SPECIMEN MATERIAL

GCSE
ENGINEERING
8852/W

WRITTEN PAPER

Mark scheme

Specimen Assessment Material

V1.0

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Qu	Part	Marking guidance	Total marks
01	1	All marks for AO1 (knowledge) 1 mark for each correct response: Aluminium, Copper, Bronze Guidance for marking: If candidate shades too many lozenges then deduct 1 mark for each additional circle. If all are shaded then award 0 marks.	3
01	2	All marks for AO1 (understanding) Ductility	1
01	3	All marks for AO1 (knowledge) Lower	1
01	4	All marks for AO1 (understanding) Injection moulding	1
01	5	2 marks for AO1 (knowledge) and 2 marks for AO1 (understanding) 1 mark for each correct response: Thermosetting (knowledge), soften (knowledge), formed (understanding), recycled (understanding).	4

02	1	6 marks for AO3 (analyse) Award 1 mark for each point made up to 2 marks for Differences, 2 marks for Shared characteristics and 2 marks for Ease of manufacture. Differences (MAX 2 marks) Stainless Steel is less likely to corrode in kitchen environment SS is more expensive SS doesn't require a finish. Shared characteristics (MAX 2 marks) Both ferrous Both able to withstand high temperatures Both are tough Can be formed into a variety of shapes Come in different forms of supply Both widely available. Ease of manufacture (MAX 2 marks) SS is harder to form SS is harder to machine SS is more difficult to weld.	6

02	2	All marks AO2 (application of knowledge and understanding) One mark each for the following steps: Calculate volume (3x2x0.003 = 0.018 m^3) Calculate mass (7700*0.018 = 138.6 kg) Correct conversion of units (tonnes to kgs). Award any other appropriate working of this calculation.	3

02	3	All marks AO2 (application of knowledge and understanding) One mark for each of the following steps: Mass/25 kg = 138.6/25=5.544 Correct rounding = 6 people Do not award 2nd mark for response of 5.544 people. Award any other appropriate working of this calculation. If student has carried an incorrect figure through from 2.3 but has used the correct method of calculation and rounding then award both marks.	2

02	4	All marks AO2 (application of knowledge and understanding) Award one mark for each of the following (example steps): 2.8/4 + 0.67 + 2x1.5 = £1.40 Or (0.25 x 2.80) + 0.67 + (2 x 0.015) = £1.40. Award any other appropriate working of this calculation, including calculation entirely in pence (140p). Accept 1.40 or 140 as a correct answer if student does not include the units.	3

02	5	All marks AO2 (application of knowledge and understanding) Allow for rounding errors. 900x0.67p = £603 1000x(0.67x0.88) = £589.60 £603-£589.60 = £13.40 Award any other appropriate working of this calculation. Answer = 1000 Saving = £13.40 Accept 13.40 as a correct answer if student does not include the units.	3

03	1	2 marks for AO1 (knowledge) and 2 marks for AO2 (application of knowledge and understanding) Award one mark for each of the following up to 4 marks. Correct equation (Strain=change in length/original length) Correct substitution into equation (200/10000 **or** 0.2/10) Correct answer = 0.02 No units applied to strain. Award any other appropriate working of this calculation.	4

03	2	1 mark for AO1 (knowledge) and 5 marks for AO2 (application of knowledge and understanding) Award one mark for each of the following: Calculate correct radius – 14.5mm (1 mark AO2 not maths)	6

		Substitute values into πr^2 (1 mark AO2 maths) Correct answer 660.52 mm^2 (1 mark maths) Substitute values into stress = force/csa (1500/660.52) (1 mark AO2 maths) Correct answer = 2.27N/mm^2 (1 mark AO2 maths) Correct units (1 mark AO1 recall) Award any other appropriate working of this calculation. Accept N/m^2 or N/mm^2 or Pascals/Mega Pascals as long as correctly converted.	

03	3	1 mark for AO1 (knowledge) and 1 mark for AO2 (application of knowledge and understanding) One mark for each of the following: Correct equation (kg= N/g (9.81)) Correct value 152.9 kg Convert Newtons to kilograms = N/g therefore 1500/9.81 = 152.9 kg Award any other appropriate working of this calculation. Award a mark for correct value with no units.	2

03	4	All marks AO1 (knowledge) $E = \sigma/\varepsilon$ ***or*** Youngs=Stress/Strain	1

03	5	4 marks for AO3 (analyse) Award 1 mark for each correct requirement up to maximum of 2 marks Plus Award 1 mark for each correct reason related to requirement up to a maximum of 2 marks. **Indicative content** This list is not exhaustive and any other correct requirements and relevant reasons should be credited. **Requirement**: Bollard must remain lowered until bus has passed over it completely. **Reason**: To avoid damage to the bus. **Requirement**: Bollard control system should be able to detect vehicles attempting to 'tailgate'	4

		Reason: To prevent unauthorised access to the road. **Requirement**: Bollard control system should give a warning when bollard is being raised. **Reason**: To prevent injury to nearby pedestrians. **Requirement**: Bollard control system should indicate when bollard is fully lowered. **Reason**: So that the driver knows it is safe to proceed.	

<table>
<tr>
<td>03</td>
<td>6</td>
<td>
3 marks for AO3 (evaluate)

Three marks available for comparison of the systems.

<table>
<tr><th>Level</th><th>Mark</th><th>Description</th></tr>
<tr><td>3</td><td>3</td><td>Justified choice of system which is based on their analysis and takes account of the context.</td></tr>
<tr><td>2</td><td>2</td><td>Choice of system based on their analysis with limited reference to context.</td></tr>
<tr><td>1</td><td>1</td><td>A choice is made with weak reference to either their analysis or the context.</td></tr>
<tr><td>0</td><td>0</td><td>Nothing of relevance or no response.</td></tr>
</table>

Indicative content:

Points may include but are not limited to:

PIC based system can be reprogrammed, making it more flexible in use – same circuit could be used in different locations.

PIC based system may be more compact than a system built from a number of integrated circuits – reducing bulk, making it easier to accommodate, therefore lowering cost of manufacture as fewer parts are used.

PIC based system could do all that a conventional IC board could do but could add additional features such as sound. In a conventional IC based system that would mean adding another dedicated IC to the board.

Far easier to update the PIC based reprogrammable system. A change on the discrete IC board will probably mean it needs a new board.

Dedicated ICs may be cheaper to purchase and don’t require any programming before they can be used.

Programs in PIC might be corrupted by voltage spikes.
</td>
<td>3</td>
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</table>

04		1 mark for AO1 (understanding) and 2 marks for AO2 (application of knowledge and understanding) Appropriate material identified (1) with some understanding of why it would be suitable (1). Additional mark available for demonstration of a clear understanding of material (1). ~~Example of application of marks Aluminium (1) as it is lightweight (1) and will, therefore, reduce the load on the wall (1).~~ Example of application of marks: Aluminium alloy (1) as it is malleable (1) and can be pressed to shape (1). **Indicative content:** Candidate may suggest materials such as: steel, aluminium alloy, ~~cast iron~~, ABS Explanation may include: Malleable allowing shaping/forming Ability to apply surface finish ~~Density/lightweight material reducing load on wall~~ Abundance/availability of material Relative cost compared to other materials.	3

05	1	All marks for AO1 (knowledge) One mark per composite listed. **Indicative content:** Concrete FRP (named) GRP/Fibre glass Plywood MDF OSB	2

<table>
<tr>
<td>05</td>
<td>2</td>
<td>All marks for AO1 (understanding)

<table>
<tr><th>Level</th><th>Marks</th><th>Description</th></tr>
<tr><td>3</td><td>5-6</td><td>Detailed explanation including all key processes to produce product.</td></tr>
<tr><td>2</td><td>3-4</td><td>Some processes described in basic detail/list form OR Majority of processes covered but insufficient detail to allow correct manufacture.</td></tr>
<tr><td>1</td><td>1-2</td><td>One or more basic processes/steps listed.</td></tr>
<tr><td></td><td>0</td><td>Nothing of relevance or no response.</td></tr>
</table>

Indicative content:

Through the use of notes and/or sketches candidates should be awarded marks based on covering the key stages as follows:
use of a mould, application of release agent, gelcoat, layers of carbon weave, resin, repetition of weave and resin to desired thickness, vacuum pack and bake/auto clave, remove from mould, trim off excess.</td>
<td>6</td>
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<tr>
<td>05</td>
<td>3</td>
<td>All marks for AO3 (analyse)

<table>
<tr><th>Level</th><th>Marks</th><th>Description</th></tr>
<tr><td>3</td><td>5-6</td><td>Demonstrates a comprehensive knowledge of the advantages and disadvantages with a thorough analysis of the concepts associated with different materials.</td></tr>
<tr><td>2</td><td>3-4</td><td>Demonstrates a reasonable knowledge of the advantages and disadvantages with an adequate analysis of the concepts associated with different materials.</td></tr>
<tr><td>1</td><td>1-2</td><td>Demonstrates a limited knowledge of the advantages and disadvantages with a basic analysis of the concepts associated with different materials.</td></tr>
<tr><td></td><td>0</td><td>Nothing of relevance or no response.</td></tr>
</table>

Indicative content:

Candidate responses may include (but are not limited to) factors such as:

GRP:
• flexible design (in terms of shape/complexity)
• reduced section area/thickness leading to efficient design
• high strength-to-weight ratio allowing less material to be used
• direction/orientation of weave leading to stiffness/strength in certain directions
• aesthetics
• ability to create complex shapes in one piece
• resistance to water and moisture
• once mould for GRP is made, it is cheaper to produce more and you can use less skilled labour.

Wood:
• sustainable
• recyclable
• prone to leakage
• expensive to make as need for skilled labour.</td>
<td>6</td>
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<table>
<tr><td>05</td><td>4</td><td>All marks for AO1 (knowledge)

Reward either a written description or through sketches and/or notes

Lift: A force which acts perpendicular to the direction of travel (1). Lift is created by a difference in air pressure. (1)</td><td>2</td></tr>
</table>

<table>
<tr><td>06</td><td>1</td><td>1 mark for AO1 (knowledge) and 1 mark for AO2 (application of knowledge and understanding)

Apply one mark for each of the following steps:
360x1/3
120^{o}

Award any other appropriate working of this calculation.</td><td>2</td></tr>
</table>

<table>
<tr><td>06</td><td>2</td><td>3 marks for AO1 (knowledge) and 3 marks for AO1 (understanding)

<table>
<tr><th>Level</th><th>Marks</th><th>Description</th></tr>
<tr><td>3</td><td>5-6</td><td>Thorough description showing interaction between cam and follower to produce reciprocating outcome.</td></tr>
<tr><td>2</td><td>3-4</td><td>Clear description which shows some understanding of the mechanism and its function.</td></tr>
<tr><td>1</td><td>1-2</td><td>Basic description showing cam and/or follower.</td></tr>
<tr><td></td><td>0</td><td>Nothing of relevance or no response.</td></tr>
</table>

Indicative content:

A rotating shaft
Cams mounted to rotating shaft
Shape of cam is designed to lift a follower
Cam can be designed for different periods of lift
The follower is held in a guide to ensure reciprocal motion
End profile of the follower may be flat, circular or contain a roller which affects the movement of the follower itself.</td><td>6</td></tr>
</table>

<table>
<tr><td>07</td><td>1</td><td>One mark for AO1 (knowledge) and 3 marks for AO2 (application of knowledge and understanding)

Award one mark for each of the following:
Recall Correct equation – V=IxR
Manipulation of equation – I = V/R
Correct use of equation to generate answer (2/4 = 0.5)
Correct units (A).

Award marks for equation and units, if correct, but incorrect answer given.</td><td>4</td></tr>
</table>

07	2	All marks for AO1 (knowledge) A – Gate B – Drain C - Source	3

07	3	All marks for AO1 (knowledge) LDR ADC or Micro controller LED, LAMP	3

07	4	4 marks for AO2 (application of knowledge and understanding) and 1 mark for AO3 (evaluate) 1 mark for correct calculation of the PP3 (cuboid) 1 mark for correct volume of AA and AAA (cylinder) 1 mark for correct answer for AA space needed 1 mark for correct answer for AAA space needed 1 mark for correct recommendation AAA – 11560mm^3 AA – 25017mm^3 PP3 – 22491mm^3 Correct Answer = AAA. Award any other appropriate working of this calculation.	5

07	5	All marks for AO3 (evaluate) **Indicative content:** Weight Size Shape Battery life Any other relevant points should be credited	3

Level	Marks	Description
3	3	Well-reasoned argument accurately referencing/supported by previous data and calculations
2	2	Adequately reasoned argument referencing/supported by some of the previous data or calculations
1	1	Evaluation or reason given but not substantiated by data analysis
0	0	Nothing of relevance or no response.

07	6	2 marks for AO1 (knowledge) and 2 marks for AO2 (application of knowledge and understanding) Award marks as follows: 1 mark per correct dimension (MAX 2): 125, 12, 3 or 6 1 mark for each correct convention (MAX 2): leader lines, solid arrow heads, dimension centred above line, diameter symbol.	4

07	7	5 marks for AO1 (understanding) and 5 marks for AO2 (application of knowledge and understanding) AO1 marks for showing understanding of the correct tool/equipment to use in the scenario and AO2 marks for showing understanding of what happens during the operation. One mark for each correct response.	10

Order	Operation	Tools/Equipment	Description
1	Cast the blank lever	E	I
2	Machine the lever to correct size and tolerances	B	H
3	Make holes for brake cable and ventilation	K	A
4	Deburr holes	F	J
5	Finish surface	C	G

<table>
<tr>
<td>07</td>
<td>8</td>
<td>1 mark for AO1 (knowledge) and 2 marks for AO2 (application of knowledge and understanding)

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>3</td><td>Detailed description with specific knowledge of the tool and how to use it.</td></tr>
<tr><td>2</td><td>Simple description of how the tool could be used – lacks detail but has correct name.</td></tr>
<tr><td>1</td><td>Correct tool name.</td></tr>
<tr><td>0</td><td>Nothing of relevance or no response.</td></tr>
</table>

Indicative content:

Vernier callipers
Micrometer
Go-nogo gauge

Marks should be awarded if students respond with an appropriately labelled diagram of a tool.</td>
<td>3</td>
</tr>
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<tr>
<td>07</td>
<td>9</td>
<td>All marks for AO3 (evaluate)

<table>
<tr><th>Marks</th><th>Description</th></tr>
<tr><td>3</td><td>Three points justified with comparison.</td></tr>
<tr><td>2</td><td>Two points justified with comparison.</td></tr>
<tr><td>1</td><td>One point justified with comparison.</td></tr>
<tr><td>0</td><td>No response or nothing worthy of credit.</td></tr>
</table>

Points might include but are not limited to:

• Quality of finish (polished die will provide a better finish than sandcasting)
• Conformity of size/repeatability (the use of a machine die will produce components that are more dimensionally accurate where removal of the pattern could impact on accuracy)
• Speed of production/easily automated (number of operations is limited to pouring, cooling and ejecting; for die casting for sandcasting, individual moulds have to be prepared for every pour).</td>
<td>3</td>
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</table>

08

2 marks for AO1 (understanding), 2 marks for AO2 (application of knowledge and understanding) and 4 marks for AO3 (evaluate)

Level	Marks	Description
3	7-8	Demonstrates comprehensive understanding of at least two different methods, providing relevant detail that is applied appropriately to the context. Robust, balanced evaluation of advantages and disadvantages of different methods with regards to environmental impact.
2	4-6	Good knowledge of at least two different methods coherently described, providing mainly correct detail that is usually appropriate to the context. Good understanding of the links between methods and impacts. Evaluation of environmental impacts is present, but unbalanced.
1	1-3	Demonstrates fragmented knowledge of different methods. Knowledge of one method 1 mark, needs more than one method to move to top of level. Understanding of links between methods and impacts is basic. Evaluation of environmental impacts is limited.
	0	Nothing of relevance or no response.

Indicative content:

Candidate responses should evaluate one or more methods of energy production with relation to a range of environmental factors which could stem from the following.

Methods of generating mains electricity

Fossil fuels

- Atmospheric pollution.
- Damage caused by resource extraction such as mining/gas/oil retrieval

Wind generation

- High capital costs but free at point of generation
- Non-polluting at the point of generation
- Local nuisance value hence big ones have to be put off-shore (also guarantees wind but maintenance is made more difficult).

Tidal

- Totally predictable
- Huge negative impact on tidal estuaries and wildlife.

Hydro

8

		• High capital cost but very low pollution (unless pump storage system, as it will then still require other means of producing electricity). Nuclear • Threat of nuclear pollution • Waste disposal issues • Dismantling issues • Constant and guaranteed supply • Tried and tested technology. Solar • High capital costs but free at point of generation • Uses lots of land • Unsightly • Unpredictable.	

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