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# General Certificate of Secondary Education **Engineering (Double Award)**

48503

Mark scheme

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4850

June 2013

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Version/Stage: Final

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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](http://aqa.org.uk)

## Question 1

| Question | Part | Sub Part | Marking Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Mark | Comments |
|----------|------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|
| 1        | a    | i        | Strength<br>Ease of working<br>Inexpensive                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2    |          |
| 1        | a    | ii       | Diameter or Ø6 millimetre or mm                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1    |          |
| 1        | a    | iii      | 1 mark for each correct view (3 total)<br>1 mark for correct orientation<br>Up to 3 marks for correct dimensions                                                                                                                                                                                                                                                                                                                                                                                 | 7    |          |
| 1        | b    | i        | Answer $25 + 350 + 450 + 350 + 25 = 1200\text{m}$<br><br>3 marks for correct response with correct calculations<br>2 marks for a close answer<br>1 mark for a good attempt / correct answer with no calculations                                                                                                                                                                                                                                                                                 | 3    |          |
| 1        | b    | ii       | Answer - Single sheet - 1200mm x 350mm<br><br>(Close answer) Try $350 \text{ into } 1250 = 3$<br>$1200 \text{ into } 2500 = 2$<br>Therefore 6 pieces may be cut from a standard sheet<br><br>(Best fit) Try $1200 \text{ into } 1250 = 1$<br>$350 \text{ into } 2500 = 7$<br>Thus 7 pieces may be cut from sheet<br><br>4 marks for correct calcs and number of casings<br>3 marks for correct answer at best fit<br>2 marks for correct procedure and close answer<br>1 mark for a close answer | 4    |          |

## Question 2

| Question | Part | Sub Part | Marking Guidance              |                                                                                                  |                                                               |                                                              | Mark | Comments                                                                                              |
|----------|------|----------|-------------------------------|--------------------------------------------------------------------------------------------------|---------------------------------------------------------------|--------------------------------------------------------------|------|-------------------------------------------------------------------------------------------------------|
| 2        | a    |          | Op. No.                       | Description of task                                                                              | Tools/Equipment required                                      | Health and safety issues                                     | 8    | <p><u>Alternative Response</u></p> <p>Op. No. 3 A C H</p> <p>Op. No. 4 F G D</p> <p>Award 4 Marks</p> |
|          |      |          | 1                             | Select one sheet 0.6mm LCS and place on Guillotine                                               | Micrometer to measure sheet thickness                         | Use of steel reinforced gloves, overalls and boots           |      |                                                                                                       |
|          |      |          | 2                             | Set up Guillotine guide rails to appropriate size and cut to outside shape de-grease and de-burr | 1 metre Rule, Guillotine                                      | Isolate/padlock Guillotine until after setting up completed. |      |                                                                                                       |
|          |      |          | 3                             | F<br>Mark-out bend lines and holes                                                               | G<br>1m rule, 300mm rule, scribe, tri square and Centre Punch | D<br>Beware of sharp edges and pointed tools                 |      |                                                                                                       |
|          |      |          | 4                             | A<br>Drill 4 x Ø6 holes and de-burr                                                              | C<br>Clamps, wooden support                                   | H<br>Use goggles and a guard                                 |      |                                                                                                       |
|          |      |          | 5                             | B<br>Bend to final shape                                                                         | Bending machine                                               | E<br>Beware of trapping fingers                              |      |                                                                                                       |
|          |      |          | 6                             | Inspect, check against specification/drawing                                                     | Drawing, Rule                                                 | Beware sharp edges                                           |      |                                                                                                       |
|          |      |          | 1 mark for each missing point |                                                                                                  |                                                               |                                                              |      |                                                                                                       |

|   |   |  |                                                                                                                                 |   |  |
|---|---|--|---------------------------------------------------------------------------------------------------------------------------------|---|--|
| 2 | b |  | Power Presswork – with press tools for cutting, piercing and bending<br>Press Brake and Punch – set up for piercing and bending | 2 |  |
|---|---|--|---------------------------------------------------------------------------------------------------------------------------------|---|--|

### Question 3

| Question | Part | Sub Part | Marking Guidance                                                                                                                                                                                                                                                                                                                                         | Mark | Comments |
|----------|------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|
| 3        | a    | i        | Process - Anodising (2 marks)<br>Plating or Sealing/Powder Coating/Lacquering (1 mark)                                                                                                                                                                                                                                                                   | 2    |          |
| 3        | a    | ii       | 1 mark for each stage of process<br><br>Description of process to include: <ul style="list-style-type: none"> <li>• chemical cleaning</li> <li>• etching/desmutting</li> <li>• Acid bath with DC electric current passed with aluminium as the anode</li> <li>• Colouring and sealing</li> <li>• Or similar for purging, powder coating, etc.</li> </ul> | 3    |          |
| 3        | b    |          | Hazards and controls include : <ul style="list-style-type: none"> <li>• Fumes – wear mask and or use fume extraction</li> <li>• Airborne particles – wear eye protection</li> </ul>                                                                                                                                                                      | 2    |          |
| 3        | c    |          | 1 mark for any two of the following <ul style="list-style-type: none"> <li>• Cheap to produce</li> <li>• Easy to die cast to required shape</li> <li>• Light but strong</li> <li>• Any other valid reason</li> </ul>                                                                                                                                     | 2    |          |

## Question 4

| Question | Part | Sub Part | Marking Guidance                                                                                                                                                                                                         | Mark | Comments |
|----------|------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|
| 4        | a    | i        | maximum size of hole = 40.02                                                                                                                                                                                             | 1    |          |
| 4        | a    | ii       | minimum size of hole = 40.00                                                                                                                                                                                             | 1    |          |
| 4        | a    | iii      | maximum size of axle = 39.99                                                                                                                                                                                             | 1    |          |
| 4        | a    | iv       | minimum size of axle = 39.97                                                                                                                                                                                             | 1    |          |
| 4        | b    | i        | 1 mark for a limited explanation and 2 marks for an explanation similar to that below.<br>To enable the wheel to revolve freely on the axle, the diameter of the axle must always be smaller than the hole in the wheel. | 2    |          |
| 4        | b    | ii       | Hole = Plug Gauge<br>Axle = Caliper or Snap gauge<br>Go – Not Go Gauge?<br>Micromotor                                                                                                                                    | 2    |          |

### Question 5

| Question              | Part          | Sub Part      | Marking Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Mark      | Comments      |               |               |                       |    |    |    |                    |    |    |    |                       |    |    |    |                     |    |    |    |           |    |    |    |                 |   |   |   |   |  |
|-----------------------|---------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------|---------------|---------------|-----------------------|----|----|----|--------------------|----|----|----|-----------------------|----|----|----|---------------------|----|----|----|-----------|----|----|----|-----------------|---|---|---|---|--|
| 5                     | a             |               | <p>1 mark for each missing value</p> <table border="1"> <thead> <tr> <th>Operation</th> <th>X co-ordinate</th> <th>Y co-ordinate</th> <th>Z co-ordinate</th> </tr> </thead> <tbody> <tr> <td>Move to start of slot</td> <td>20</td> <td>45</td> <td>10</td> </tr> <tr> <td>Start to mill slot</td> <td>20</td> <td>45</td> <td>-5</td> </tr> <tr> <td>Continue to mill slot</td> <td>20</td> <td>15</td> <td>-5</td> </tr> <tr> <td>Change of direction</td> <td>50</td> <td>15</td> <td>-5</td> </tr> <tr> <td>Exit slot</td> <td>50</td> <td>15</td> <td>10</td> </tr> <tr> <td>Return to datum</td> <td>0</td> <td>0</td> <td>0</td> </tr> </tbody> </table> | Operation | X co-ordinate | Y co-ordinate | Z co-ordinate | Move to start of slot | 20 | 45 | 10 | Start to mill slot | 20 | 45 | -5 | Continue to mill slot | 20 | 15 | -5 | Change of direction | 50 | 15 | -5 | Exit slot | 50 | 15 | 10 | Return to datum | 0 | 0 | 0 | 6 |  |
| Operation             | X co-ordinate | Y co-ordinate | Z co-ordinate                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |               |               |               |                       |    |    |    |                    |    |    |    |                       |    |    |    |                     |    |    |    |           |    |    |    |                 |   |   |   |   |  |
| Move to start of slot | 20            | 45            | 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |               |               |               |                       |    |    |    |                    |    |    |    |                       |    |    |    |                     |    |    |    |           |    |    |    |                 |   |   |   |   |  |
| Start to mill slot    | 20            | 45            | -5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |               |               |               |                       |    |    |    |                    |    |    |    |                       |    |    |    |                     |    |    |    |           |    |    |    |                 |   |   |   |   |  |
| Continue to mill slot | 20            | 15            | -5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |               |               |               |                       |    |    |    |                    |    |    |    |                       |    |    |    |                     |    |    |    |           |    |    |    |                 |   |   |   |   |  |
| Change of direction   | 50            | 15            | -5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |               |               |               |                       |    |    |    |                    |    |    |    |                       |    |    |    |                     |    |    |    |           |    |    |    |                 |   |   |   |   |  |
| Exit slot             | 50            | 15            | 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |               |               |               |                       |    |    |    |                    |    |    |    |                       |    |    |    |                     |    |    |    |           |    |    |    |                 |   |   |   |   |  |
| Return to datum       | 0             | 0             | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |               |               |               |                       |    |    |    |                    |    |    |    |                       |    |    |    |                     |    |    |    |           |    |    |    |                 |   |   |   |   |  |
| 5                     | b             |               | <p>3 marks for a complete explanation<br/>                     2 marks for limited explanation of both CAD and CAM<br/>                     1 mark for a limited explanation of either CAD or CAM</p> <p>CAD software is used to draw the exact shape and dimensions of the component to be machined this information is then converted to a Part Program that can be downloaded on to a CNC machine for the manufacture of the component.</p>                                                                                                                                                                                                                  | 3         |               |               |               |                       |    |    |    |                    |    |    |    |                       |    |    |    |                     |    |    |    |           |    |    |    |                 |   |   |   |   |  |

**Question 6**

| Question | Part | Sub Part | Marking Guidance                                                                                                                                                                                                                                                                                                                                                                               | Mark | Comments |
|----------|------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|
| 6        | a    |          | 2 marks each for three of the following <ul style="list-style-type: none"> <li>• Pick and Place for automated assembly from circuit boards to complete appliances</li> <li>• Materials handling - from stores or between machines</li> <li>• Processes – welding, painting, etc.</li> <li>• Work holding – hot wire forming, laser cutting, etc.</li> <li>• Any other valid example</li> </ul> | 6    |          |
| 6        | b    |          | <ul style="list-style-type: none"> <li>• Robotic arms need to be well guarded to protect human workers.</li> <li>• Malfunctions can cause serious damage to personnel and equipment.</li> </ul>                                                                                                                                                                                                | 2    |          |

**Question 7**

| Question | Part | Sub Part | Marking Guidance                                                                                                                                                                                                                                             | Mark | Comments |
|----------|------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|
| 7        | a    |          | 1 mark each for two of the following outputs and inputs <ul style="list-style-type: none"> <li>• Inputs – air temperature, air quality (dust etc.), humidity</li> <li>• Outputs – regulated air temperature, filtered air, regulated humidity.</li> </ul>    | 4    |          |
| 7        | b    |          | 2 marks for a good explanation<br>1 mark for a limited explanation <ul style="list-style-type: none"> <li>• Thermo Chromic materials – colour change in response to temperature</li> <li>• Any application of the above or other smart materials.</li> </ul> | 2    |          |

## Question 8

| Question | Part | Sub Part | Marking Guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Mark | Comments |
|----------|------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------|
| 8        |      |          | <ul style="list-style-type: none"> <li>• Maintaining Machines bearings, etc. to give optimum efficiency</li> <li>• Replace old machinery with modern energy efficient equipment</li> <li>• Turn off lights and/or machines when not in use</li> <li>• Ensure good quality control to reduce number of faulty parts made</li> <li>• Contribute to energy usage by generating wind or solar power</li> <li>• Reduce waste / Recycle to minimise transport/fuel costs</li> <li>• Access off peak energy tariff</li> <li>• Accurate control of material usage to minimise machining/processing</li> </ul> <p>Technical knowledge will be assessed as follows:</p> <p><b>(1 mark a very limited explanation covering 1 point above<br/>                 (2 marks a limited explanation covering at least 2 points above or a good explanation of 1 point above)<br/>                 (3 marks a good explanation covering at least 2 points above)<br/>                 (4 marks a good explanation covering at least 3 points above)</b></p> <p>In addition to the above the Quality of Written Communication will also be assessed in this response as follows:</p> <p><b>(1 mark for a limited response with significant errors in grammar, punctuation and spelling).<br/>                 (2 marks for a weakly presented response with some errors in grammar, punctuation and spelling).<br/>                 (3 marks for a good response with few errors in grammar, punctuation and spelling).<br/>                 (4 marks for a fluent response with no errors in grammar, punctuation and spelling).</b></p> | 8    |          |

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|  |  | <p><b>Level 1</b> Candidates express straightforward ideas clearly, if not always fluently. Arguments stray from the point on occasion or may be weakly presented. There may be many or a number of errors of grammar, punctuation and spelling.</p> <p><b>Level 2</b> Candidates express complex ideas very clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. There may be occasional or few/no errors of grammar, punctuation and spelling. For full marks, a candidates response must be within this band.</p> |  |  |
|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|