

GCSE

Design and Technology: Electronics and Control Systems

Unit **A515/01**: Sustainability and technical aspects of designing and making electronics

General Certificate of Secondary Education

Mark Scheme for June 2015

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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Annotations

| Annotation | Meaning |
|-------------|--|
| BP | 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. |
| ✓ | correct response |
| X | Incorrect response |
| L1 | level 1 response in (*) question |
| L2 | level 2 response in (*) question |
| L3 | level 3 response in (*) question |
| BOD | Benefit of doubt |
| SEEN | Nothing written or drawn, NR allocated as mark. |
| REP | Repetition either from question or from earlier part of response |

| Question | | Answer | Mark | Guidance |
|----------|-----|--|------|---|
| 1 | | C | 1 | |
| 2 | | C | 1 | |
| 3 | | D | 1 | |
| 4 | | B | 1 | |
| 5 | | D | 1 | |
| 6 | | Restriction of Hazardous Substances | 1 | Both must be correct for mark |
| 7 | | Any of: <ul style="list-style-type: none"> • Wind • Solar • Tidal • Geothermal • Biomass • Hydro-electric | 1 | Allow other legitimate sources if they are genuinely renewable |
| 8 | | May contribute to the 'greenhouse' effect, cause global warming or cause habitat/wildlife change/death. | 1 | Do not allow 'damage to ozone layer' or 'production of acid rain' |
| 9 | | Product will degrade naturally /rot/decay/return to nature | 1 | 'Rot down in landfill' acceptable |
| 10 | | Recycle | 1 | Accept Primary, secondary and tertiary recycling |
| 11 | | False | 1 | |
| 12 | | False | 1 | |
| 13 | | True | 1 | |
| 14 | | True | 1 | |
| 15 | | True | 1 | |
| 16 | (a) | Any of: <ul style="list-style-type: none"> • Winding handle • Solar panel • Tuning dial • Telescopic aerial • Volume/on/off switch • Speaker grill | 3 | Allow any other valid response. |

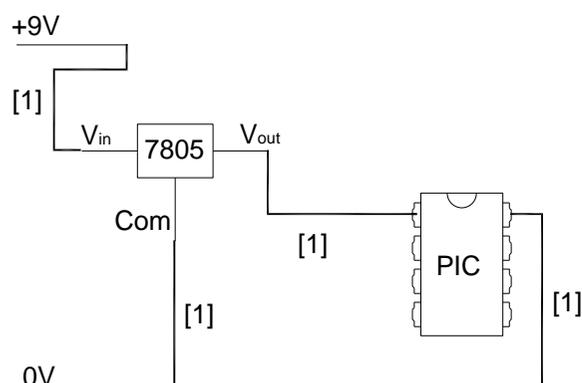
| Question | | Answer | Mark | Guidance |
|----------|-----|---|------|---|
| | (b) | Any of: <ul style="list-style-type: none"> • Means that you don't have to keep on winding • Always ready to use (if it was charged up previously) • Long product life • Reduces built-in obsolescence • Could accept power from other sources e.g. solar | 1 | Answer must reference charging method |
| | (c) | Any of: <ul style="list-style-type: none"> • Can be taken apart for recycling of case and components • Rechargeable battery can be disposed of safely • No big investment in tools to dismantle • Minimal labour needed – 1 person could do it all • Quicker to take to pieces not changing tools • So more can be processed in any one time • Making better use of labour force • Separate parts can be sorted as required | 2 | 'Quick' or 'fast' needs to be qualified for a mark. Allow reference to repair |
| | (d) | <ol style="list-style-type: none"> 1. Already given as 'Melted down and refined'. 2. Sorted then melted down and re-used 3. Ground up and used as filler 4. Removed, tested and re-used | 3 | |
| | (e) | Any of: <ul style="list-style-type: none"> • Give to charity shop • Sell at boot fair • Pass on to family or friend • Give to LDC 'good cause' • Online auction site • Freecycle | 2 | Allow others that pass the item on unchanged for re-use. |
| | (f) | Sketches and notes that embody the basic principles of grasping the product/holding it down whilst winding/rotating the handle in a rotary manner/extending aerial/facing sunlight/operating controls | 3 | Allow equivalent actions that would work in some way. Principle is required rather than high levels of artistic accuracy. |

| Question | | Answer | Marks | Guidance | |
|----------|------|---|-------|--|--|
| | | | | Content | Levels of response |
| | (g)* | <p>Candidates should identify the benefits to the end-user. E.g.</p> <ul style="list-style-type: none"> • less reliance on bought in power / batteries • fuel use reduced e.g.kerosene/paraffin for lighting, diesel / petrol for generators, mains electricity. • Circuitry can be optimised for low consumption so it makes better use of limited energy. • Examples given of other products that use 'wind up' technology'. • Use of radio for keeping up to date with news. • Use of radio for emergencies. | 6 | Maximum of 2 marks for short bullet point list | <p>Level 3 (5-6 marks) Thorough explanation, showing a clear understanding of how wind-up products can improve the day to day lives of people in third world countries. There will 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, showing a some understanding of how wind-up products can improve the day to day lives of people in third world countries. 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, showing limited understanding of how wind-up products can improve the day to day lives of people in third world countries. There will be little or no</p> |

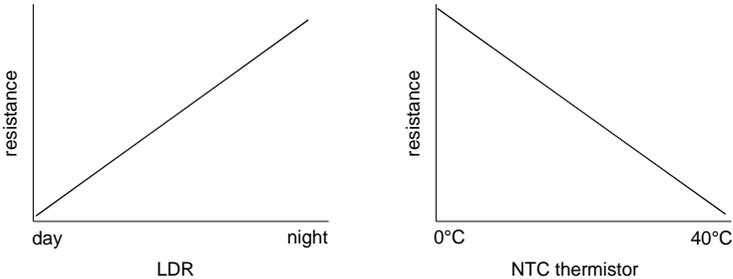
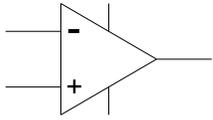
| Question | | | Answer | Mark | Guidance |
|--------------------------|--|--|--------|-----------|--|
| | | | | | <p>use of specialist terms. Answers may be ambiguous or disorganised or 'list like'. Errors of grammar, punctuation and spelling may be intrusive.</p> <p>(0) Response worthy of no marks</p> |
| Question 16 total | | | | 20 | |
| Section A Total | | | | 35 | |

| Question | | | Answer | Mark | Guidance | | | | | | | | |
|---|-----------|-------|--|--------|--|---|--------|---|-------|---|---------|-----|------------------------------------|
| 17 | (a) | (i) | <table border="1"> <tr> <td>symbol</td> <td>component</td> </tr> <tr> <td></td> <td>switch</td> </tr> <tr> <td></td> <td>motor</td> </tr> <tr> <td></td> <td>battery</td> </tr> </table> <p>1 mark for each correct, 3 x 1.</p> | symbol | component |  | switch |  | motor |  | battery | [3] | Allow mark for reference to switch |
| symbol | component | | | | | | | | | | | | |
|  | switch | | | | | | | | | | | | |
|  | motor | | | | | | | | | | | | |
|  | battery | | | | | | | | | | | | |
| | | (ii) | <p>Features indicating injection moulding are:</p> <ul style="list-style-type: none"> • Smooth curved shape • Ejector pin marks visible • Webs for stiffness and holding batteries • Moulded labelling for batteries • Different thicknesses visible on edges <p>2 x 1 marks for suitable features</p> | [2] | Allow mark for reference to integrated internal features e.g. interlocking parts | | | | | | | | |
| | | (iii) | The area of design is ergonomics . | [1] | Accept any method of indication. No marks if two area are circled. | | | | | | | | |
| | | (iv) | Connection in series | [1] | Allow mark for 'series' | | | | | | | | |
| | (b) | (i) | <p>A relay is used:</p> <ul style="list-style-type: none"> • If control circuit and motor circuit voltage differ • To reduce electrical interference • To isolate control circuit | [1] | Allow mark for understanding shown. Reference to safety must be qualified | | | | | | | | |

| | | | | |
|--------------|-------|---|-------------|--|
| | (ii) | | [1] | All four voltages must be entered correctly for mark. |
| | (iii) | <p>If the motor terminals are connected to X and Y, 1 mark The motor shaft will change direction when the relay coil is energised, 1 mark.</p> | [2] | |
| (c) | (i) | <p>R1 is protective / current limiting resistor limiting the current to the transistors. D1 is a diode in reverse bias to prevent transistor damage through back emf. 1 mark for each.</p> | [2] | <p>Use of resistor must reference the transistor Diode must reference back EMF or protecting the transistor(s)</p> |
| | (ii) | <p>The cost is very little more than either separate transistors or a Darlington transistor. There may be other parts of a circuit that can use the spare Darlington transistors in the array. Transistors can be connected in parallel to increase the current carrying capacity. The IC is lower on the circuit than discrete transistors./ reduced footprint than individual components Fewer components needed as base resistors (and clamping diodes) are included 2 x 1 marks for valid reasons.</p> | [2] | |
| TOTAL | | | [15] | |

| Question | | Answer | Mark | Guidance |
|----------|---------|---|------|--|
| 18 | (a) (i) | The range of output voltage is between +4.8V and +5.2V 1 mark. | [1] | Both values needed for the mark. |
| | (ii) |  <p>1 mark for each correct connection, 4 x 1.</p> | [4] | |
| | (iii) | +9V and +12V | [1] | Both voltages needed for the mark. |
| | (b) | Reasons could be: <ul style="list-style-type: none"> • Pad D would fit but thin walls would lead to pad breaking, • Pads A and B are both too large and would join together shorting between pins. • Pad C is the most suitable, narrow enough but larger area for solder. | [1] | Allow mark for a reason that shows that pads A,B and D are not suitable. |
| | (c) | The 0.33µF capacitor will smooth the dc voltage at V_{in} . The 0.1µF capacitor will remove noise and smooth any fluctuation on V_{out} due to load and increase stability. Sketches used may show voltage ripple and the effect after capacitors have been added to the circuit. 2 marks for clear explanation. | [2] | Allow 2 marks for full explanation of purpose of either one of the capacitors. |

| Question | | Answer | Marks | Guidance | |
|----------|------|--|-------------|----------|---|
| | | | | Content | Levels of response |
| | (d)* | <p>Discussion could include:</p> <ul style="list-style-type: none"> • appropriate PPE • guarding of machines • accident procedures • reduction of risks to hearing • reduction of risk to long term health • training in the use of machines and hand tools. • risk assessment, how it is carried out • how the resulting risks are made known to users of equipment. • use of safety symbols on machines and chemical containers | [6] | | <p>Level 3 (5-6 marks) Shows detailed appreciation of how risk is assessed and the measures that can be taken to ensure the safety of users. 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 safety, response restricted to PPE measures with some examples used. 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 (0-2marks) Shows limited appreciation of safety in the workshop. No examples used. There will be little or no use of specialist terms. Answers may be ambiguous or disorganised. Errors of grammar, punctuation and spelling may be intrusive.</p> <p>0 Response worthy of no marks.</p> |
| | | TOTAL | [15] | | |

| Question | Answer | Mark | Guidance |
|----------|---|------|--|
| 19 (a) | 1 mark for each, 2 x 1 marks  | [2] | |
| (b) (i) | [1] inverting input non-inverting input [1]  | [2] | |
| (ii) | If inverting input voltage > non-inverting input voltage the output is low If non-inverting input voltage > inverting input voltage the output is high | [2] | Allow marks for understanding shown. |
| (iii) | $V_{out} = 33K / 68K + 33K \times V_{in}$ [1] $V_{out} = 0.3267 \times 9$ [1] $V_{out} = 2.94V$ [1] | [3] | 3 marks for correct answer with no working Allow marks for 2.9V, and 3V (only if working out is correct). |
| (c) (i) | Notes / sketches should refer to a temporary fixing method, e.g. screw terminals, plug and socket, jack plug. Suitable method, 1 mark. clear drawing / description, 1 mark. | [2] | No marks for soldered connection. |
| (ii) | NOR gate, 1 mark. | [1] | |

| Question | | Answer | Mark | Guidance | | | | | | | | | | | | | | | | |
|----------------|----------|--|----------------|----------|-------|-------|--------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|----------|----------|-----|--|
| | (d) | 1 mark for each row correct. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Colour showing</th> <th>Out 3</th> <th>Out 4</th> <th>Out 5</th> </tr> </thead> <tbody> <tr> <td>red on</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td>green on</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> <tr> <td>yellow on</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> </tbody> </table> | Colour showing | Out 3 | Out 4 | Out 5 | red on | 1 | 0 | 0 | green on | 0 | 0 | 1 | yellow on | 1 | 0 | 1 | [3] | |
| Colour showing | Out 3 | Out 4 | Out 5 | | | | | | | | | | | | | | | | | |
| red on | 1 | 0 | 0 | | | | | | | | | | | | | | | | | |
| green on | 0 | 0 | 1 | | | | | | | | | | | | | | | | | |
| yellow on | 1 | 0 | 1 | | | | | | | | | | | | | | | | | |
| | | TOTAL | [15] | | | | | | | | | | | | | | | | | |

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