GCSE

Design and Technology Electronic Products

Paper 1

Mark scheme

45401
June 2013

Version: Final Mark Scheme

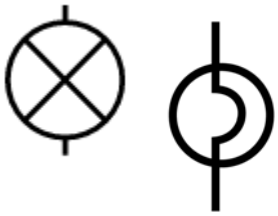
Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this 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**		Alternative Lamp Symbols as shown only  Buzzer symbol as shown only 	1 mark 1 mark Total (2 marks)
1	**b**		Note: No marks for simply describing function of component. Lamp Advantages: 1 mark for each point made Low cost / relatively small size / widely available / can be replaced easily when in use/ low weight/ audibly impaired/ suitable responses Buzzer: 1 mark for each point made Advantages Audible/ low cost/ compact/ less likely to fail than a lamp/ easier to identify in fog or low light or when visually obstructed/ alternative back up to visual device/ visually impaired/suitable responses	1-2 marks 1-2 marks Total (4 marks)

Question	Part	Sub Part	Marking Guidance	Marks
1	c		Drawings and notes should indicate each of the following: **Casing and Construction** – A maximum of 3 marks. 1 mark each for each material, process or construction feature. • Materials used HIPs, Acrylic, EVA, PVC (Foam) Depron or similar Line Bent, vacuum formed/ mould/ Press Formed (Plug and yoke) rebated edge, mitred corners, prepared shapes and joints • Features included mechanical joints screws, rivets, Tensol cement or other suitable fastening/fixing • Reference to dimensions **Control and light positions** – maximum of 2 marks. • A suitable position for the on/off switch drawn or labeled. 1 mark • A suitable position for the light output drawn or labeled. 1 mark **Means of attachment** – maximum of 2 marks The diagram or notes should indicate attachment to a model aircraft using any of the following: Magnets, plastic clips, adhesive, screwed connection/fixture of a mechanical fixing eg: nut/bolt, self tapping screw, cable tie, velcro, rubber loops and pins or a design feature eg: dovetail slot, key hole slot or similar. 1 mark for drawing and 1 mark for labelled feature **Visual Appeal –** maximum of 2 marks The appearance, shape and construction should show some aesthetic and or aerodynamic quality. 1 Mark for a simple response 2 Marks for justified or explained	1-3 marks 1-2 marks 1-2 marks Total (9 marks)

Question	Part	Sub Part	Marking Guidance	Marks
1	d		Drawing should indicate each of the following either in one coherent diagram/drawing or separate ones: **Means of fixing and controls for light or lights** • A suitable method to secure the visual output. Eg, Bezel,Clip, MES 1 mark • A suitable method to secure the on/off switch. Eg nut and washer, interference fit 1 mark (Note: If surface mounted visibility or access to switch required) • Further labelling and annotation gains an additional mark 1 mark **Battery fixing and access** • A diagram showing a battery/batteries/compartment 1 mark • An access lid or cover with hinge/sliding/rotary feature 1 mark • A pen cell battery box holder, clip or fixture, cable tie, snap connector, Velcro fastener or button cell holder 1 mark **Circuit fixing and wiring** • Reference to a PCB or other wired circuit eg: veroboard/matrix board 1 mark • Circuit fastened to case with screws, stand offs, or suitable clip or fixture 1 mark • Wiring detail shows: edge connector, flying leads connector pins, shrink wrap, terminal blocks or similar 1 mark	1-3 marks 1-3 marks 1-3 marks Total (9 marks)

Question	Part	Sub Part	Marking Guidance	Marks
1	**e**	**i**	INPUT - PROCESS- OUTPUT Written in INPUT BOX Sensor or suitable other input transducer / switch / PTM / Rotary SW / Slide SW / Toggle SW / SPST / membrane SW/Tilt switch Written in PROCESS BOX Oscillator / PIC/ Microcontroller / Astable / 555 IC or other suitable device Written in OUTPUT BOX LED(s) / LAMPS / EL wire / EL panel or similar	1 mark 1 mark 1 mark Total (3 marks)
1	**e**	ii	A diagram and notes featuring circuit components about how the process block controls the flashing output. • **<u>Basic</u>** explanation no details: eg: 'it sends/receives a signal' or 'it provides power' 1 mark • **<u>Additional technical detail</u>** referring to named process i.e. Astable/Oscillator/Frequency generator/555 or similar response 1 mark • High level response including circuit diagram and or control programme (1-2 marks) • Clear supporting and relevant sketches 1 mark	1 -5 marks Total (5 marks)

			Section B	
Question	**Part**	**Sub Part**	**Marking Guidance**	**Marks**
2	**a**		LED connection details Indication that it is the flat on case Indication that it is the short leg	1 mark 1 mark Total (2 marks)
2	**b**		Advantages of a 7 segment display compared with separate LEDs Advantages: **maximum of 3 marks** Simple point – 1 mark each Justified or explained – 2 marks • Single package • Simpler to assemble • Enables a numerical value to be read off up to 9 • Has a decimal point built in • Available in different sizes • Looks better • Other suitable responses Disadvantages : **maximum of 3 marks** Simple point – 1 mark each Justified or explained – 2 marks • More difficult to repair or replace than LEDs • Needs a display driver • More complicated to drive than LEDs • More difficult to design the PCB • Needs to be mounted on PCB rather than flying leads • Limited LED colour • LEDs are more readily available • LEDs are easily replaced separately • LEDs can be mounted on flying leads away from PC • Harder to fit to a case • Other suitable responses	1-3 marks 1-3 marks Total (6 marks)

Question	Part	Sub Part	Marking Guidance	Marks
2	**c**		State formula used : • 1 mark for V=IR or 'Ohms Law' or any variation V/I=R or V/R=I • 1 mark for 2 (volts) • 1 mark for recognition of 20/1000 (amps) • 1 mark for correct answer **with** units – 100R or Ω or ohms	Total (4 marks)
2	**d**		Explanation of points • number of LEDs in series • voltage drop across each LED at around 2 volts • The need for a resistor to also drop some voltage. • The estimated minimum operating voltage of around 4x 2volts. • The limited supply voltage available for the number of LEDs Basic/ limited statement with 1 point made 1 mark OR Detailed (2 points) or justified response 2 marks	Total (2 marks)
2	**e**		• Resistor Colour Code Bands Band 1 Blue Band 2 Grey Band 3 Brown	1 mark 1 mark 1 mark Total (3 marks)
3	**a**		Correctly identifying the two time delay components Components circled Capacitor Resistor	1 mark 1 mark Total (2 marks)

Question	Part	Sub Part	Marking Guidance	Marks
3	b	i	Correctly identify circuit schematic as a: Monostable	1 mark Total (1 mark)
3	b	ii	Explained functions of each part of the timer circuit A- Trigger / PTM to start timer function / Pull up resistor with switch to create negative spike/ pull down PTM B - 1 mark for recognising that they are timing components or naming them as resistor and capacitor. 1 mark for creates time delay C - 1 mark for the timer chip with some reference to pin 3 goes high when pin 2 goes low and 1 mark for pin 3 returns low at the end of the time period.	1-2 marks 1-2 marks 1-2 marks Total (6 marks)
3	b	iii	Calculation of time delay for RC 1 mark for formula T = R x C or R x C 1 mark for 100 000 or similar 1 mark for 1000/ 1000 000 or similar 1 mark for correct answer **with units** (100s) Accept 0.1MΩ x 1000F for 2 marks	1-4 marks Total (4 marks)

Question	Part	Sub Part	Marking Guidance	Marks
4			**QWC question** This question is about soldering components; the process and health and safety issues **6 marks for technical content** (1 mark for each point made up to a maximum of 6) which could include some reference to several of these key words: Copper tip, Tin /lead composition, melting point, heat sink, cleaning tip, holding tools, de-soldering, braid, lead free solder, work mat, tweezers, tinning, fume extraction, cold soldering, reflow, flux, multicore, solder side, component side, goggles or safety spectacles, burns, aprons, reference to populating, Or other suitable technical responses **4 marks for QWC** as follows **4 marks** Outstanding written response with good grammar, spelling and punctuation. **3 marks** for good use of space available with minor errors **2 marks** for limited coverage and some grammatical errors **1 mark** for poor coverage and/ or significant errors	Total (10 marks)
5	**a**		Give 2 detailed reasons for using microcontrollers: Reason 1 basic 1 mark detailed or justified 2 marks Reason 2 basic 1 mark detailed or justified 2 marks Responses from the list below • Wide range of functionality • Programmable • Re-programmable to upgrade or optimise over time • Adaptive inputs and outputs • It can monitor analogue and digital inputs • High speed calculations/operation of device • Single chip solution to replace complex circuit • Smaller PCB size possible • Replace less reliable logic or complex circuits • Or other suitable responses	1-2 marks 1-2 marks Total (4 marks)

Question	Part	Sub Part	Marking Guidance	Marks
5	**b**		1 mark for stating purpose 1 mark for explaining why important E.G. • Notch locates some components for placing • Notch indicates top of chip for pin numbering • Notch helps identify pin 1 on chip	Total (2 marks)
5	**c**		Drawn input details **1 mark** for each correct point • Push to make switch (PTM) connected to supply rail and input wire • Resistor connected to PTM/input wire and 0 rail • Correct PTM **and** Resistor symbols used	1 mark 1 mark 1 mark Total (3 marks)
5	**d**		Micro controller program alternatives for 1Hz flashing LED for 5 seconds. Solution could be basic or flowchart or similar Decision on input 1 mark Yes path 1 mark No path loops back 1 mark LEDs/ outputs ON 1 mark Wait for a time 1 mark LEDs / Outputs OFF 1 mark Wait for a time 1 mark Wait times correct to give 1Hz 1 mark Flashing sequence runs for 5 seconds 1 mark Loop back to beginning 1 mark	Total (10 marks)

Question	Part	Sub Part	Marking Guidance	Marks
6			Batteries Three separate simple statements **1 mark each** Or three detailed and justified responses **2 marks each.** Any reference to the following: • Harmful to the environment when disposed of • Metals leach into soil and watercourses • Use a lot of energy to manufacture • Use scarce chemical resources in manufacture • Unused batteries left in products leak • Direct human health hazard	Total (6 marks)
7	**a**		• On the diagram diode to be drawn in series with the circuit facing clockwise. **1 mark**  • Correct Diode symbol used **1 mark** (Note: Award mark with or without circle)	Total (2 marks)
7	**b**		**1 mark** for describing diode behaviour **2nd mark** for saying **how this diode behaviour** protects the circuit if the battery is connected the wrong way round.	Total (2 marks)

<table>
<tr><th>Question</th><th>Part</th><th>Sub Part</th><th>Marking Guidance</th><th>Marks</th></tr>
<tr><td>8</td><td>a</td><td></td><td>Correctly identify:

AND, AND gate</td><td>Total
(1 mark)</td></tr>
<tr><td>8</td><td>b</td><td></td><td>Correctly complete truth table as below
<table>
<tr><td>B</td><td>A</td><td>Z</td></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td></tr>
</table></td><td>3 marks

Total
(3 marks)</td></tr>
<tr><td>9</td><td>a</td><td></td><td>Using CAD:
3 separate responses required
From the list below each response can be:
A single simple response 1 mark
Detailed response justified or qualified. 2 marks

• 2D drawing for production or tooling
• 3D visualisation
• 2D files to generate CAM programmes
• PCB layout
• PCB production
• Schematic design
• Component virtual testing- no damage
• Mould making or enclosure modelling
• To reduce development time
• On screen bread boarding
• Microcontroller-
Flow chart design
Programming language
Programming chips</td><td>Total
(6 marks)</td></tr>
</table>

Question	Part	Sub Part	Marking Guidance	Marks
9	b		Vacuum forming process: Single point made 1 mark Detailed and justified response 2 marks Detailed response including at least two points 3 marks NOTE- Do not accept an unqualified 'quick, easy, cheap etc) • Reduced production time • Lower costs/ investment required • Improve accuracy/ tolerances • Improve repeatability • Utilises less skilled labour • To form complex shapes more easily • Forming is generally lower cost than fabricating • Simpler moulds possible • Various self-finished colours possible • Efficiency of labour • Other suitable responses	Total (3 marks)

Question	Part	Sub Part	Marking Guidance	Marks
9	c		**1 mark** for a specific **one off product** named **1 mark** each for points made from the list below, **up to 2 marks** • Is a single part/product • Often complex and highly specialised • One client • Requires skilled work/workforce • Specialist materials may be required • Expensive to produce in time and tooling • Set up costs and labour costs on one part/product • Bespoke design more customer liaison **1 mark** for a specific **high volume product** named **1 mark** each for points made from the list below, **up to 2 marks** • Tooling required – to allow repeatability • Lower unit cost – due to speed of production • Design and development cost spread over many units • Quality Control • Quality Assurance • Tolerances – to allow parts and sub-assemblies to fit • Less skilled workforce • Use of jigs and fixtures – as tooling • Materials Storage • Distribution • Packaging requirement Or other suitable factors or criteria	Total (6 marks)
				TOTAL 120