(a)	(iii)	<p>Any appropriate sustainability point relating to the design of an e-scooter.</p> <p>e.g.</p> <ul style="list-style-type: none"> • Most components are easily recyclable (1) minimising the impact on the environment at end of product life (1) • The e-scooter will use an energy efficient motor (1) so that it is cheaper to run/so that it is more environmentally friendly (1) • Standard components used where possible (1) to make production more energy/resource efficient (1) • Design so that it can be repaired (1) so that replacing components can prolong overall product life (1) <p>Award credit for any other appropriate response.</p>	2	Simple answer 1 mark, justified answer 2 marks.
13	(b)		<p>Any appropriate engineering design specification requirement relating to the design of an e-scooter.</p> <p>e.g.</p> <ul style="list-style-type: none"> • Customer (1) The e-scooter needs to be usable by a range of users (1) • Size (1) The e-scooter should be large enough to allow a range of users to operate it. (1) • Safety (1) The e-scooter should be able to be operated safely with a good braking system (1) carry the weight of a range of users (1) • Function (1) The e-scooter should be portable (1) easy to operate (1) easily move a range of users (1) • Material (1) The e-scooter should use materials that do not rust (1) are: strong (1) durable (1) lightweight (1) easy to manufacture <p>Award credit for any other appropriate response.</p>	4	Award 1 mark for an engineering design specification requirement, justified answer 2 marks.

Question		Answer	Mark	Guidance
14	(a)	<p>Any six from:</p> <ul style="list-style-type: none"> • Create 3D model in CAD (1) • Convert CAD file to STL file (1) • Send STL file to the 3D printer (1) • The 3D printer draws out the layer (1) • Load 3D printer with extruding material (1) • Extrudes material from the nozzle onto the print bed (1) • This step is repeated until the item is produced layer by layer (1) • Remove the 3D model from the print bed when cool (1) • Remove any supports from the 3D model (1) • Clean up the surface of the 3D model (1) • Make the surface of the 3D model smooth (1) 	6	1 mark for each correct point in the correct order up to a maximum of 6 marks.
14	(b)	<p>Advantages:</p> <ul style="list-style-type: none"> • The ability to produce complex shapes (1) which cannot be produced by other processes (1) • Can produce a 3D model in a single operation (1) quicker than multiple machining processes (1) • Can produce 3D models as and when required (1) • Waste reduction (1) As material is added layer by layer no material is wasted (1) <p>Disadvantages:</p> <ul style="list-style-type: none"> • The materials in the model may not match the materials in the final product (1) so it may have different mechanical properties (1) • There are not many materials available to use on a 3D printer only certain plastic (1) <p>Award credit for any other appropriate response.</p>	4	2 x 2 2 marks for explanation of advantage 2 marks for explanation of disadvantage

Question			Answer	Mark	Guidance
15	(a)		<p>Front view:</p> <ul style="list-style-type: none"> • Shape is correct (1) • Plan view is aligned (1) • Side view is aligned (1) 	2	One mark for each correct point drawn, up to a maximum of two marks.
15	(b)	(i)	<ul style="list-style-type: none"> • Diameter 	1	
15	(b)	(ii)	<ul style="list-style-type: none"> • Material 	1	
15	(c)		<p>Any one from:</p> <ul style="list-style-type: none"> • To show an object in 3D (1) • For presentation purposes (1) • To show a client/customer (1) 	1	

Question		Answer	Mark	Guidance
15	(d)	Any three from: <ul style="list-style-type: none"> • Rethink • Reuse • Reduce • Refuse 	3	
15	(e)	Any two points from: <ul style="list-style-type: none"> • Health and safety regulations are followed (1) protects workers (1) keeps products safe (1) • Products are made are to a high quality (1) • Quality control allows products to be made consistently to the same standard (1) • Product recalls/failures are reduced (1) 	2	
16	(a)	Any two points from: <ul style="list-style-type: none"> • Qualitative comparison with the design brief and specification (1) – Allows design checks to be made using details agreed with a client (1) • Ranking matrices (1) – Allows design features to be checked using a numerical system to highlight the best designs (1) <p>Award credit for any other appropriate response.</p>	2	
16	(b)	Any two points from: <ul style="list-style-type: none"> • Measuring tools - Vernier callipers/micrometers (1) • used with reference to the dimensions on the working drawings (1) • measured between the two jaws/rules measured by comparing to the graduated scale (1) <p>Award credit for any other appropriate response.</p>	2	Award 1 mark for naming the measuring tool. 1 mark for describing use.

Question		Answer	Mark	Guidance
16	(c)	<p>Level 3 (5–6 marks) A thorough discussion including a range of advantages and disadvantages of using CAD software, compared to the manual production of drawings, showing understanding of all the points stated. Consistent use of appropriate terminology</p> <p>Level 2 (3–4 marks) An adequate discussion stating some advantages and disadvantages of using CAD software compared to the manual production of drawings, showing an understanding of some of the points stated. Some use of appropriate terminology.</p> <p>Level 1 (1–2 marks) A brief discussion stating only either advantages or disadvantages of using CAD software compared to the manual production of drawings, showing limited understanding. Little or no use of appropriate terminology.</p> <p>0 = a response that is irrelevant and/or not worthy of a mark. Annotate with 'Seen' at end of response.</p>	6	<p>Up to six marks for a discussion or detailed explanation of the advantages and disadvantages of using CAD software compared to the manual production of drawings.</p> <p>Responses may include reference to:</p> <ul style="list-style-type: none"> • Increased accuracy • Previous drawings can be edited • Drawings can be quickly changed • Drawings can be shared electronically • Products can be tested virtually • People from around the world can work on the same drawing at different times of the day • Libraries of standard parts can be used on the drawings • Electronic files can be sent direct to machines to make products • CAD software can be expensive • CAD software has to be updated • Training will be required to use the software • Training is expensive