# GCSE

# DESIGN AND TECHNOLOGY ELECTRONIC PRODUCTS

45401
Mark scheme

4540
June 2014

Version 1.0: Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

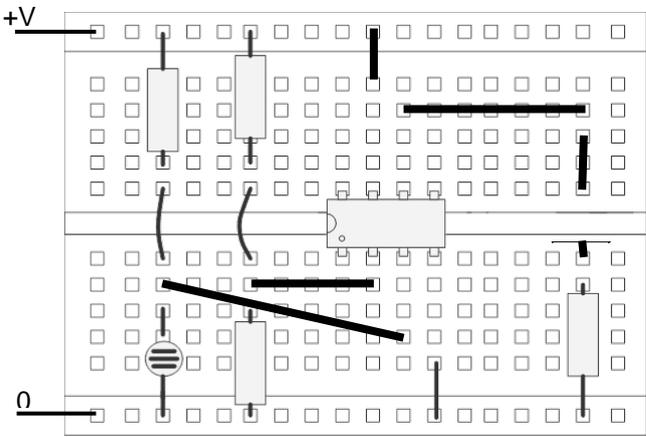Further copies of this Mark Scheme are available from aqa.org.uk

**FOR EXAMINERS – PLEASE NOTE THAT IF YOU ARE UNSURE HOW TO AWARD A RESPONSE FROM A CANDIDATE, PLEASE SEEK CLARIFICATION OR ADVICE FROM YOUR TEAM LEADER OR THE PRINCIPAL EXAMINER.**
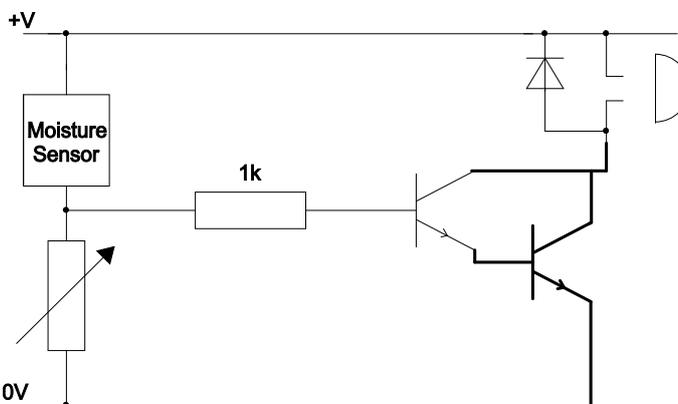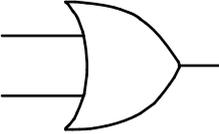
**Section A**

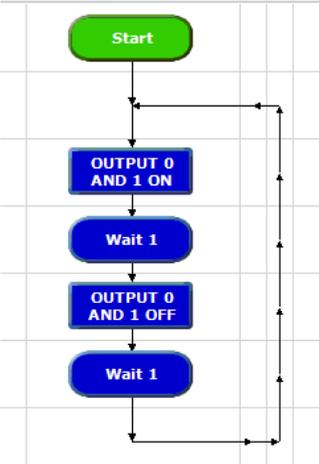| Question | Part | Sub Part | Marking Guidance | Marks |
|---|---|---|---|---|
| 1 | a | | *1 mark* for each specific component<br><br>Process: transistor, Darlington, astable, 555, PIC, op-amp, FET, thyristor or any suitable response<br><br>Output: LED, buzzer, bulb, speaker, piezo, siren, bell, or any suitable response. | **Total 4** |
| 1 | b | | *Up to 3 marks*<br><br>*Award:*<br>*1 mark* for a simple response<br>*2 marks* for a reasoned or justified response, or several simple responses.<br>*3 marks* for 2 or more justified responses.<br><br>Reference to, for example,<br>• small size<br>• low cost<br>• visible/audible from a distance<br>• ease of availability<br>• reliability | **Total 3** |
| 1 | c | | *Construction – up to 2 marks*<br>*1 mark* for each reference to a construction detail e.g. vacuum formed, injection moulded, fabricated, screwed, glued, dimensions, material<br><br>*Location of input and output components – up to 2 marks*<br>*1 mark each* for a coherent reference to :<br>location of temp.sensing component<br>location of' temp too high' output component<br>(The component must be in a realistic location on the case – e.g. not on an edge)<br><br>*1 mark* for a reference to the feature to make the product visually appealing e.g. shape, logo, colour that is justified.<br><br>Specific reference to a hygiene feature – *up to 2 marks*<br>e.g. rounded corners, membrane switch, ease of cleaning, suitable material<br><br>*1 mark* for indicating how the battery can be charged. This could simply be the recharging point in the case.<br>**No credit** for removing battery for re-charging purposes.<br><br>*Quality of communication – up to 3 marks*<br>*3 marks* for a clear, neatly drawn coherent idea, and clear notes<br>*2 marks* for a clear sketch with further detail in notes<br>*1 mark* for a very basic sketch, or sketch with brief notes. | **Total 11** |

| 1 | d | | A circuit diagram and notes showing how the input/process/output components combine to create a working solution.<br><br>Explanation:<br><br>*1 mark* for a very basic response that lacks technical detail, and/or would not work.<br><br>Additional technical detail *2 to 3 marks*<br>A largely complete solution with some notes, but lacking detail in notes. Some parts of the circuit would work.<br><br>High level response *4 to 5 marks*<br>A complete solution, with well-explained notes, that would work.<br><br><br>Quality of diagram: *up to 3 marks*<br>*3 marks* for a clear, neatly drawn circuit diagram, with some components labelled or with values.<br>*2 marks* for a clear circuit diagram.<br>*1 mark* for a very basic circuit diagram. | **Total 8** |
| 1 | e | | *Up to 5 marks*<br><br>For each method:<br><br>*1 mark* for simple reference to one method<br>*2 marks* for a justified or explained method<br>*3 marks* for objective, well-detailed method.<br><br>Testing/evaluating methods could include:<br>• User review/questionnaire<br>• Use of product in real world location<br>• Calibration/ measurement of accuracy<br>• Testing in a fridge<br>• Shop customer review<br>• Test of visibility/audibility of outputs<br>• Test battery life | **Total 5** |
| 1 | f | | *Up to 4 marks*<br><br>*1 mark* for simple point<br>*2 marks* for a justified or explained point<br><br>Disposal methods could include:<br><br>• Case re-cycled<br>• Sold/ passed on to another user<br>• Taken to a disposal point<br>• Battery to be re-used in another product<br>• Battery placed in proper battery disposal bin | **Total 4** |

| 2 | a | | *1 mark* for each correctly drawn symbol as per the specification.<br><br>(note: PTM throw must be long enough to touch poles<br>      Ignore if circle drawn round LED; it is acceptable<br>      Accept variable resistor symbol)<br><br>*1 mark* for loudspeaker/speaker<br>*1 mark* for bell | **Total 6** |
|---|---|---|---|---|
| 2 | b | | *1 mark each*<br><br>        Buzzer -  polarised<br>   NPN transistor -  polarised<br>       PTM -  non-polarised<br>    Thermistor -  non-polarised | **Total 4** |
| 2 | c | | *1 mark* for long/short lead<br>*1 mark* for 'minus signs' drawn on case<br><br><br>( if axial lead cap drawn, 1 mark for 'waist', 1 mark for minus signs) | **Total 2** |
| 2 | d | | *Up to 2 marks*<br>*1 mark* for each reason<br><br>Reasons could include:<br>  • smaller component<br>  • smaller board<br>  • cheaper than through hole components<br>  • automated assembly<br>  • possibility of double sided boards<br>or similar suitable response<br><br>( answers such as cheap…quick…easy…no marks unless qualified) | **Total 2** |

| 3 | a | | *Up to 6 marks*<br><br>*1 mark* for pin 7 to +V<br>*1 mark* for pin 3 to LDR/resistor junction<br>*1 mark* for pin 2 to resistor/resistor junction<br><br>*1 mark* for drawing LED on breadboard in a functioning position. (symbol or pictorial)<br>*1 mark* for indicating orientation of LED (polarity)<br><br>*1 mark* for connecting LED to pin 6<br><br>Note: if wires or components share the same hole, only penalise this once.<br><br> | |
| | | | | **Total 6** |
| 3 | b | | *Up to 3 marks*<br><br>*1 mark* for each response, for example,<br><ul><li>incorrect connections</li><li>faulty I.C.</li><li>faulty component</li><li>incorrect polarity of component</li><li>wrong value of resistor</li><li>broken wire</li><li>faulty breadboard</li><li>power supply connections</li></ul>or similar suitable response. | **Total 3** |
| 3 | c | | *Up to 4 marks*<br><br>*1 mark* for each reference to a distinct step which could include:<br><br><ul><li>select V range</li><li>lead to anode</li><li>lead to cathode</li><li>probes on either side of LED</li><li>take a reading</li></ul>or similar suitable response | **Total 4** |

| 3 | d | | *1 mark* for a simple explanation<br>*2 marks* for a detailed explanation<br><br>• Working model,<br>• actual sized model,<br>• functioning circuit,<br>• real-world testing.<br>or similar suitable response | **Total 2** |
|---|---|---|---|---|
| 4 | a | | *1 mark* each correctly named connection – base, collector, emitter | **Total 3** |
| 4 | b | | *1 mark* for reference to:<br><br>Protection of the transistor, or stops too much current on the base, or prevents the transistor 'blowing' | **Total 1** |
| 4 | c | | *Up to 2 marks*<br><br>*1 mark* for reference to protection of transistor<br>*1 mark* for reference to back E.M.F. | **Total 2** |
| 4 | d | | *Up to 4 marks*<br><br><br><br>*1 mark* for added transistor drawn<br>*1 mark* for emitter of first transistor to base of second<br>*1 mark* for emitter of second transistor to 0V<br>*1 mark* for both collectors correctly connected to buzzer | **Total 4** |
| 4 | e | | *Up to 2 marks*<br><br>*1 mark* for each response, which could include:<br>• smaller circuit board<br>• easier to assemble<br>• less chance of making a mistake<br>• fewer components so more reliable<br>• justified reference to cost of components<br>or any suitable response | |

| | | | | |
|---|---|---|---|---|
| | | | (No marks for the unjustified quick…easy…cheap…) | **Total 2** |
| **5** | **a** | **i** | *1 mark* for buzzer | **Total 1** |
| **5** | a | ii | *1 mark*<br>Reed switch, magnetic reed switch, vibration sensor, PIR, tilt switch, proximity switch, PTB or any suitable specific component.<br><br>Note: do not accept 'motion sensor' | **Total 1** |
| **5** | b | | *Up to 2 marks*<br><br>.<br><br>*1 mark* for correct shape of symbol<br>*1 mark* for drawing three leads correctly | **Total 2** |
| **5** | **c** | | *Up to 3 marks* | **Total 3** |
| **6** | **a** | | *Up to 2 marks*<br>*1 mark* for basic response – goes on/off, or causes LED to flash.<br><br>*1mark* for further technical detail .e.g. pin 3 goes high/low, pulse generator, clock, or other suitable response | **Total 2** |
| **6** | **b** | | *Up to 5 marks*<br><br>*1 mark* for the formula<br><br>*1 mark* for correct substitution of resistor values<br>   [ ( 1000 + 200,000)    or, if using MΩ x µF, (0.001 x 0.2)]<br><br>*1 mark* for correct substitution of cap. Values<br>   [ 10/1,000,000 or, if using MΩ, x 10] | |

For question 5b:



For question 5c:

| B | A | Q |
|---|---|---|
| 0 | 0 | **0** |
| 0 | 1 | **1** |
| 1 | 0 | 1 |
| 1 | 1 | **1** |

| | | | | |
|---|---|---|---|---|
| | | | *1 mark* for correct answer 0.716 ( accept rounded to 0.7)<br>*1 mark* for units Hertz or Hz<br><br><br> | **Total 5** |
| **6** | **c** | | *Up to 6 marks*<br>*1 each for:*<br><br>• Pin 8 to +V<br>• Pin 1 to 0V<br>• Pin 6 to res/cap junction<br>• Pin 2 to res/cap junction<br>• Resistor and LED pads drawn<br>• Pin 3 correctly drives the LED<br><br>( if tracks cross, disregard one of the tracks) | **Total 6** |
| **6** | **d** | | *Up to 2 marks*<br>*1 mark* each for<br>• thicker tracks,<br>• larger solder pads/lands,<br>• add text,<br>• strain relief holes,<br>• consideration of PCB size.<br>or suitable response | **Total 2** |
| **7** | **a** | | *Up to 2 marks*<br>*1 mark each* for reference to<br>• IC can cost more<br>• computer/software/download cable needed<br>• limited to around 6V, so regulator may be needed<br>• programming skills required<br>• need for programming<br>Or similar suitable response. | **Total 2** |
| **7** | **b** | | *Up to 2 marks*<br>1 mark for digital signal having only 2 states<br>1 mark for analogue signal being variable. | **Total 2** |
| **7** | **c** | | *Up to 5 marks*<br><br>1 for outputs on<br>1 for wait 1 | |

| | | | | |
|---|---|---|---|---|
| | | | 1 for outputs off<br>1 for wait 1<br>1 for loop<br>Basic or other program systems acceptable<br><br>( simple re-writes of the question, giving no evidence of a programming system – no marks) | **Total 5** |
| **7** | **d** | | *Up to 5 marks*<br><br><br><br>1 for compare of light level with yes/no routes correct<br>1 for 1 on, 0 off<br>1 for correct timing<br>1 for 0 on, 1 off<br>1 for loop back to the compare<br><br>Note: do not penalise if an LED remains on in light conditions.<br><br>Basic or other program systems acceptable<br>( simple re-writes of the question, giving no evidence of a programming system – no marks) | **Total 5** |
| | | | | |

| 8 | | | | QWC Question<br><br>Looking for details of hazards and precautions for two processes.<br><br>Hazards could include:<br>   • Material in eyes<br>   • Hands trapped or injured<br>   • Clothing caught in machinery<br>   • Cuts to fingers<br>   • Breathing-in dust<br>   • Burns to hands or other parts of body<br>   • Tripping<br>   • Irritation to skin<br><br>Precautions could include:<br>   • Wearing of goggles/safety glasses<br>   • Use of clamps and vices<br>   • Wearing aprons<br>   • Rolling-up sleeves<br>   • Removal of ties<br>   • Wearing of face masks/ filters<br>   • Well-ventilated environment<br>   • Wearing gloves<br>   • Good workshop safety practice.<br><br>Consider the technical content and quality of communication.<br>Marks awarded as follows:<br><br>0 marks – no answer worthy of credit.<br><br>1-2 marks<br>Very limited coverage of just hazards or precautions, or just one process discussed. Many spelling and punctuation mistakes. Limited use of technical vocabulary.<br><br>3-4 marks<br>Some coverage of hazards and precautions for two processes using some technical terms. Some spelling, punctuation or grammar errors. Poor structure of answer, and repetition made.<br><br>5-6 marks<br>Good coverage and a well-structured response. Hazards and precautions for two processes discussed using specific terms and vocabulary. There may be one or two spelling or punctuation mistakes, or minor grammar error.<br><br>7-8 marks<br>Good coverage and depth of answer, and a well-structured response. Hazards and precautions for two processes discussed using technical terms, and specific names of tools and equipment. Excellent spelling, grammar and punctuation. Avoidance of repetition. | |
| | | | | | **Total 8** |
| | | | | | **TOTAL 120** |