



Rewarding Learning

**General Certificate of Secondary Education
2016**

Engineering

Paper 1

Assessment Unit 3

assessing

Engineering Technology

[GEE31]

TUESDAY 24 MAY, 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 Engineering.

Candidates must:

- recall, select and communicate their knowledge and understanding of engineering in a range of contexts (AO1);
- apply skills, knowledge and understanding, including quality standards, in a variety of contexts, and plan and carry out investigations and tasks involving a range of tools, equipment, materials and components (AO2); and
- analyse and evaluate evidence, make reasoned judgements and present conclusions (AO3).

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.

Type 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 limited.

Level 2: Quality of written communication is satisfactory.

Level 3: Quality of written communication is excellent.

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

Level 1 (Limited): The level of accuracy of the candidates spelling, grammar and punctuation is limited. The candidate makes a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary.

Level 2 (Satisfactory): The level of accuracy of the candidates spelling, grammar and punctuation is satisfactory. The candidate makes a satisfactory selection and use of an appropriate form and style of writing supported with appropriate use of diagrams as required. Relevant material is organised with some clarity and coherence. There is some use of specialist vocabulary.

Level 3 (Excellent): The level of accuracy of the candidates spelling, grammar and punctuation is excellent. The candidate successfully selects and uses the most appropriate form and style of writing, supported with precise and accurate use of diagrams where appropriate. Organisation of relevant material is excellent. There is excellent use of appropriate specialist vocabulary.

			AVAILABLE MARKS
1	<p>(a) Pulley system Winch (2 × [1])</p>	[2]	4
	<p>(b) Metal staircase Metal bridge (2 × [1])</p>	[2]	
2	Any one from the list below:		10
	<p>(a) Wing nut/Thumb screw It is used with a threaded bolt or bar to join two pieces of material together.</p>	[1] [1]	
	<p>(b) G cramp A G cramp is used to clamp work securely.</p>	[1] [1]	
	<p>(c) Allen key It is used to tighten or loosen bolts and screws that have a hexagonal socket in the head (allen screws)</p>	[1] [1]	
	<p>(d) Transmission chain Used for transmission of mechanical power.</p>	[1] [1]	
	<p>(e) Spring washer Maintain assembly tension or to prevent a nut from loosening</p>	[1] [1]	
3	(a) and (b)		
	Candidate chooses any two of the listed engineering processes.		
	Soldering		
	Tools or items of equipment that may be used in the process. Soldering iron Table mat Soldering iron holder and sponge. (2 × [1])	[2]	
	Specific safety precautions when carrying out the process. Keep your hands away from the heated point of the soldering iron when soldering. Always replace the soldering iron in the holder when not in use. (2 × [1])	[2]	
	Specific quality control issues which should be carried out in the chosen process. The joint should be neat in appearance. The joint should not have excessive solder. The joint has to be clean. The soldered joints should be free from scratches, sharp edges, grittiness, looseness, blistering, or other evidence of poor workmanship. The joint has to be strong enough for its purpose. (2 × [1])	[2]	

Turning

Tools or items of equipment that may be used in the process.

Tool post with appropriate tool, e.g. facing off tool.

Cutting tool.

Parting tool.

Threading tool.

Drill.

Tail stock.

Chuck.

Students may refer to wood turning in their answers.

(2 × [1])

[2]

Specific safety precautions when carrying out the process.

Make sure the work is secured in the chuck.

Rotate the workpiece to ensure that it is centred.

Ensure that the workpiece is parallel with the centre line of the lathe.

Ensure the guard is in position.

(2 × [1])

[2]

Specific quality control issues which should be carried out in the chosen process.

Make sure the finished component is within tolerance.

Make sure the settings on the lathe are correct.

Make sure the finish on the component is to a high standard.

(2 × [1])

[2]

Welding

Tools or items of equipment that may be used in the process.

Welding torch.

Welding mask.

Welding rod.

Welding screen.

Specific type of welder.

(2 × [1])

[2]

Specific safety precautions when carrying out the process.

Make use of welding bay.

Ensure appropriate clothing and face protection is worn (gloves, mask, apron).

Make use of ventilation/extraction.

Be aware of the high temperatures and safety associated with cooling times, e.g. be aware of hot material when cooling.

(2 × [1])

[2]

Specific quality control issues which should be carried out in the chosen process.

Radiographic and ultrasonic weld inspection.

Surface crack detection using liquid penetrant.

Destructive weld testing.

Visual inspection/appearance of welded joint.

Make sure the material to be welded is sufficiently molten, e.g. correct temperature

(2 × [1])

[2]

AVAILABLE
MARKS

Tapping

Tools or items of equipment that may be used in the process.

Set of taps.

Material that needs to be tapped.

Vice.

Drill.

Drill bit.

(2 × [1])

[2]

Specific safety precautions when carrying out the process.

Make sure the work is well secured for tapping.

The drill bit must be secured in the drill.

After drilling secure material in vice, use a tap and suitable wrench and ensure that it is aligned with the hole.

Use appropriate clothing when drilling.

(2 × [1])

[2]

Specific quality control issues which should be carried out in the chosen process.

The machine cutting the thread has to be set to the appropriate thread dimensions.

When the thread is cut with due care, e.g. backwards and forwards with the tap.

Test the thread with a bolt.

Apply tolerance checks to the thread. Ensure the threaded components meet ISO standards.

(2 × [1])

[2]

12

- 4 (a) A composite material is the combination of two or more materials [1] with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components. [1]

All alternative answers will be considered.

[2]

- (b) Material – concrete [1]

Use – Building foundations, bridges, roads, runways, claddings, septic tanks, windowsills [1]

or

Material – Shape memory polymer [1]

Use – Shrink wrap packaging [1]

or

Material – Glass reinforced plastic [1]

Use – Canoes [1]

All alternative answers will be considered.

(2 × [1])

[2]

- (c) Cricket bat.

Ice hockey stick.

Skis.

Skateboards.

Canoes.

Surfboard.

Squash/racket.

All alternative answers will be considered.

(2 × [1])

[2]

			AVAILABLE MARKS	
(d)	(i)	Aluminium alloy/mild steel/titanium. All alternative answers will be considered. (1 × [1])	[1]	9
	(ii)	Light weight/strength or easily welded or readily available or low cost/excellent corrosion resistance. All alternative answers will be considered. (1 × [1])	[1]	
	(iii)	Difficult to weld the joints/needs a protective coating because it corrodes. All alternative answers will be considered. (1 × [1])	[1]	
5	(a)	[1] for example [1] for explanation		8
	(i)	Robotic Welding. [1] High quality consistent finish which is reproduced every time. [1] All alternative answers will be considered. (1 × [2])	[2]	
	(ii)	Pick and place machines in electronic circuit manufacture [1] can work 24/7. [1] All alternative answers will be considered. (1 × [2])	[2]	
	(iii)	Robotic spraying. [1] It removes the human from the hazardous spraying environment. [1] All alternative answers will be considered. (1 × [2])	[2]	
	(b)	Small batch production which would not warrant robotics. All alternative answers will be considered. (2 × [1])	[2]	
	(c)	Any three from: Mark rivet holes Drill rivet holes Drill rivet holes in each of the scissor blades Insert correct size of rivet through the holes Use a ball pein hammer to round a mushroom head on one side of the blades All alternative answers will be considered. (3 × [1])	[3]	
6	(a)	Cheap, malleable, surface hardness can be increased through heat treatment. All alternative answers will be considered. (2 × [1])	[2]	
	(b)	Any one from: Dip coating Injection moulding (1 × [1])	[1]	

- 7 (a) Commercial wheelie bin**
 The designer has used modern CAD processes to design the bin. [1]
 Assuming the bin is made from plastic it will have been manufactured using injection moulding process. [1]
 Holes can be pre-drilled in the base. [1]
 All alternative answers will be considered.
 (3 × [1]) [3]
- (b)** Using CAD for the designs flaws can be eliminated before manufacture begins [1] so that the final pieces are produced error free and of a consistently high quality. Fewer products will therefore be returned by the customer. [1]
 All alternative answers will be considered.
 (2 × [1]) [2]
- (c) Workforce**
 Any **one** from:
 Some areas of the workforce have been depleted while other areas may have increased.
 The workforce is more skilled in the use of modern technology.
 Traditional skills in engineering are being lost.
 (1 × [1])
- Working environment**
 The working environment has improved because modern technologies have made the workplace a cleaner and safer environment to work in.
 All alternative answers will be considered.
 (1 × [1]) [2]
- 8 (a)** 3D modelling on the computer[1] which allows you to produce a range of orthographic views. [1]
 Designers can work remotely [1] and send their designs to clients and other team members. [1]
 All alternative answers will be considered.
 (2 × [1]) [2]
- (b) (i)** Computer Integrated Manufacture [1]
- (ii)** Any **three** from:
 All operations are logged on computers.
 Complete control of the industrial process is achieved through the use of computers.
 Production can be monitored using computers.
 There is a direct link between all departments using ICT.
 There is a direct link between the designers and the production line.
 All alternative answers will be considered.
 (3 × [1]) [3]
- (iii)** CAM is associated with the manufacture of products or parts [1] and is a part of the CIM process [1] whereas CIM is the total integration of all production processes in a company [1] and makes substantial use of communication technology [1]

 A definition of each process will only score [1] each.
 All alternative answers will be considered.
 (4 × [1]) [4]

AVAILABLE
MARKS

7

10

9 Any **one** from each of the three sectors:

Electrical

Resistor

Function – Used to restrict the flow of current in an electrical circuit. [1]

Where it could be used – Television. [1]

Capacitor

Function – Used to store energy electrostatically in an electric field. [1]

Where it could be used – Computer. [1]

Thermistor

Function – A type of resistor, its resistance varies with temperature. [1]

Where it could be used – A heating system. [1]

Transistor

Function – Used to amplify and switch electronic signals and power. [1]

Where it could be used – Radio [1]

(2 × [1])

[2]

Mechanical

Pulley

Function – Used as a rotational drive fitted to the end of a motor. [1]

Where it could be used – Car. [1]

Gear train

Function – It is positive drive system fitted on the end of a drive shaft. [1]

Where it could be used – Winch. [1]

Spring

Function – Compress and expand generally to provide mechanical movement. [1]

Where it could be used – Stapler. [1]

Lever

Function – Produces mechanical movement about a fixed point to reduce the effort required. [1]

Where it could be used – Tip snips, shears. [1]

(2 × [1])

[2]

Pneumatic/Hydraulic

Cylinder

Function – Used to produce linear movement to operate other hydraulic or pneumatic actuators. [1]

Where it could be used – Bus doors. [1]

Reservoir

Function – Used to create a time delay in a pneumatic circuit or as a storage system for compressed air. [1]

Where it could be used – Compressor. [1]

Shuttle Valve

Function – A shuttle valve is a type of valve which allows fluid to flow through it from one of two sources. [1]

Where it could be used – Lifts. [1]

Flow Control Valve

Function – A flow control valve regulates the flow or pressure of a fluid/air. [1]

Where it could be used – Opening and closing pneumatic doors. [1]

All alternative answers will be considered.

(2 × [1])

[2]

6

10 Indicative content

Discussion focussing on:

- Increased equipment
 - Continuous production
 - Increased running costs
 - Increased health and safety considerations, e.g. temperature control, ventilation
- All alternative answers will be considered.

Quality of written communication is assessed in this question.

Response Type	Description	Mark Band
	<ul style="list-style-type: none"> • When a response is not worthy of credit, a [0] should be awarded 	[0]
Limited	<ul style="list-style-type: none"> • The points discussed are limited and not related to modern production processes. • Student discusses up to 3 examples. • Little or none of the indicative content. • The accuracy of spelling, punctuation and grammar is limited. The level of technical vocabulary is limited 	[1]–[2]
Satisfactory	<ul style="list-style-type: none"> • The points discussed are appropriate. • Some of the indicative content. Student discusses up to 3 examples. • The accuracy of spelling, punctuation and grammar is satisfactory. The level of technical vocabulary is satisfactory. 	[3]–[5]
Very Good	<ul style="list-style-type: none"> • The points discussed are clear and relevant. • Most or all of the indicative content. • Student discusses 3 examples. • The accuracy of spelling, punctuation and grammar is very good. The level of technical vocabulary is very good. 	[6]–[8]

[8]

8

Total

80