GCSE

Design and Technology Electronic Products

Paper 1

Mark scheme

45401

June 2015

Version: V1 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.

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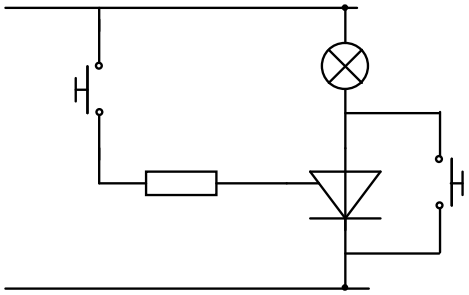
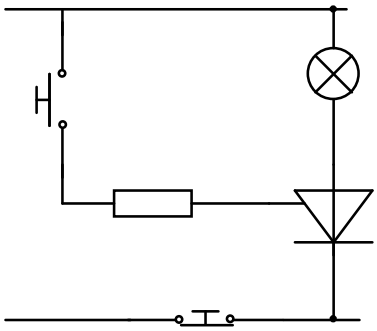
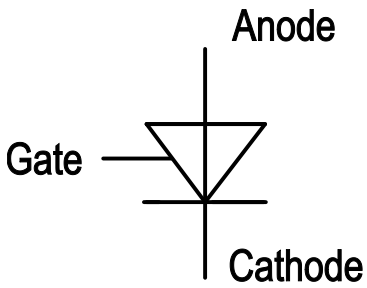
FOR EXAMINERS – PLEASE NOTE THAT IF YOU ARE UNSURE HOW TO AWARD A RESPONSE FROM A CANDIDATE, PLEASE SEEK CLARIFICATION OR ADVICE FROM YOUR TEAM LEADER OR THE PRINCIPAL EXAMINER.

Section A

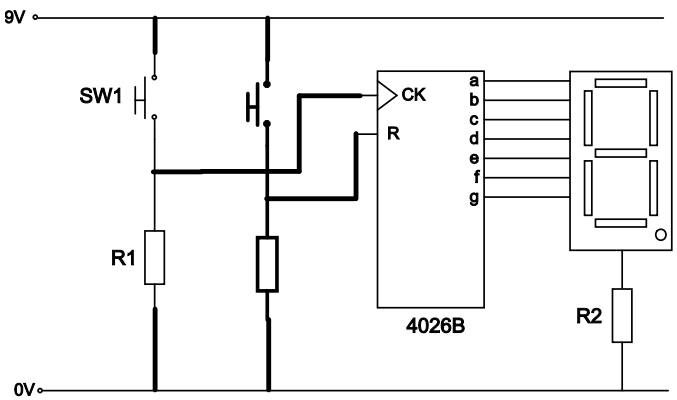
Question	Part	Sub Part	Marking Guidance	Marks
1	**a**		Design requirements – *up to 4 marks* 1 mark for each requirement. 2 case and 2 circuit requirements asked for. Case: reference to a material, colour, dimension, safety, hygiene, weight, number of shapes, theme of toy or similar. *1 mark each* *e.g. the case needs to be brightly coloured.* Circuit: reference to output component, input, battery access, circuit board, function of circuit, small or compact circuit (not just 'small') or similar. *1 mark each* *e.g. the circuit needs to have a bright LED output.* Do not credit repetition of the requirements given in the brief	Total (4 marks)
1	**b**		Mark both designs holistically, giving credit for best features. 7-8 marks – 2 creative designs that meet all the stated criteria and the ideas are well-communicated. 5-6 marks – 2 ideas with less evidence of creativity, but still meeting the criteria, and good communication. 3-4 marks – 1 idea that is clearly communicated, or 2 ideas with little creativity and detail. 0-2 marks – a very basic attempt with poor clarity of communication. Evidence of creativity could include, for example, bright colours, plays a tune, light output pattern, case has cartoon characters, interesting sequence of LEDs, shape of the case.	Total (8 marks)

1	**c**		Case development - *up to 10 marks.* Case construction details – *up to 2 marks* *1 for each ref. to a method e.g. vacuum forming, injection moulding, gluing, joints, dimensions, battery access* materials – *up to 2 marks* *1 mark to ref. to a generic material e.g wood, metal, plastic.* *2 marks for a specific material e.g. HIPS, polystyrene, acrylic, ABS, or similar suitable material.* Shapes trigger output – *up to 3 marks* 1 mark for naming input component. 1 mark for indication of how it is triggered. 1 mark for suggesting how input component is fitted. Quality of communication of case development – *up to 3 marks* 0 marks for unclear development of how the case is made. 1 mark for basic sketch with little or no relevant annotation of how the case is made. 2 marks for a clear sketch and some detailed annotation of case construction. 3 marks for a coherent sketch, clearly communicated with good detail in annotations. A full and comprehensive design showing development from the ideas stage.	Total (10 marks)
1	**d**	**i**	Reference to the use of a microcontroller, programmed to create a more complex and interesting output -*up to 2 marks* 1 mark for reference to programming. 1 mark for creating a more complex output. e.g. Several LEDs flashing in a sequence Sounder playing a tune Sounder playing 'sound effects' Voice created by microcontroller Toy vibrates	Total (2 marks)
1	**d**	**ii**	*Up to 3 marks* *1 mark* for each specific component named Input components could include PTM switch, reed switch, LDR, or other suitable response. Output components could include LED, bi-colour or tri-colour LED, bulb or lamp, buzzer, piezo transducer, sounder, bell, or similar.	

			Note: if 2 light or 2 sound outputs are named, award only 1 mark.	Total (3 marks)
1	**e**		*Up to 4 marks* for circuit diagram and notes. *1 mark* for a basic sketch showing some symbols for microcontroller *or* output components. No notes worthy of credit. (If a 555 has been drawn, award 1 mark if output components have been accurately drawn). *2 marks* for a circuit diagram showing a microcontroller and output component(s), where parts of the circuit are correctly connected. *3 marks* for a coherent circuit diagram with correct connections for outputs. *4 marks* for circuit with both sound and light output components correctly connected.	Total (4 marks)
1	**f**		Discussion of safety features of toys – *up to 4 marks.* Award *2 marks* for each justified point made. Award *1 mark* for a simple, unjustified point. As the question asks for a discussion, award *a maximum of 2 marks* in total if the answer only contains unjustified points. Safety issues could include reference to: sharp edges, small pieces can be a choking hazard, weight, loose pieces, non-toxic finish, age range of user, children should not be able to access a battery, or similar responses.	Total (4 marks)
2	**a**		Switch A Name: micro-switch – 1 mark Use: a suitable and realistic use or application – 1 mark e.g. limit switch, door safety switch Switch B Name: rotary switch – 1 mark Use: a suitable and realistic use or application – 1 mark e.g. motor speed control, different output selection, switching different circuits, volume control	Total

			If the use seems a realistic or possible, award the mark.	(4 marks)
2	**b**		 *1 mark* for correct PTM symbol *1 mark* if the switch correctly triggers the thyristor. *1 mark* for PTM between lamp and anode, **or** up to +V *1 mark* for PTM to 0V (If a PTB switch is used to reset the thyristor: *1 mark* for correct PTB symbol *1 mark* for correct position of PTB which will break the flow of current through the thyristor). 	Total (4 marks)
2	**c**		1 mark each.  	Total

				(3 marks)
2	**d**		*Up to 2 marks* *1 mark for each reference to:* A device with two stable states. A device that is either on or off. A device that is either high or low A memory device. A latch.	Total (2 marks)
2	**e**		Membrane switches – up to 4 marks. Simple response – sealable, easy to clean, low profile, light, complex layouts are easily achieved or similar 1 mark each *up to 4 marks.* Explained or justified point made – *2 marks each*	Total (4 marks)
3	**a**		Potential Divider calculation *Up to 4 marks* *1 mark* for the correct formula Vout = R2/ R1 + R2 x Vs *1 mark* for correct substitution of Vs – 9v *1 mark* for correct substitution of resistor values - 10 and 20 (or 10k and 20k) *1 mark* for correct answer with units – 3 volts or 3v.	Total (4 marks)
3	**b**	**i**	Diode – *1 mark*	Total (1 mark)
3	**b**	**ii**	Function of the diode – *up to 2 marks* *1 mark* for reference to transistor protection *1 mark* for reference to back emf	Total

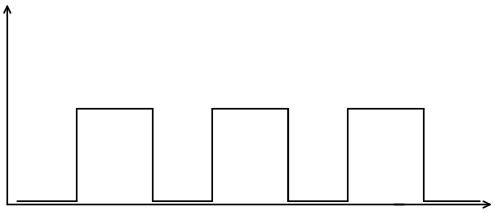
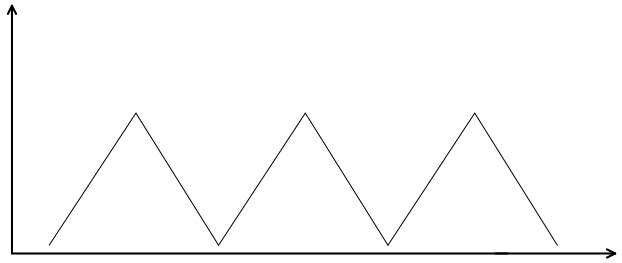
				(2 marks)
3	**c**		CAD for a PCB layout – *up to 2 marks* *1 mark each* for a reference to: Can be faster than drawing by hand Can be edited or amended quickly Text can be added with ease The design can be auto routed The layout can be tested on screen prior to production The design can be saved conveniently Similar appropriate suggestions (an unjustified 'quick…easy…cheap…'no mark)	Total (2 marks)
4	**a**		 *Up to 5 marks* *1 mark each for:* Connecting R1 to 0V Connecting SW1 to +V Connecting the junction of R1 and SW1 to the input pin CK A PTM switch and resistor connected to +V and 0V respectively as in the diagram Connecting the junction of the PTM and resistor to the reset pin labelled R.	Total (5 marks)

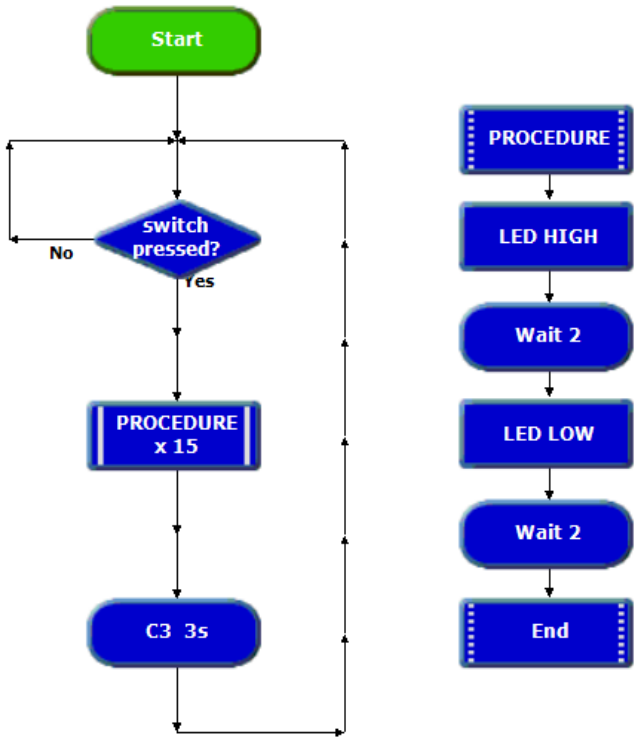
4	**b**		Pull down resistor – *up to 2 marks* *1 mark* for reference to one of the following: tying the input pin to zero volts keeping the input pin low until triggered the input pin will be floating high if not tied to zero volts. *1 mark* for preventing accidental triggering or counting.	Total (2 marks)
4	**c**		Switch bounce – *up to 2 marks* 1 mark for a stating what switch bounce is. 1 mark for describing the effect on a circuit or component. Statements could include, for example, Contacts inside switch bounce Inaccurate counting- the number 'jumps' Several pulses produced for each press of the switch Suitable similar response	Total (2 marks)
4	**d**		Eliminating switch bounce – *2 marks* Naming a specific component – 1 mark monostable Schmitt trigger 40106 IC debouncer circuit RC network/low pass filter. *1 mark* for stating what the component does Creates a clean digital signal Similar suitable response Simple response – 1 mark Explained or justified – 2 marks.	Total (2 marks)

5			QWC Question Looking for advantages and disadvantages of electronic devices in cars. Advantages could include: Improved safety by warning of seat belt not worn, icy conditions, open doors Diagnostics of engine problems Sat-nav systems to save time Hands-free communication Fuel monitoring Entertainment for passengers Parking sensors Rear-facing camera to help reversing Disadvantages could include: Cost of products Increased maintenance time and cost Weight of vehicle Distraction of the driver Greater incentive for theft from vehicle Consider the technical content and quality of communication. Marks awarded as follows: 0 marks – no answer worthy of credit. 1-2 marks Limited coverage. Just one product discussed. Many spelling and punctuation mistakes. Limited use of technical vocabulary. 3-4 marks Discussion of advantages and disadvantages of two products. Some spelling, punctuation or grammar errors. Poor structure of answer, and repetition made. 5-6 marks Good coverage and a well-structured response. Advantages and disadvantages for at least two products discussed using specific terms and vocabulary. There may be one or two spelling or punctuation mistakes, or minor grammar error. 7-8 marks Excellent coverage and depth of answer, and a well-structured response. Several products discussed using technical terms in good detail. Excellent spelling, grammar and punctuation. Avoidance of repetition.	Total (8 marks)

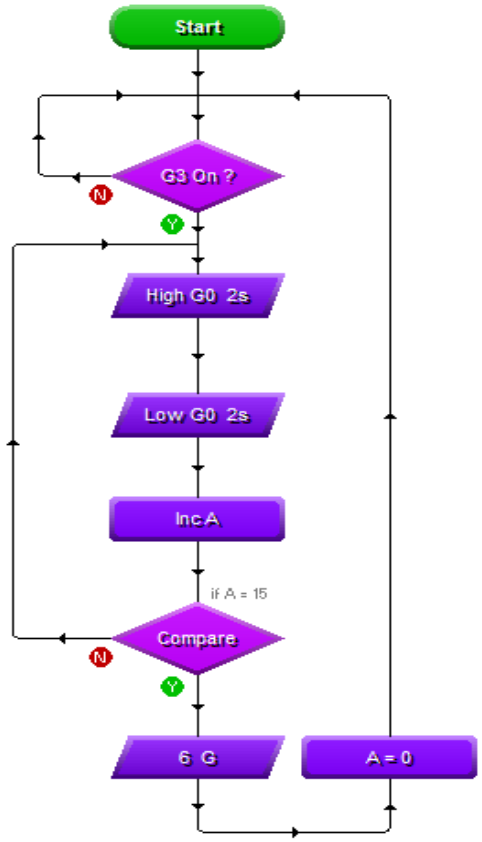
6	**a**		Rapid prototyping- *up to 3 marks* Reference to: complex 3-D shapes can be produced good for prototyping before production product can be made from 3-d graphical image complex components can be produced quickly *1 mark* for each simple response *2 marks* for a justified or explained point	Total (3 marks)
6	**b**		Reasons for choosing injection moulding – *up to 3 marks* Reference to: Low cost for each component Identical products produced Complex shapes can be made Low skilled workers can operate machine The mould can be re-used many times *1 mark* for each simple response *2 marks* for a justified or explained point	Total (3 marks)
6	**c**		1 mark for each correct suggestion – *up to 3 marks* Round corners, draught angle, vent holes, filleted joins, smoothing the faces of the former, or similar. Note: suggestions of re-designing the product gain no marks.	Total (3 marks)
6	**d**		Stages in vacuum forming. *1 mark* for each major stage – *up to 4 marks* Material clamped into place Heat applied Vacuum pump switched on Formed shape removed *1 mark* for these main stages in the right order. *Up to 2 more marks* for additional information or stages. Additional information or stages can include: Cut plastic sheet to size Check that material is soft Heater removed Former raised into material Pump off / table lowered Allow plastic to cool Trim excess material	Total (7 marks)

7	**a**	**i**	Polarised component – 1 mark A simple response would suffice. E.g. The component would not function correctly The circuit would not work The component has +ve and –ve legs.	Total (1 mark)
7	**a**	**ii**	Polarised components – *1 mark* for each correct response Either: C1, IC1 or buzzer	Total (2 marks)
7	**b**		Explaining the function of the monostable *1 mark* for each point made. (It is not necessary to explain every component to gain 4 marks) When PTM pressed, or pin 2 low, circuit triggered. Pin 3 high for a time, then low Buzzer is initially on, and then switches off for a time. Time controlled by R2 and C1 Capacitor C1 charges through resistor R2 555 is the process component	Total (4 marks)
7	**c**		1 mark for formula T= R x C 1mark for demonstrating that 56,000 has been used 1 mark for demonstrating that 1000/1 million or 0.001 has been used. 1 mark for 56 seconds (unit needed for mark) note: 0.056 x 1000 is also correct (0.056MΩ x 1000μF)	Total (4 marks)
7	**d**		Adjusting time period – *up to 2 marks* 1 mark for adding variable resistor Further mark for identifying where it goes – (either as a replacement for R2 or added in series with R2) If a candidate suggests 'Use rotary switch to switch different values of resistor R2 into the circuit', award 2 marks.	Total (2 marks)

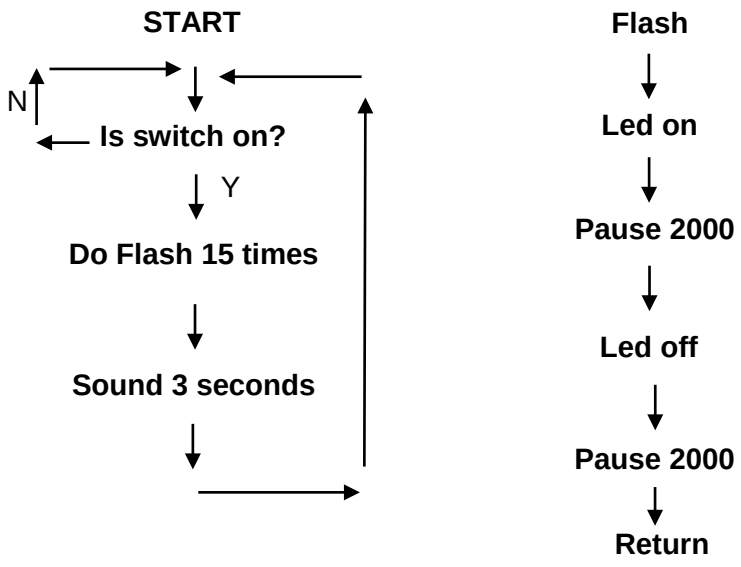
7	**e**		Output of astable – *up to 2 marks*  2 marks for drawing a clear square wave 1 mark for drawing a repeating wave A response as below – *1 mark* 	Total (2 marks)
7	**f**		Comparing a buzzer and piezo sounder – *up to 2 marks* *1 mark* for each point made Responses could include; Buzzer can only create one sound Piezo can play different tones, can be used to play music, different frequencies piezo sounders need a drive circuit to make a sound, a buzzer can just be connected to a power source. Similar, suitable response	Total (2 marks)

7	**g**		Microcontroller question – *up to 7 marks* *1 mark* for checking the state of the input with yes and no paths correct *1 mark* for LED or output high *1 mark* for LED or output low *1 mark* for correct frequency *1 mark* for repeat x 15 *1 mark* for playing a sound for 3 seconds *1 mark* for return loop Basic or other program systems acceptable. [simple re-writes of the question, giving no evidence of a programming system – no marks] Example of correct flowchart: 	

Alternative example:



Alternative example:



			Example of correct basic program: main: if pin3 = 1 then PROCEDURE goto main PROCUDURE for b = 1 to 15 gosub flash next b sound 4, 3000 goto main prc flash let pins = 1 pause 2000 let pins = 0 pause 2000 return **To reward use of procedure, or similar:** **for candidates who do not use procedure, award maximum of 6 marks.**	Total (7 marks)
				TOTAL 120