

GCSE

Design and Technology: Electronics and Control Systems

Unit **A515/02**: Sustainability and technical aspects of designing and making pneumatics

General Certificate of Secondary Education

Mark Scheme for June 2017

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All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Annotations

| Annotation | Meaning |
|---|---|
|  | Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response. |
|  | Level 1 |
|  | Level 2 |
|  | Level 3 |
|  | Noted but no credit given |
|  | Tick |

SECTION A

| Question | Answer | Mark | Guidance |
|----------|---|------|--|
| 1 | A | 1 | |
| 2 | A | 1 | |
| 3 | B | 1 | |
| 4 | D | 1 | |
| 5 | A | 1 | |
| 6 | Reduction in the amount of waste materials. | 1 | Allow other valid responses related to less environmental pollution. |
| 7 | Reduction in emissions of carbon dioxide or greenhouse gases made in order to compensate for an emission made elsewhere. | 1 | |
| 8 | <ul style="list-style-type: none"> • Use less energy / power • Last longer • Easier recycling process and less waste. | 1 | |
| 9 | <ul style="list-style-type: none"> • The colour red is often used in warning and hazard signs • It symbolises danger • It stands out against other colours • It is a very visible colour in daylight. | 1 | |
| 10 | Refuse | 1 | |
| 11 | True | 1 | |
| 12 | True | 1 | |
| 13 | False | 1 | |
| 14 | False | 1 | |
| 15 | False | 1 | |

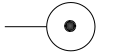
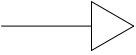
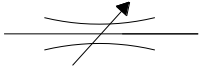
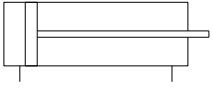
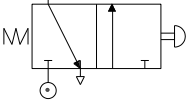
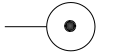
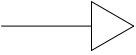
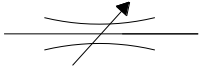
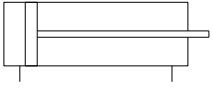
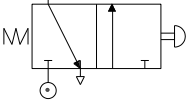
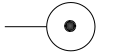
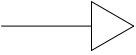
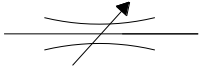
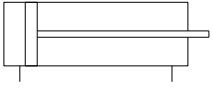
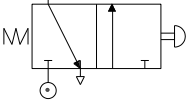
| Question | | Answer | Marks | Guidance |
|----------|-----|---|-------|--|
| 16 | (a) | <p>Any of the following:</p> <ul style="list-style-type: none"> • Spring loaded • Quick lock and release button - allow 'control button' • Comfortable (ergonomic) handle • Flexible lead • Clip is attached easily to dog's collar • Durable / tough plastic case. <p style="text-align: right;">3 x 1 marks</p> | 3 | <p>Accept any other valid response.</p> <p>Do not allow 'extendable', 'portable' or 'ergonomic' with no link to a feature.</p> |
| | (b) | <ul style="list-style-type: none"> • Batteries have limited life / need to be replaced • No harm to the environment • No batteries to dispose of • No additional expense e.g. battery disposal. <p style="text-align: right;">2 x 1 marks</p> | 2 | Accept any two answers or other valid response. |
| | (c) | <p>Simple statement e.g.: its properties can change. (Does not state how the change is triggered) 1 mark.</p> <p>A material whereby its properties can be changed by external stimuli, such as stress, temperature, moisture, pH, electric or magnetic fields, 1 mark.</p> | 2 | |
| | (d) | <ul style="list-style-type: none"> • Both features included in the redesign [2 x 1] • Specific materials identified [1] • Components identified [1] • Helpful annotation to explain thinking. [1] | 5 | |

| Question | Answer | Marks | Guidance |
|----------|--|-------|----------|
| (e) | <ul style="list-style-type: none">• Low cost to manufacture• Easy to work / shape / form• Can be recycled / made from recycled materials• Biodegradable• Print directly to surface / decorate• Protect contents• Durable / strong• Lightweight and easy to transport. <p style="text-align: right;">2 x 1 marks</p> | 2 | |

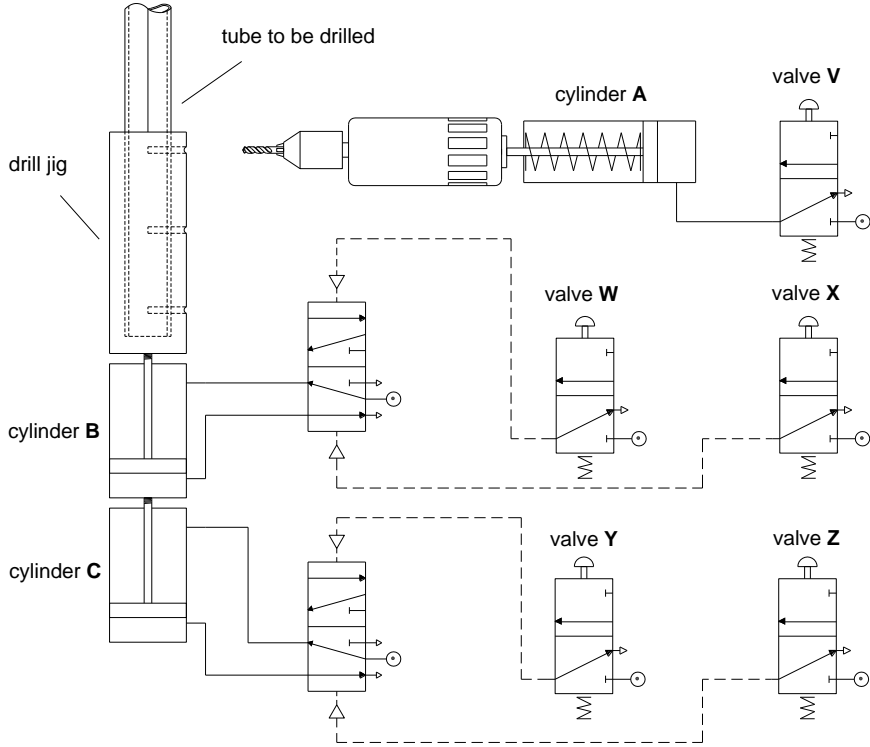
| Question | | | Answer | Marks | Guidance | |
|----------|------|--|---|-------|---|--|
| | | | | | Content | Levels of response |
| | (f)* | | <p><u>Advantages</u></p> <ul style="list-style-type: none"> • Improved living standards • Increase in public health benefits • Interconnected nations share best practice. Kyoto Protocol, for example • Larger markets, create more jobs • Ease of internet purchase. <p><u>Disadvantages</u></p> <ul style="list-style-type: none"> • Worldwide shortages of finite materials • Worker exploitation (ETI) • Increased energy consumption • impact on carbon footprint • transportation impact • toxic waste in relation to production & manufacture • Changes to social and spiritual well being • Spread of human, animal and plant diseases. | | Maximum of 2 marks for a bullet point list. | <p>Level 3 (5-6 marks) Thorough explanation, with examples, showing a clear understanding of how globalisation affects the environment. There may be three or more clearly identified and explained points. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate will demonstrate the accurate use of spelling, punctuation and grammar.</p> <p>Level 2 (3-4 marks) Adequate explanation, possibly with examples, showing a sound understanding of how globalisation affects the environment. There will be some use of specialist terms, although these may not always be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, grammar and punctuation.</p> <p>Level 1 (1-2 marks) Basic explanation, possibly without examples, showing some understanding of how globalisation affects the environment.. There will be little or no use of specialist terms. Answers may be ambiguous or disorganised or 'list like'. Errors of grammar, punctuation and spelling may be intrusive.</p> |
| | | | | [6] | | |

| | | | | | | |
|--|--|--|-------|------|--|----------------------------------|
| | | | | | | (0) Response worthy of no marks. |
| | | | TOTAL | [35] | | |

SECTION B

| Question | | | Answer | Mark | Guidance | | | | | | | | | | | | |
|--|---|------|---|------|---|--------------|---|---------------------|---|----------------------------------|---|----------------------------------|--|--|--|-----|--|
| 17 | (a) | (i) | <table border="1"> <thead> <tr> <th>Name</th> <th>Symbol</th> </tr> </thead> <tbody> <tr> <td>A air supply</td> <td> [1]</td> </tr> <tr> <td>B exhaust [1]</td> <td></td> </tr> <tr> <td>C bi-directional flow restrictor</td> <td> [1]</td> </tr> <tr> <td>D double acting [1] cylinder [1]</td> <td></td> </tr> <tr> <td>E push button spring return [1] 3 port 2 way valve [1]</td> <td></td> </tr> </tbody> </table> | Name | Symbol | A air supply |  [1] | B exhaust [1] |  | C bi-directional flow restrictor |  [1] | D double acting [1] cylinder [1] |  | E push button spring return [1] 3 port 2 way valve [1] |  | [7] | |
| Name | Symbol | | | | | | | | | | | | | | | | |
| A air supply |  [1] | | | | | | | | | | | | | | | | |
| B exhaust [1] |  | | | | | | | | | | | | | | | | |
| C bi-directional flow restrictor |  [1] | | | | | | | | | | | | | | | | |
| D double acting [1] cylinder [1] |  | | | | | | | | | | | | | | | | |
| E push button spring return [1] 3 port 2 way valve [1] |  | | | | | | | | | | | | | | | | |
| | | (ii) | <p>Wear in components can be reduced by using:</p> <ul style="list-style-type: none"> • A lubricator unit, 1 mark. in the air line, 1 mark • Filter unit, 1 mark and drain valve, 1 mark • Electroplating components, 1 mark to resist corrosion, 1 mark • Use of a cushioned cylinder, 1 mark to prevent damage when valves change state, 1 mark. | [2] | <p>Accept reference to oil in the compressed air or used externally on components.</p> <p>Accept reference to the result of cushioning.</p> <p>Accept reference to reducing friction.</p> | | | | | | | | | | | | |

| | | | | | |
|--|------------|--------------|--|------------|---|
| | (b) | (i) | The cylinder will begin to outstroke [1] and return as soon as valve V is released. [1] | [2] | |
| | | (ii) | The cylinder will outstroke [1] and remain outstroked, drilling the hole [1]. | [2] | |
| | | (iii) | Different materials require different drilling speeds, 1 mark. | [1] | Accept reference to hardness of materials |
| | | (iv) | A risk assessment should be carried out. | [1] | Allow any other valid response, including suitable PPE. |
| | | | TOTAL | 15 | |

| Question | Answer | Mark | Guidance |
|-------------------|--|------------|---|
| <p>18 (a) (i)</p> |  | <p>[4]</p> | <p>1 mark for each correct connection, 4 x 1 marks.</p> |
| | <ul style="list-style-type: none"> • Secure fixing, 1 mark • Allow for removal, 1 mark • Accurate alignment, 1 mark • Drill prevented from twisting against bracket, 1 mark • Clear annotation of sketches, 1 mark. | <p>[5]</p> | |

| Question | | | Answer | Marks | Guidance | |
|----------|------|--|--|-------|---|---|
| | | | | | Content | Levels of response |
| | (b)* | | <p>Discussion should include some but not all of the following points:</p> <p>Reliability</p> <ul style="list-style-type: none"> • Low maintenance • Interchangeable parts • Flexible system with most components being robust and able to stand up to hostile environments. <p>Health and Safety</p> <ul style="list-style-type: none"> • No risk of electric shock when working in wet conditions • Risk of air lines becoming unattached and causing damage • Risk to user of compressed air or pressurised oil against skin. <p>Cost</p> <ul style="list-style-type: none"> • High initial setup cost • The majority of components can be reused in a new setup • Less risk of obsolescence than | | Maximum of 2 marks for a bullet point list. | <p>Level 3 (5-6 marks) Shows detailed understanding of reliability, safety and cost aspects in pneumatic equipment. Suitable examples used. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate can demonstrate the accurate use of spelling, punctuation and grammar.</p> <p>Level 2 (3-4 marks) Shows some understanding of reliability, safety and cost aspects in pneumatic equipment. There will be some use of specialist terms although these may not always be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, punctuation and grammar.</p> <p>Level 1 (1-2marks) Shows understanding of reliability, safety and cost aspects in pneumatic equipment. No examples used. There will be little or no use of specialist terms.</p> |

| | | | | | | |
|--|--|--|--|-------------|--|--|
| | | | electronic components <ul style="list-style-type: none">Parts are readily available and system can generally be repaired. | [6] | | Answers may be ambiguous or disorganised. Errors of grammar, punctuation and spelling may be intrusive. 0 Response worthy of no marks. |
| | | | TOTAL | [15] | | |

| Question | | Answer | Mark | Guidance |
|----------|---------|--|-----------|---|
| 19 | (a) | <pre> graph LR V1[V] --> W[W] W --> V2[V] V2 --> Y[Y] Y --> V3[V] V3 --> XZ[X/Z] XZ --> ZX[Z/X] </pre> | [5] | <p>Do not award first two boxes as these are given on the question. Allow the last two boxes in any order X-Z or Z-X</p> <p>1 mark each for order of cylinder operation, 3 x 1 marks. 1 mark each for operating valve V to drill hole in all positions.</p> |
| | (b) | <p>Rearrangement of formula $P = F / A$, 1 mark Substitution of values $P = 60 / \pi \times 12.5 \times 12.5$, 1 mark $60 / 490.6$, 1 mark $P = 0.12 \text{ Nmm}^{-2}$, 1 mark.</p> | [4] | Award 4 marks for correct answer with no working. |
| | (c) (i) | <p>Reed switch, 1 mark Cylinder, 1 mark.</p> | [2] | Award 1 mark for reed switch without reference to cylinder |
| | (ii) | <p>When the cylinder outstrokes and instrokes, the magnet at C closes the reed switches at A and B. [1] The closed reed switch can be used to signal an operation by the microprocessor. [1]</p> | [2] | |
| | (iii) | <ul style="list-style-type: none"> • There may be a cost advantage as the power (air) is already available near to the drill position, 1 mark • Lower cost to operate and maintain, 1 mark • There will be no need to have an electrical supply to the circuit, 1 mark. • Safer, as no sparking can occur, 1 mark • Higher torque available, 1 mark • Pneumatic powered drill will be more robust / reliable and require less maintenance, 1 mark. | [2] | 2 x 1 marks |
| | | TOTAL | 15 | |

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