



*Rewarding Learning*

**General Certificate of Secondary Education  
2022**

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**Engineering and Manufacturing**

Unit 3

*assessing*

Materials, Processes and Systems

**[GEM31]**

**WEDNESDAY 22 JUNE, MORNING**

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**MARK  
SCHEME**

## General Marking Instructions

### **Introduction**

Mark schemes are intended to ensure that the GCSE examinations are marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' 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.

### **Assessment objectives**

Below are the assessment objectives for GCSE Engineering and Manufacturing.

Candidates must:

- AO1** Recall, select and communicate their knowledge and understanding of engineering and manufacturing in a range of contexts;
- AO2** Apply skills, knowledge and understanding, including quality standards in a variety of design contexts. Plan and carry out investigations and making tasks involving an appropriate range of tools, equipment, materials and processes; and
- AO3** Analyse and evaluate evidence, design proposals and outcomes, make reasoned judgements and present conclusions and recommendations.

### **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 16-year-old which is the age at which the majority of candidates sit their GCSE 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 16-year-old GCSE 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.

### **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**

Tasks and questions requiring candidates to respond in extended writing are marked in terms of 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.

### **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.

### **Quality of written communication**

Quality of written communication is taken into account in assessing candidates’ responses to all tasks and questions that require them to respond in extended written form. These tasks and questions are marked on the basis of levels of response. The description for each level of response includes reference to the quality of written communication.

For conciseness, quality of written communication is distinguished within levels of response as follows:

- Level 1: Quality of written communication is basic.
- Level 2: Quality of written communication is satisfactory.
- Level 3: Quality of written communication is good.
- Level 4: Quality of written communication is excellent.

In interpreting these level descriptions, examiners should refer to the more detailed guidance provided below:

**Level 1 (Basic):** The level of accuracy of the candidate’s spelling, grammar and punctuation is basic. The candidate makes a limited selection and use of an appropriate form and style of writing. There is little use of specialist vocabulary.

**Level 2 (Satisfactory):** The level of accuracy of the candidate’s spelling, grammar and punctuation is satisfactory. The candidate makes a satisfactory selection and use of an appropriate form and style of writing. There is some use of specialist vocabulary.

**Level 3 (Good):** The level of accuracy of the candidate’s spelling, grammar and punctuation is good. The candidate makes a good selection and use of an appropriate form and style of writing supported with good use of diagrams as required. There is good use of specialist vocabulary.

**Level 4 (Excellent):** The level of accuracy of the candidate’s spelling, grammar and punctuation is excellent. The candidate successfully selects and uses the most appropriate form and style of writing. There is excellent use of appropriate specialist vocabulary.

### **COVID-19 Context**

Given the unprecedented circumstances presented by the COVID-19 public health crisis, senior examiners, under the instruction of CCEA awarding organisation, are required to train assistant examiners to apply the mark scheme in case of disrupted learning and lost teaching time. The interpretation and intended application of the mark scheme for this examination series will be communicated through the standardising meeting by the Chief or Principal Examiner and will be monitored through the supervision period. This paragraph will apply to examination series in 2021–2022 only.

Section A

AVAILABLE  
MARKS

- 1 (a) (i) Any **one** from the list below:  
• High tensile strength  
• Formability  
(1 × [1]) [1]  
**Correct alternative responses will be given credit.**
- (ii) Any **one** from the list below:  
• Powder coating  
• Painting  
• Spraying  
(1 × [1]) [1]  
**Correct alternative responses will be given credit.**
- (b) One [1] tonne [1]  
(2 × [1]) [2]
- (c) (i) Sketch [3] annotation [1] [4]
- (ii) Any **one** from the list below:  
• Aids repeatability  
• Reduce waste  
• Eliminates the need to mark out  
• Precision  
(1 × [1]) [1]  
**Correct alternative responses will be given credit.**
- (iii) Any **one** from the list below:  
• Will not come loose with vibration  
• Rivets have high shear strength  
• Quick assembly process  
• Permanent joining method  
• Easier to assemble  
(1 × [1]) [1]  
**Correct alternative responses will be given credit.**

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			AVAILABLE MARKS	
2	(a) (i)	Using a threaded stud [1] and a nut. [1] or Nut [1] and bolt [1] (2 × [1]) <b>Correct alternative responses will be given credit.</b>	[2]	
	(ii)	It is permanently attached. [1] It makes it difficult to replace the castor if the castor is broken. [1] (1 × [1]) <b>Correct alternative responses will be given credit.</b>	[1]	
	(b) (i)	Any <b>one</b> from the list below: • Assembly • Batch • Mass production (1 × [1]) <b>Correct alternative responses will be given credit.</b>	[1]	
	(ii)	A relevant feature of the chosen production method [1] with relevant justification [1] (2 × [1]) <b>Correct alternative responses will be given credit.</b>	[2]	
3	(c)	Any <b>three</b> from the list below: - Hydraulic ram - Axle - Castors/Wheels - Foam Grip - Handle - Plastic handle - Split pin (3 × [1]) <b>Correct alternative responses will be given credit.</b>	[3]	9
	(a)	$£3450 + £680 + £475 = £4605$ [1] $£4605/1500$ [1] $= £ 3.07$ [1]	[3]	
(b)	$C = \pi d$ [1] $25.2[1] \times \pi = 79.168$ [1] $24.8 [1] \times \pi = 77.911$ [1] $79.168 - 77.911 = 1.257\text{mm}$ [1] (6 × [1])	[6]	9	

4 The solution should make reference to:

- holes for rivets in the bracket
- holes for rivets in the body of the jack
- holes must be aligned/positioning
- detail of rivet heads
- diameter of rivet – clearance hole

**Correct alternative responses will be given credit.**

Response Type	Description	Mark Band
	Level of response not worthy of credit	<b>0</b>
<b>Basic</b>	Basic detail of the attachment of the castor bracket with few relevant points.  Basic quality sketches of the component.  Basic annotation and use of technical vocabulary.	<b>[1]–[3]</b>
<b>Satisfactory</b>	Satisfactory detail of the attachment of the castor bracket with some relevant points.  Satisfactory quality sketches of the component.  Satisfactory annotation and use of technical vocabulary.	<b>[4]–[6]</b>
<b>Good</b>	Good detail of the attachment of of the castor bracket with most relevant points.  Good quality sketches of the component.  Good annotation and use of technical vocabulary.	<b>[7]–[9]</b>
<b>Excellent</b>	Excellent detail of the attachment of the castor bracket with all relevant points.  Excellent quality sketches of the component.  Excellent annotation and use of technical vocabulary.	<b>[10]–[12]</b>

[12]

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AVAILABLE MARKS

5 Indicative content:

**Key features**

- different types of wheels: castor for maneuverability, axle and wheels at the front which can support the load. Wheels for parallel motion
- use of the jack handle to raise and lower
- use the carrier handle
- the linkage and levers to ensure the car support place will rise vertically when operated
- the function of the pins to enable movable parts to rotate
- any reference to user experience such as safety features e.g.: use on uneven ground
- limitations of the product

**Correct alternative responses will be given credit.**

<b>Response Type</b>	<b>Description</b>	<b>Mark Band</b>
	Level of response not worthy of credit	<b>0</b>
<b>Basic</b>	Discussion points associated with the key features of the trolley jack are limited and basic in content and explanation.  The level of accuracy of spelling, punctuation and grammar is basic in most cases.  Form and style is generally inappropriate as is the use of specialist terms and technical vocabulary.	<b>[1]–[3]</b>
<b>Satisfactory</b>	Discussion points associated with the key features of the trolley jack are satisfactory in content and explanation.  The level of accuracy of spelling, punctuation and grammar is satisfactory in most cases.  Form and style is generally appropriate as is the use of specialist terms and technical vocabulary.	<b>[4]–[5]</b>
<b>Good</b>	Discussion points associated with the key features of the trolley jack are clear in content and explanation.  The level of accuracy of spelling, punctuation and grammar is good in most cases.  Form and style is generally appropriate as is the use of specialist terms and technical vocabulary.	<b>[6]–[8]</b>
<b>Excellent</b>	Discussion points associated with the key features of the trolley jack are detailed and excellent in content and explanation.  The level of accuracy of spelling, punctuation and grammar is excellent in most cases.  Form and style is appropriate as is the use of specialist terms and technical vocabulary.	<b>[9]–[10]</b>

[10]

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**Section A**

**50**

**AVAILABLE MARKS**

Section B

AVAILABLE  
MARKS

- 6 (a) (i) Eye protection [1]
- (ii) First aid [1]
- (iii) Dust masks [1]  
(3 × [1]) [3]  
**Correct alternative responses will be given credit.**
- (b) Any **two** different applications for example:  
- Opening and closing of bus doors/train doors.  
- brakes  
- locking mechanisms of doors  
(2 × [1]) [2]  
**Correct alternative responses will be given credit.**
- (c) (i) A: Bulb [1]  
B: Resistor [1]  
C: Capacitor [1]  
(3 × [1]) [3]
- (ii) • To build up and store electrical energy [1]  
• and discharge when required. [1]  
(1 × [2]) [2]  
**Correct alternative responses will be given credit.**
- 7 (a) Any **two** main from the list below:
- CAD can produce very accurate 2D and 3D drawings.
  - CAD drawings can be edited or modified, shared and saved.
  - CAD drawings can be linked to other programs.
- (2 × [1]) [2]  
**Correct alternative responses will be given credit.**
- (b) Reference to any **eight** of the following points:
- Mark position of the centre of the hole [1]
  - Centre punch to enable drilling [1]
  - Drill the hole [1]
  - The drill diameter must be the tapping size/Make reference to tapping size/smaller hole [1]
  - Make use of the metric taps [1]
  - Start the hole using taper tap [1]
  - Check for squareness using a plug tap [1]
  - Complete threading using a plug tap [1]
  - Use of cutting compound/lubricant [1]
  - Use a tap wrench [1]
  - Reference to the process of turning the wrench [1]
- (8 × [1]) [8]  
**Correct alternative responses will be given credit.**

10

10



- 8 (a) A ferrous metal is a metal which contains iron and a non-ferrous metal does not contain iron. [1]
- (b) (i) Chipboard is made from glued wood chips which are pressed together [1]  
 Plywood is made of layers/plies which are glued together with adjacent layers having their wood grain at 90 degrees to one another [1]  
 (1 × [2]) [2]
- Correct alternative responses will be given credit.**
- (ii) Any **one** from the list below:  
 • Bath tubs. [1]  
 • Outer skin for boats. [1]  
 (1 × [1]) [1]
- Correct alternative responses will be given credit.**
- (c) Acrylic to Acrylic – Tensol cement. [1]  
 Wood to Wood – PVA. [1]  
 Low carbon steel/Low carbon steel – welding/brazing/hard solder/riveting [1]  
 (3 × [1]) [3]
- Correct alternative responses will be given credit.**

AVAILABLE  
MARKS

7

- 9 (a) (i)  $\pi r^2$   $3.14 \times 60^2 = 11\,304 \text{ mm}^2$  [1]  
 $\pi = 3.142$  or use of  $\pi$  from the calculator
- (ii) Area =  $\pi D \times H$  [1]  
 $3.14 \times 120 \times 140 = 52\,752 \text{ mm}^2$  [1]  
 $\pi = 3.142$  or use of  $\pi$  from the calculator  
 $(1 \times [1])$  [1]
- (iii) Area of cans =  $50.24 + 50.24 + 301.44 \times 10 = 4019.2 \text{ cm}^2$  [1]  
Sheet area =  $42 \times 130 = 5460 - 4019.2 = 1440.8 \text{ cm}^2$  [1]  
% waste =  $1440.8/5460 \times 100 = 26.4\%$  [1]  
 $(3 \times [1])$  [3]
- (b) Any **two** from the list below:  
- To stop the can reacting with the contents of the can/to act as a barrier/to preserve food [1]  
- Avoid contamination of the food [1]  
- To prevent corrosion [1]  
- Aesthetics [1]  
 $(2 \times [1])$  [2]  
**Correct alternative responses will be given credit.**
- (c) Any **two** from the list below:  
• Less energy required to recycle the metal compared to creating new material.  
• More cost effective to recycle.  
• less damage to the environment as less quarrying in mines  
• reduces the reliance on less landfill sites  
• less energy required to produce a metal from recycled material than from ore  
• waste metal has value  
• waste metal can be recycled multiple times without deterioration  
• waste metal can be recycled into multiple products  
 $(2 \times [1])$  [2]  
**Correct alternative responses will be given credit.**

AVAILABLE  
MARKS

9

- 10 (a)** Any **two** from the list below:
- High tensile strength.
  - Durability/long lasting
  - Hardness: resistance to wear and tear
  - Stiffness
  - Toughness
  - High compressive strength
- (2 × [1]) [2]  
**Correct alternative responses will be given credit.**
- (b) (i)** Stress = force/cross-sectional area  
= 750N/0.3 × 0.05. [1]  
Answer = 50,000N/m<sup>2</sup> [1]  
**or**  
Award full marks for the correct answer.  
(2 × [1]) [2]
- (ii)** Strain = change in length/original length  
= 0.002/0.1 [1]  
Answer = 0.02 [1]  
**or**  
Award full marks for the correct answer.  
(2 × [1]) [2]
- (iii)** Young's modulus = stress/strain  
= 50000/0.02m. [1]  
Answer = 2500000 N/m<sup>2</sup>. [1]  
**or**  
Award full marks for the correct answer.  
(2 × [1]) [2]

- 11 (a)** Any **two** from the list below:
- Parts not ordered until needed
  - No need for warehouse space
  - Investment in stock not huge
  - Overproduction/surplus products
  - Close relationship with supplier
- [2].
- (b)** Any **two** discussion points which focus on two of the following issues:
- Workers will require a different skill set
  - Workers will require re-training to remain employable
  - Skill set may change more often
  - Workers will need to be more adaptable
  - Higher education demands for employability
  - Higher level of entry level qualifications required
  - Location of jobs may change – become more global
  - Work force may be required to be more mobile
- (4 × [1]) [4]  
**Correct alternative responses will be given credit.**

**Section B**

**Total**

AVAILABLE MARKS	
8	
6	
<b>50</b>	
<b>100</b>	