



Rewarding Learning

**General Certificate of Secondary Education
2019**

Engineering and Manufacturing

Unit 3

assessing

Materials, Processes and Systems

[GEM31]

THURSDAY 13 JUNE, MORNING

**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.

Section A

**AVAILABLE
MARKS**

- 1 (a) (i)** Any **one** from:
 • High tensile strength
 • Relatively low density
 (1 × [1]) [1]

Correct alternative responses will be given credit.

- (ii)** Any **one** from:
 • Powder coating
 • Dip coating
 (1 × [1]) [1]

Correct alternative responses will be given credit.

- (b)** Factor of safety is a term describing the load [1] carrying capacity of a system beyond [1] the expected or actual loads.
 (2 × [1]) [2]

- (c) (i)** Conformité Européenne/CE mark [1]

- (ii)** Any **one** from:
 • Product is safe to use
 • Customer confidence in product
 (1 × [1]) [1]

Correct alternative responses will be given credit.

- (d) (i)** Counter/Clock [1]

Correct alternative responses will be given credit.

(ii)

Segment Letter	Marked as appropriate
a	✓
b	
c	✓
d	✓
e	
f	✓
g	✓

[1]

8

			AVAILABLE MARKS
2	<p>(a) Any two from:</p> <ul style="list-style-type: none"> • Reduced costs • Easily replaced by consumer if lost or damaged • Readily available <p>(2 × [1])</p> <p>Correct alternative responses will be given credit.</p>	[2]	
	<p>(b) Any two from:</p> <ul style="list-style-type: none"> • Low level skilled workers can complete isolated tasks • Enables the efficient production of identical parts • Allows for the quick identification of defects <p>(2 × [1])</p> <p>Correct alternative responses will be given credit.</p>	[2]	
	<p>(c) (i) Direct costs are costs that can be specifically attributed to a single product.</p> <p>Correct alternative responses will be given credit.</p>	[1]	
	<p>(ii) Any one from:</p> <ul style="list-style-type: none"> • Labour costs for the rowing machine • Raw material costs for the rowing machine • Packaging of the rowing machine <p>(1 × [1])</p> <p>Correct alternative responses will be given credit.</p>	[1]	
	<p>(d) (i) Indirect costs arise as part of the business but cannot be attributed to a specific product.</p> <p>Correct alternative responses will be given credit.</p>	[1]	
	<p>(ii) Any one from:</p> <ul style="list-style-type: none"> • Management of the rowing machine company • Administration in the rowing machine company • Marketing of the rowing machine <p>(1 × [1])</p> <p>Correct alternative responses will be given credit</p>	[1]	8
3	<p>(a) $£6500 + £800 + £11700 = £19000$ [1]/10000 = 1.9 = £1.90 [1]</p> <p>(2 × [1])</p>	[2]	
	<p>(b) $£65 \times 10 = £650$ [1] 5% of 650 = 32.5 [1] × 8 = £260 [1]</p> <p>(3 × [1])</p>	[3]	
	<p>(c) $0.04 \times 0.08 = 0.0032\text{m}^2$ [1] × 2.4 m [1] = 0.00768m^3 [1] × 10 = 0.0768m^3 [1]</p> <p>(4 × [1])</p>	[4]	
	<p>(d) $8 \times 60 = 480$ minutes [1]/48 = 10 rowing machine per employee [1] × 6 employees = 60 rowing machine [1]</p> <p>(3 × [1])</p>	[3]	12

- 4 Possible solutions could be:
- Spring loaded clips and securing bracket
 - Threaded screw and threaded tube
 - Magnetised parts and/or locating pins
 - Screw/spring loaded clip

Correct alternative responses will be given credit.

Response Type	Description	Mark Band
	Level of response not worthy of credit	0
Basic	Shows basic understanding of the removal and attachment of the digital display unit with few relevant points. Basic quality sketches of the component. Basic annotation and use of technical vocabulary.	[1]–[3]
Satisfactory	Shows satisfactory understanding of the removal secure attachment of the digital display unit with some relevant points. Satisfactory quality sketches of the component. Satisfactory annotation and use of technical vocabulary.	[4]–[6]
Good	Shows good understanding of the removal and secure attachment of the digital display unit with mostly relevant points. Good quality sketches of the component. Good annotation and use of technical vocabulary.	[7]–[9]
Excellent	Shows excellent understanding of the removal and secure attachment of the digital display unit with all relevant points. Excellent quality sketches of the component. Excellent annotation and use of technical vocabulary.	[10]–[12]

[12]

12

5 Indicative content:

Identification of **two** quality control checks:

- Tolerance of bar and sliding mechanism
- Angle of bar and feet accurate to ensure stability
- Ensure all joints are secure
- Correct attachment of pull handle to fly weight
- Guarded moving parts
- Functional test to ensure correct operation

Safety for the user:

- Prevent the lateral movement of sliding part or from working loose
- Feet level to prevent wobble
- Stability and long product lifespan
- Prevent the pull handle coming loose during use
- Reduce risk of user/clothing entanglement
- Ease of use

Correct alternative responses will be given credit.

Response Type	Description	Mark Band
	Level of response not worthy of credit	0
Basic	Limited discussion points associated with the quality control checks and user safety which are 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.	[1]–[3]
Satisfactory	Some discussion points associated with the quality control checks and user safety which 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.	[4]–[5]
Good	A range of discussion points associated with the quality control checks and user safety which are good 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.	[6]–[8]
Excellent	Detailed discussion points associated with the quality control checks and user safety which are 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.	[9]–[10]

[10]

AVAILABLE
MARKS

10

Section B

6	(a) Simple gear system	[1]	
	(b) Belt and pulley	[1]	
	(c) Any two from: <ul style="list-style-type: none"> • Belts do not require lubrication • Belts can slip for safety reasons • Belts can transfer motion over longer distances (2 × [1]) Correct alternative responses will be given credit	[2]	
	(d) (i) Dovetail joint	[1]	
	(ii) Lap joint	[1]	
	(iii) Mitre joint	[1]	7
7	(a) Thermosetting plastic	[1]	
	(b) Any one from: <ul style="list-style-type: none"> • Resists scratches • Will not deform easily when exposed to heat (1 × [1]) Correct alternative responses will be given credit.	[1]	
	(c) Any two from: <ul style="list-style-type: none"> • Available in large sheets • Can be coated with a veneer • Does not warp or twist (2 × [1]) Correct alternative responses will be given credit.	[2]	
	(d) $0.6 [1] \times 2.4 = 1.44 \text{ m}^2 [1]$ (2 × [1])	[2]	6

AVAILABLE
MARKS

- 8 (a) (i) Injection moulding [1]
(ii) Extrusion [1]
(iii) Vacuum forming [1]
(iv) Die casting [1]
- (b) Any **two** from:
• To improve material properties, e.g. hardness, strength
• To alter the melting point
• To reduce density
(2 × [1]) [2]
Correct alternative responses will be given credit.
- (c) Clean the surface of the watering can [1] dip in a container of molten zinc [1] quench or air dry the watering can [1] The zinc gives an aesthetic/non corrosive finish [1] (4 × [1]) [4]
Correct alternative responses will be given credit.

- 9 (a) Lever [1]
(b) Fulcrum labelled as shown in (c)(ii) [1]
(c) (i) Arrow pointing down from the right pan labelled CW [1]
(ii) Arrow pointing down from the left pan labelled ACW [1]



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- (d) $6 \times 0.08 = 0.06 \times F$ [1]
 $0.48 = 0.06 F$
 $0.48/0.06 = F$
 $F = 8$ [1]
(2 × [1]) [2]
- (e) (i) Riveting [1]
(ii) Any **two** from:
• Relatively inexpensive
• Permanent method of joining
• Quick method of attaching multiple parts
(2 × [1]) [2]
Correct alternative responses will be given credit.

AVAILABLE
MARKS

10

9

10 (a)

Material Type	Process	Item of Equipment
Metal	Cut an internal thread	Tap
Wood	Mark a line parallel to a straight edge	Marking Gauge
Metal	Create indent/locate centre of hole to be drilled	Centre Punch
Wood	Apply force to wood chisel to cut tenon joint	Mallet

(4 × [1])

[4]

(b) Any **two** from:

- Vernier – Slide/micrometer – screw adjustment
- Vernier – Outside and inside/micrometer – outside measurement
- Vernier has a lower resolution/micrometer has a better resolution

(2 × [1])

[2]

Correct alternative responses will be given credit

(c) Any **three** from:

- Machinery/equipment/tools used to produce to narrow tolerances are often more expensive [1]
- It is less expensive to make products to a tolerance rather than to exact dimensions [1]
- Raw material sizes can present inconsistencies which are expensive to account for when producing parts/components [1]
- Quality control checks will add to production costs [1]

(3 × [1])

[3]

Correct alternative responses will be given credit.

9

11 (a)

(i) Any **two** from:

- Possible fire risk
- Fumes produced
- Limited depth of cut

(2 × [1])

[2]

Correct alternative responses will be given credit.

(ii) Any **two** from:

- CNC milling machine
- CNC lathe
- 3D printer

(2 × [1])

[2]

Correct alternative responses will be given credit.

(b) Any **two** from:

- Consistency/duplicate parts
- Efficiency/speed
- Lower running costs
- Reduced waste

(2 × [1])

[2]

Correct alternative responses will be given credit.

(c) Any **three** from:

- Large initial setup costs
- Ensure product/business viability
- Limited manufacturing space
- Staff training required

(3 × [1])

Correct alternative responses will be given credit.

[3]

Total

**AVAILABLE
MARKS**

9

100