1145-32 Level 3 Advanced Technical Extended Diploma in Engineering (720)

1145-532 Level 3 Engineering - Theory exam (2)

March 2022 Mark Scheme

Q no.	Acceptable answer(s)	Guidance	Max mks	Ref
Q1	1 mark for each of the following, **up to a maximum of 6 marks**: • Carry out risk assessments (1) to identify and reduce potential sources of harm (1). • To provide appropriate training (1) to ensure employees are competent (1). • To provide a safe working environment for staff (1) and visitors (1). • To provide suitable toilet facilities (1) to prevent unsanitary working conditions (1). • To ensure that machines have appropriate guards (1) reducing the risk of entanglement/injuries due to ejected parts or swarf etc. (1). • To provide fire extinguishers (1), and put in place fire evacuation procedures (1) to ensure safety in the event of a fire (1). • Any other appropriate response.	Maximum of 3 marks just for stating responsibilities	6	307 1.2 AO 2
Q2	1 mark for each of the following, **up to a maximum of 6 marks**: • Cylinders of oxygen (1) and a fuel gas such as acetylene (1) are attached to a cutting torch (1). • The gas stream is ignited (1) and trained on the steel plate where the cut is required (1). • The metal is melted/burnt into a metal oxide (1) that flows/is blown out of the kerf as slag (1). • The cut surface may be subsequently dressed or machined to improve the surface finish (1). • Any other appropriate response.		6	307 2.4 AO 1

<table>
<tr>
<td>Q3</td>
<td>1 mark for each correct example of a typical tool or piece of equipment used up to a maximum of 4 marks. Accept appropriate alternatives:
<table>
<tr><th>Activity</th><th>Tool or equipment</th></tr>
<tr><td>Cutting a thread</td><td>E.g. die or lathe</td></tr>
<tr><td>Measuring a diameter to ± 0.01 mm</td><td>E.g. micrometer</td></tr>
<tr><td>Sequential tightening of bolts</td><td>E.g. spanner or wrench</td></tr>
<tr><td>Testing the accuracy of a plane surface</td><td>E.g. scribing block</td></tr>
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<td></td>
<td>1
1
1
1</td>
<td>307
2.3,
3.1,
3.2,
5.1
AO1</td>
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<td>Q4</td>
<td>1 mark each for up to a maximum of 4 of:

It can identify customer needs that are not being met (1) and there is the potential for a new product (1).
It can also identify where customers are dissatisfied with existing products (1), giving the opportunity to improve products (1) to gain a competitive advantage (1).
It can be used to justify investment in the development of a product or process (1).
Any other appropriate response.

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<td>4</td>
<td>308
1.2
AO2</td>
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<td>Q5 a)</td>
<td>1 mark for each of the following up to a maximum of 6 marks:

Gasification is a waste to energy process (1) that uses organic- or fossil fuel-based carbonaceous materials (1).
Materials are heated to high temperatures, typically >700ºC (1), in the presence of a controlled amount of oxygen (1) or steam (1).
Thermo-chemical decomposition occurs (1) and results in a gaseous mixture (1).
The gas mixture produced is carbon monoxide, hydrogen and carbon dioxide (1); this is called syngas/producer gas (1) and can be burnt as a fuel (1).
Any other appropriate response.

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<td>6</td>
<td>308
3.1,
3.2
AO2</td>
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</table>

Q5 b)	1 mark for each of the following **up to a maximum of 6 marks**: • Pyrolysis is carried out in the absence of oxygen whereas in gasification the materials are exposed to some oxygen but not enough for combustion to occur (1). • Whereas gasification produces syngas, pyrolysis produces volatile products depending upon the materials used (1) such as ethylene (1). • Pyrolysis typically leaves a solid residue (1) enriched in carbon, known as char (1). • The pyrolysis of some materials is carried out at much lower temperatures than gasification (1) e.g. 350-500^{o}C for biofuels (1) • Pyrolysis is sometimes followed by a second-phase gasification stage (1). • Any other appropriate response.	Accept answers from perspective of gasification as well	6	3083.1, 3.2 AO2
Q5 c)	1 mark for each of the following **up to a maximum of 8 marks**: • Low carbon technologies could reduce demand on fossil fuel (1) which in a non-renewable/finite resource (1), also reducing the risk of pollution during oil production (1). • Could be used to process biomass into biofuel, reducing the need to dispose of biological waste from other industries (1). • Could allow the processing of plastic waste materials (or car tyres) that would reduce the need for landfill (1) or even allow existing landfill to be used as a resource (1), freeing up land for other purposes (1) and reducing local pollution (1). • It could reduce the dumping of plastic waste at sea (1) which presents a significant risk to wildlife (1). The fuel oil produced from plastic may contain less sulphur and other adverse elements (1), causing less pollution at the point of use (1). • Any other appropriate response.		8	3081.3, 3.1, 3.2, 3.3 AO2

Q6	1 mark for each of the following points **up to a maximum of 6 marks**: • Immersive AR and VR environments such as holorooms (1) could allow designers to test and evaluate innovative product designs without the expense of making physical prototypes (1), reducing development costs for innovative products (1). • These could also be used to get customer feedback on designs at an early stage (1) reducing the risk in investment decisions (1). • Affordable virtual reality (VR) headsets will allow the wearer to experience created products (1), or to simulate manufacturing operations (1), identifying any issues that need to be addressed (1) and potential opportunities for improvement (1). • Any other suitable answer.	Award up to a maximum of 3 marks for stating applications	6	3084.2 AO2
Q7	1 mark for each of the following **up to a maximum of 2 marks**: • A system, where access to (or ability to edit) some data may be limited to certain groups or individuals (1), whereas other data may be shared publicly (1). • Any other appropriate point.	Answers must be descriptive to gain marks	2	3085.2 AO2

Q8	For no awardable content, award 0 marks. **Level 1 (1-4 marks)** Basic – descriptive response based on recall of knowledge, relating only to a single aim of research and development, e.g. an improvement in product performance or a manufacturing improvement. Candidates at the top of this level may be characterised by showing some understanding of the potential benefit of the stated aim. **Level 2 (5-8 marks)** Clear – more detailed response, describing a range of aims of research and development, e.g. improvements in product performance and manufacturing improvements. Shows recall of knowledge about aims of research and development and understanding of the main reason for each of the aims considered. Candidates at the top of this level may demonstrate understanding of secondary outcomes arising from the achievement of the aims. **Level 3 (9-12 marks)** Detailed – response showing awareness of a broad variety of aims during research and development (e.g. multiple improvements in product performance and manufacturing improvements), with analysis and evaluation of how they could affect the outcome if achieved. There is substantiation of which considerations are deemed more important, with understanding of the potential secondary outcomes arising from the achievement of the aims. Candidates at the top of this level may be characterised by analysing and evaluating the conflicting outcomes of different aims.	Indicative content: • Ensuring compliance of the product with safety regulations • Making the new process or technology fit for purpose • Ensuring that the materials produced or modified using the process are fit for purpose • Reducing product failure rates during manufacture and in service • Improving performance over existing processes and products • Refining and improving the production process • Meeting the needs of the enablers for the development • Technology push and market pull • Any other relevant response, including the use of relevant examples.	12	AO 4 307: 1.1, 1.4 308: 1.1, 1.2, 2.1, 2.2