



Mark Scheme (Final)

May 2015

Version 5

NQF BTEC Level 1/Level 2 Firsts in
Engineering

Unit 1: The Engineered World
(20526E)

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.

Question Number	Answer	Mark
1a	Forging (1)	(1)
1b	Chemical (1)	(1)

Question Number	Answer	Mark
2	Cardiac pacemaker – Biomedical (1) Helicopter rotor blade – Aerospace (1) 1 mark for each correct answer	(2)

Question Number	Answer	Mark
3a	Award one mark for each up to a maximum of two marks. <ul style="list-style-type: none"> • Assembly (1) • Surface mounting electronic components (1) • Inspection (1) • Pick and place (1) • Handling hazardous/hot/cold/awkward/small/heavy components (1) <p>Accept any other appropriate alternative.</p>	(2)
3b	Award one mark for one of the following. <ul style="list-style-type: none"> • High frequency of reprogramming for different batches (1) • High set up and maintenance costs (1) • Reprogramming for each batch can lead to substantial downtime (1) • Often require skilled labour to program/reprogram them (1) • Retraining of staff may be required (1) • Health and safety considerations are not immediately visible (1) <p>Accept any other appropriate alternative. Do not accept cost/health and safety/time without link to small batches.</p>	(1)

Question Number	Answer	Mark
4a	Smartphone (1) 	(1)
4b	electrical/electronic (1)	(1)

Question Number	Answer	Mark
5	Ultrasonic testing (1) Force measurement (1) 1 mark for each correct answer	(2)

Question Number	Answer	Mark
6	Award one mark for identifying an advantage and a further one mark for extension, up to a maximum of two marks. <ul style="list-style-type: none"> • Implants can be very small (1) because titanium has a high strength to weight ratio (1) • Dental implants will last a long time (1) because titanium maintains its high strength over time (1) • There is no danger of infection (1) because titanium is an inert material (eg. Not affected by chemical/acid/corrosive agents) (1) • Titanium has a similar elastic modulus to bone (1) therefore it can match the bone it is being implanted into (1) • Dental implants will not give problems with MRI scans, etc. (1) as titanium is non-magnetic (1) <p>Accept any other appropriate alternative. Do not accept strong/light etc without justification/expansion.</p>	(2)

Question Number	Answer	Mark
7a	<p>Award one mark for each up to a maximum of two marks.</p> <ul style="list-style-type: none"> • Good surface finish requiring little if any additional machining (1) • Turning allows perfectly round/concentric components to be produced (1) • Able to produce a size/dimension to the required tight tolerances for this type of application (1) • Can carry out all operations if CNC turning centres are used (1) • Can produce stepped surface required for seals (1) • Repeatable products can be produced (1) • Can be produced very quickly if CNC turning centres are used (1) <p>Accept any other appropriate alternatives.</p>	(2)
7b	<p>Award one mark for one of the following.</p> <ul style="list-style-type: none"> • So the spindle/cutting speeds can be increased (1) • To reduce tool wear (1) • To reduce friction (1) • To reduce built up edge (1) • To reduce cutting force requirements (1) • Enables greater depth of cut (1) • To lubricate the tool/workpiece (1) • Prevent corrosion (1) • To keep tool/workpiece cool (1) • Improved surface finish (1) • Helps swarf removal (1) <p>Accept any other appropriate alternatives.</p>	(1)

Question Number	Answer	Mark
8	<p>Award one mark for identifying a reason and a further one mark for extension, up to a maximum of two marks.</p> <ul style="list-style-type: none"> • Prevents blindness caused by welding arc/prevents damage to the eyes (1) because the mask has a UV filter to protect the eyes (1) • The mask can protect the face from burns (1) because sparks can occur when welding(1) • Hair is protected from burning(1) as the helmet fits over the hairline (1) • The filter can be changed (1) to suit varying arc/welding intensity (1) <p>Accept any other appropriate alternatives. Don't accept 'safety' without clarification/justification.</p>	(2)

Question Number	Answer	Mark
9	<p>High tolerances can be specified (1) Little waste material is produced (1)</p> <p>1 mark for each correct answer</p>	(2)

Question Number	Answer	Mark
10	<p>Award one mark for identifying a reason and a further one mark for extension, up to a maximum of two marks each.</p> <ul style="list-style-type: none"> • The turbine blades will remain stable (1) because superalloys have high creep resistance/due to single crystal structure (1) • The turbine blades will not fail/exhibit fatigue (1) as superalloys have high fatigue resistance (1) • The turbine blades will not suffer surface degradation (1) as the alloying process gives them good corrosion/oxidation resistance (1) • The turbine blades will not deform (1) because superalloys have high temperature strength properties (1) <p>Accept any appropriate alternatives provided it relates to the application identified. Do not accept strong/hard/strength/lightweight</p>	(4)

Question Number	Answer	Mark
11	punctures (1) weight (1) 1 mark for each correct answer	(2)

Question Number	Answer	Mark
12	Poka-yoke (1)	(1)

Question Number	Answer	Mark
13	Continuous production (1)	(1)

Question Number	Answer	Mark
14	<p>Award one mark for identifying a way and a further one mark for extension, up to a maximum of two marks each.</p> <ul style="list-style-type: none"> • By minimising overproduction (1) through the use of just-in-time techniques when making the shaft (1) • Removing the forging process/change the process (1) by machining the shaft in its entirety (1) • By minimising heat loss at the forging stage/use of heat exchanger (1) through careful layout/planning/collection of waste energy to minimise operator movement/transportation/energy use (1) • By using sensors during production of the shaft (1) so that lighting/heating/processes switch off when not in use (1) • Use regenerative drives on machine tools (1) which recover power from electrical energy used (1) • Use CAM/CNC software (1) which can reduce cycle times and energy used by minimising tool/workpiece movement (1) • Manufacture in batches/bulk (1) to overcome start up/shut down issues (1) <p>Accept any other appropriate alternatives. Do not accept reasons not linked to process e.g. insulate building/energy saving light bulbs.</p>	(4)

Question Number	Answer	Mark
<p>15</p>	<p>PV panels (1)</p>  <p>Water heater (1)</p> 	<p>(2)</p>

Question Number	Answer	Mark
<p>16</p>	<p>Award one mark for identifying an advantage and a further one mark for extension, up to a maximum of two marks.</p> <ul style="list-style-type: none"> • A CNC measuring device is quicker than conventional measuring (1) because it can carry out multiple measuring operations simultaneously (1) • Human/reading error is eliminated (1) because CNC based measuring system gives more consistent/accurate measurements (1) • It can help with SPC/process control (1) as measurement data can be automatically downloaded/statistically analysed (1) • A CNC measuring device can operate in a controlled environment (1) enabling highly precise measurement/protecting humans from hazardous environments (1) <p>Accept any other appropriate alternatives. Do not accept quicker/more accurate without expansion/justification.</p>	<p>(2)</p>

Question Number	Answer	Mark
17	<p>Award one mark for identifying a disadvantage and a further one mark for extension, up to a maximum of two marks each.</p> <ul style="list-style-type: none"> • TIG requires careful positioning of the filler rod (1) as it is melted in the weld pool (1) • TIG welding requires precise arc control (1) otherwise fusion of parent materials will be poor (1) • TIG welding requires experienced welders (1) because the welds are small and materials are often thin (1) • TIG welding does not generate smoke (1) so welders are more susceptible to arc eye (1) • TIG welding would only be economical for specialist application (1) due to the availability of less complex and cheaper/faster joining processes (1) • TIG welding requires very accurate edge preparation for quality joints (1) which requires more set-up time than alternatives (1) <p>Accept any other appropriate alternatives. Do not accept slower/more expensive without justification.</p>	(4)

Question Number	Answer	Mark
18	<p>Award one mark for identifying an advantage and a further one mark for extension, up to a maximum of two marks.</p> <ul style="list-style-type: none"> • Bionic eyes can be used to help control movement for paraplegics (1) as they can send electronic messages to muscles or prosthetic limbs (1) • A bionic eye can be part of a whole body control system (1) because it can be linked to other electronically controlled biomedical devices (1) • Can be used to transmit vision/signals (1) to allow other users/devices to gather/display data (1) <p>Accept any appropriate alternatives provided it relates to the application identified.</p>	(2)

Question Number	Indicative Content	Mark
19	<p>Possible judgement Applying LCA could make the product more sustainable and reduce its carbon footprint. There may be long term cost benefits however the short term cost implications need to be carefully considered. Similarly the technology required to implement these changes may be challenging and the environmental impact of the production of the panels could possibly be greater than the impact of the panels in use.</p> <p>Possible advantages from the LCA</p> <ul style="list-style-type: none"> • Raw materials extraction – The company may be able to source raw material that has a lower environmental impact than those currently used, or may be able to obtain the raw material in a more environmentally friendly way • Material production – The manufacturing process could be made leaner and more energy efficient, with greater use of recycled materials in order to reduce the environmental impact • Production of parts – Alternative processes could be used/merged/eliminated to be more energy efficient • Assembly – Assembly processes could be changed to use less energy and produce less waste • Use – The product could be made more efficient in use thus increasing the potential for generating green energy and reducing carbon use • Disposal/recycling – the product could be manufactured to allow more parts to be recyclable or reusable with less use of any harmful or toxic residues <p>Possible disadvantages from the LCA</p> <ul style="list-style-type: none"> • Raw materials extraction – The company may find that the raw materials used cannot be changed and have a considerable environmental impact • Material production – This may not be feasible as it is unlikely that processing of the raw material, to produce the finished material ready for manufacture, can be easily changed • Production of parts – This may cost money/resources as improvements to processes require investment in new machinery or techniques • Assembly – It is likely that the assembly of parts will require processes that consume energy and raw materials • Use – It is possible that the energy saved in use will not compensate for the energy required to manufacture the panels • Disposal/recycling – disassembly and recycling of parts is likely to be difficult and expensive 	

Model answer

Using LCA could allow Sunnydays to improve the sustainability of its products by changing the way it extracts raw materials. It could find a more sustainable material, having a lower environmental impact. However, it may not be feasible to use that material from a cost/manufacturing perspective.

It may find changes to an assembly process could use less energy, therefore producing less waste. However, it may mean more energy needs to be consumed elsewhere in the process, e.g. during manufacture of the panels.

Use of the panels saves energy, which should be balanced against the energy used in production.

The LCA may also find more parts that could be reused/recycled, however the disassembly and recycling of parts may be more difficult and costly.

The impact on the sustainability of the product, by improving the sustainability of each of these processes, should be weighed against the cost issues involved and the environmental impact of each of the stages should be weighed against any possible benefits of the products use.

Level	Mark	Descriptor
	0	No rewardable material
Level 1	1-3	Basic/implicit considerations of LCA; or only one element considered. This answer is likely to be in the form of a list. Points made will be superficial/generic and not applied/directly linked to the product in the question. No conclusion produced or the conclusion summarises only one element of the argument being considered.
Level 2	4-6	Considerations of LCA with more than one element considered. The answer will be unbalanced. A conclusion is present, but this is either implicit or as a result of unbalanced consideration of the arguments. There is little or unfocused justification of the conclusion. Most points made will be relevant to the product in the question, but the link will not always be clear.
Level 3	7-8	Balanced explanation of all stages of the LCA. A conclusion is produced which is justified and clearly linked to the consideration of arguments for and against and their relative importance to the situation. The majority of points made will be relevant and there will be a clear link to the product in the question.

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