

# 1145-20 Level 2 Technical Award in Engineering

## 1145-502 Level 2 Engineering - Theory exam

### March 2022 Mark Scheme

| Q no. | Acceptable answer(s)   | Guidance   | Max mks | Ref               |
|-------|--|--|---------|-------------------|
| Q1a)  | <p>i)<br/>1 mark for any suitable response. For example:</p> <ul style="list-style-type: none"> <li>To show the parts in an assembly (1).</li> <li>To show the location of components/assemblies (1).</li> <li>Any other suitable response.</li> </ul> <p>ii)<br/>1 mark for any suitable response. For example:</p> <ul style="list-style-type: none"> <li>To show how the parts of a product fit together (1).</li> <li>To show the relationship between the different parts of a product (1).</li> <li>Any other suitable response.</li> </ul> <p>iii)<br/>1 mark for any suitable response. For example:</p> <ul style="list-style-type: none"> <li>To show specific features on a component (1).</li> <li>Any other suitable response.</li> </ul> |  | 3       | 201<br>1.1<br>AO1 |
| Q1 b) | <p>1 mark for <b>each</b> of the following, <b>up to a maximum of 3 marks</b>:</p> <ul style="list-style-type: none"> <li>Drawing ID number (1)</li> <li>Owner of the drawing (1)</li> <li>Version number (1)</li> <li>Revision date (1)</li> <li>Scale of drawing (1)</li> <li>Standards used (1)</li> <li>Any other suitable response.</li> </ul>  |  | 3       | 201<br>1.2<br>AO1 |
| Q1 c) | <p>Advantages, e.g.:</p> <ul style="list-style-type: none"> <li>Drawings can be created directly/automatically from a 3D CAD model (1) thus saving time (1).</li> <li>Drawings can be easily modified (1), making errors less likely (1).</li> <li>Drawings can be password protected (1), making them more secure (1).</li> <li>Any other suitable response.</li> </ul> <p>Disadvantages, e.g.:</p>   | 1 mark for identifying any suitable advantage. 1 mark for explanation. | 4       | 201<br>2.1<br>AO2 |

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|              | <ul style="list-style-type: none"> <li>High setup costs (1) as computers/software are more expensive than manual drawing equipment (1).</li> <li>Computers can be hacked (1) leading to drawings being stolen if they are not password protected (1).</li> <li>Engineers may be unfamiliar with CAD software (1) so time is needed to train them in how to use it (1).</li> <li>Any other suitable response.</li> </ul>   | 1 mark for identifying any suitable disadvantage. 1 mark for explanation.  |  |  |
| <b>Q1 d)</b> | <p>1 mark for any of the following, <b>up to a maximum of 2 marks:</b></p> <ul style="list-style-type: none"> <li>Extrude (1)</li> <li>Revolve (1)</li> <li>Loft (1)</li> <li>Sweep (1)</li> <li>Any other suitable response.</li> </ul>  |  | 2  | 201<br>3.2<br>AO1  |
| <b>Q2 a)</b> | <p>Toggle switch - purpose:</p> <ul style="list-style-type: none"> <li>To make or break a circuit when the toggle is moved (1).</li> </ul> <p>Toggle switch – application. For example:</p> <ul style="list-style-type: none"> <li>As a switch for a table lamp (1) that needs to latch on until turned off (1).</li> <li>As a power on/off switch (1) for an alarm circuit (1).</li> <li>Any other suitable response.</li> </ul> <p>Thermistor - purpose:</p> <ul style="list-style-type: none"> <li>Senses changes in temperature level (1).</li> </ul> <p>Thermistor - application. For example:</p> <ul style="list-style-type: none"> <li>Sensor for a greenhouse (1) that turns on a cooling system when it becomes too warm (1).</li> <li>As part of a potential divider circuit (1) used to trigger a transistor switch (1).</li> <li>Sensor for a fire alarm (1) that turns on when high heat levels are detected (1).</li> <li>Any other suitable response.</li> </ul> <p>Motor - purpose:</p> <ul style="list-style-type: none"> <li>Produces rotary motion when current flows through it (1).</li> </ul> <p>Motor - application. For example:</p> <ul style="list-style-type: none"> <li>On a production line robot arm (1) to move an item from one station to the next (1).</li> <li>Wheels on an electric train (1) that turn when the battery provides power (1).</li> <li>In reverse as a generator (1) for a wind turbine (1).</li> <li>Any other suitable response.</li> </ul> | <p>1 mark for stating the purpose and up to 2 marks for describing an application. Applications can be product or circuit based.</p> | 1<br><br>2<br><br>1<br><br>2<br><br>1<br><br>2 | 201<br>3.2<br>AO1<br>AO2<br><br>201<br>3.2<br>AO1<br>AO2<br><br>201<br>3.2<br>AO1<br>AO2 |
| <b>Q2 b)</b> | <p>1 mark for <b>each</b> of the following:</p> <ul style="list-style-type: none"> <li>Monostable produces a single pulse (1)</li> <li>Astable produces multiple pulses (1)</li> </ul>  |  | 2  | 201<br>3.2<br>AO2  |

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| <b>Q2 c)</b> | <p>1 mark for <b>each</b> of the following, <b>up to a maximum of 3 marks</b>:</p> <ul style="list-style-type: none"> <li>• To create a recess (1) so that the head of a screw is level with or below the surface of a part (1).</li> <li>• To stop parts snagging on each other (1).</li> <li>• To allow free movement of surfaces (1).</li> <li>• To allow clearance (1).</li> <li>• Any other appropriate answer.</li> </ul>  |  | 3 | 201<br>3.1<br>AO2 |
| <b>Q3 a)</b> | <p>1 mark for <b>each</b> correct response:</p> <p>i) <math>m^2</math> (1)<br/>ii) W (1)<br/>iii) F (1)</p>  |  | 3 | 201<br>4.1<br>AO1 |
| <b>Q3 b)</b> | <p>1 mark for the following:<br/>Unit of measurement made up from a combination of different base units (1).</p>   |  | 1 | 201<br>4.1<br>AO1 |
| <b>Q3 c)</b> | <p>i)<br/><b>Maximum of 2 marks</b> for purpose:<br/>To measure dimensions such as external diameter (1), internal diameter (1) or the depth of a hole (1).</p> <p>ii)<br/><b>Maximum of 2 marks</b> for examples of typical use:</p> <ul style="list-style-type: none"> <li>• measuring the external diameter of a shaft or rod (1)</li> <li>• measuring the internal or external diameter of a pipe or tube (1)</li> <li>• Any other appropriate example.</li> </ul> |  | 4 | 201<br>4.3<br>AO2 |
| <b>Q4 a)</b> | <p>1 mark for <b>each</b> of the following, <b>up to a maximum of 2 marks</b>:</p> <ul style="list-style-type: none"> <li>• Film (1)</li> <li>• Powder (1)</li> <li>• Any other suitable response.</li> </ul>  |  | 2 | 202<br>1.2<br>AO1 |
| <b>Q4 b)</b> | <p>1 mark for <b>each</b> suitable point, <b>up to a maximum of 2 marks</b>:</p> <ul style="list-style-type: none"> <li>• Thermoplastic polymer can be heated and re-moulded many times (1) whereas a thermosetting polymer can only be moulded once (1).</li> <li>• Any other suitable response.</li> </ul>   | Response must refer to both thermoplastic polymers and thermosetting polymers for full marks.  | 2 | 202<br>1.2<br>AO1 |
| <b>Q4 c)</b> | <p>i)<br/>1 mark for any relevant material type:</p> <ul style="list-style-type: none"> <li>• Non-ferrous metal (1)</li> <li>• Ferrous metal (1)</li> <li>• Composite material (1)</li> <li>• Any other suitable response.</li> </ul>  | i) Award 1 mark for any suitable material type given. Candidates <b>do not</b> need to name a specific material to gain the mark. Do not | 1 | 202<br>1.2<br>AO2 |

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|              | <p>ii)</p> <p>1 mark for <b>each</b> suitable point. For example:</p> <ul style="list-style-type: none"> <li>• Good tensile strength (1) so the frame does not break when subjected to pulling stresses (1).</li> <li>• Good compressive strength (1) so the frame does not break when subjected to pushing stresses (1).</li> <li>• High corrosion resistance (1) so the bicycle is suitable for use in wet weather (1).</li> <li>• Low relative cost (1) so cheaper for consumer to buy (1).</li> <li>• Low weight (1) so would make it easier to increase speed of the bicycle (1).</li> <li>• Any other relevant point.</li> </ul> | <p>allow metal on its own.</p> <p>ii) <b>Maximum</b> of 1 mark <b>each</b> for <b>two</b> properties and 1 mark <b>each</b> for explanations.</p> | 4 |                   |
| <b>Q5 a)</b> | <p>Award 1 mark <b>each</b> for the following:</p> <ul style="list-style-type: none"> <li>• MIG/MAG (1)</li> <li>• TIG (1)</li> <li>• Any other suitable response.</li> </ul>  |   | 2 | 202<br>2.2<br>AO1 |
| <b>Q5 b)</b> | <p>Award 1 mark <b>each</b> for the following:</p> <ul style="list-style-type: none"> <li>• Wave (1)</li> <li>• Surface mount technology/SMT (1)</li> <li>• Hand soldering (1)</li> <li>• Any other suitable response.</li> </ul>  |   | 2 | 202<br>2.2<br>AO1 |
| <b>Q5 c)</b> | <p>1 mark for <b>each</b> suitable point <b>up to a maximum of 4 marks</b>. For example:</p> <ul style="list-style-type: none"> <li>• Can be used to join dissimilar materials (1).</li> <li>• Provides a permanent join (1).</li> <li>• Provides a clear finish (1).</li> <li>• Strong/hard wearing (1) so well suited to applications where durability is needed (1).</li> <li>• Waterproof (1) so suits outdoor applications (1).</li> <li>• Can be used to join composite materials (1).</li> <li>• Any other suitable response.</li> </ul>  | <p>Answer must be an explanation for <b>full marks</b>.</p>   | 4 | 202<br>2.2<br>AO2 |
| <b>Q6</b>    | <p>1 mark <b>each</b> relevant descriptive point <b>up to a maximum of 6 marks</b>. For example:</p> <ul style="list-style-type: none"> <li>• Use a pattern to create a mould in sand (1).</li> <li>• Incorporate the pattern and sand in a gating system (1).</li> <li>• Remove the pattern (1).</li> <li>• Fill the mould cavity with molten metal (1).</li> <li>• Allow the metal to cool (1).</li> <li>• Break away/crack the sand mould (1).</li> <li>• Remove the sand casted object (1).</li> <li>• Quench the cased object in water (1).</li> <li>• Any other relevant point.</li> </ul>                                       |   | 6 | 202<br>2.1<br>AO1 |

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|-------|--|--|----|--|
| Q7 a) | <p>1 mark for <b>each</b> of the following <b>up to a maximum of 2 marks</b>:</p> <ul style="list-style-type: none"> <li>• Fused deposition modelling/3D printing (1)</li> <li>• Stereolithography (1)</li> <li>• Selective laser sintering (1)</li> </ul>   |  | 2  | 202<br>3.3<br>AO1  |
| Q7 b) | <p>1 mark for <b>each</b> up to <b>4 marks</b>:</p> <ul style="list-style-type: none"> <li>• Does not require physical materials/components (1) thus reducing cost (1).</li> <li>• Extremely accurate (1) so less chance of errors (1).</li> <li>• The model can be produced very quickly (1) thus reducing time needed to bring the final product design to manufacture (1).</li> <li>• Any other suitable response.</li> </ul>   | 1 mark for <b>each</b> suitable reason. 1 mark for further explanation of <b>each</b> .  | 4  | 202<br>3.1<br>AO2  |
| Q7 c) | <p>1 mark for correct response:</p> <ul style="list-style-type: none"> <li>• To give it a realistic appearance. (1)</li> <li>• Any other suitable response. (1)</li> </ul>   |  | 1  | 202<br>3.2<br>AO1  |
| Q7 d) | <p>1 mark for <b>each</b> up to <b>4 marks</b>:</p> <ul style="list-style-type: none"> <li>• Uses physical components (1) so produces accurate results (1).</li> <li>• No soldering required/clip together assembly (1) so changes can be made quickly/easily (1).</li> <li>• Easy to fault find (1) as layout follows block diagram (1).</li> <li>• Any other suitable response.</li> </ul>   | 1 mark for <b>each</b> suitable reason. 1 mark for further explanation of <b>each</b> .  | 4  | 202<br>3.4<br>AO2  |
| Q8    | <p><b>Band descriptors</b><br/>No answer worthy of credit, e.g. insufficient work submitted, answer not relevant to the question, answer is factually incorrect.<br/><b>(0 marks)</b></p> <p><b>Band 1</b> – basic – largely descriptive response based on recall of knowledge relating to either design or manufacturing. A few influencing factors have been given. Candidates at the top of this band may give reasons for one or two influences.<br/><b>(1-4 marks)</b></p> <p><b>Band 2</b> – clear – more detailed response showing some level of understanding, relating to both design and manufacturing. A range of influencing factors have been given with some supporting discussion. Candidates at the top of this band may have considered the secondary implications of some influences.<br/><b>(5-8 marks)</b></p> | <p><b>Indicative content:</b></p> <p><i>Designing the product:</i></p> <ul style="list-style-type: none"> <li>• The product must be designed so that it meets criteria relating to dimensions, cost, aesthetics, sustainability, safety and function.</li> <li>• Selection of appropriate materials and/properties.</li> <li>• Selection of appropriate mechanical or</li> </ul> | 12 | 201<br>1.1,<br>1.2,<br>2.1,<br>2.2,<br>3.1,<br>3.2,<br>4.2,<br>4.3<br><br>202<br>1.1,<br>1.2<br>2.1,<br>2.2,<br>3.1,<br>3.2,<br>3.3,<br>3.4,<br>3.5,<br>4.1,<br>4.2<br>AO4 |

**Band 3** – detailed – very detailed response showing a high level of understanding, relating to both design and manufacturing. A wide variety of influencing factors given and discussed in detail. Conclusions are presented that are both valid and fully justified. Candidates at the top of this band may have considered both the secondary implications and conflicting requirements of some influences.

**(9-12 marks)**

- electrical components.
- Selection and use of appropriate CAD or physical modelling techniques to check design will function as required, e.g. 3D virtual modelling, block modelling and rapid prototyping.
- Required dimensions/tolerances must be shown in engineering drawings.

*Manufacturing the product:*

- Availability of the equipment needed to manufacture the product.
- Selection and use of appropriate manufacturing tools, equipment and processes.
- Selection and use of appropriate joining and finishing techniques.
- Selection and use of appropriate measuring techniques/equipment to test finished product against criteria.

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|  |  | Any other appropriate response. |  |  |
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