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General Certificate of Secondary Education June 2010

Design and Technology (Electronic Products) 45401

UNIT 1

Final

Mark Scheme

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

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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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Section A

1 (a) **Waterproof materials**

May include any plastics or coated metals, battery powered, 1 mark

Stated materials 1 mark

Waterproof features
A clear understanding of moisture and circuit problems clarified in the sketch and annotation.
Reference to any of the following:

Gasket
Seal
O-ring
Membrane
Lip seal
Overlapped case joints
Encapsulated circuit
And
Waterproof constructional materials 1 mark *(3 marks)*

Switch on and off
may include:
Water activated switch
Pressure activated
Latching switch
Slide switch
Remote lead on switch 1 mark

OR

Clearly defined and explained by words and or diagram relating to above 2 marks *(2 marks)*

Visual communication

Attractive 2D sketch / section view or 3D pictorial view that identifies the principal parts	3 marks	
	OR	
Good clear diagram but less well labelled but with design appeal	2 marks	
	OR	
Diagram poorly executed but labelled	1 mark	
	OR	
Diagram only with poor appeal	1 mark	*(3 marks)*

Adjustable for water level

Mechanical positioning: Levers, brackets wires, hangars, screwthread, flexible arms or similar solutions		
OR		
Electronic:		
Shielded wires, tubes, multiple sensors or similar		
Elegant, small, detailed solution		
Detailed but weaker solution	3 marks	
Poor solution but some detail	2 marks	
Any reference to the following: Float switch Reed Moisture Microswitch Slotted optical Reflective optical Variable resistor Tilt switch	1 mark	*(3 marks)*

Output device

Any response

Buzzer
Bell
Piezo sounder
Loudspeaker (remote)
Lamp
LED (various)

1 mark for a correct response and 1 mark

1 mark for suitable explanation 1 mark *(2 marks)*

Easy attachment to bath

Suckers, Brackets, hangars, moulded part, attached to bottom of bath, Around overflow or taps

Detailed well 2 mark

Weak design with some detail 1 mark *(2 marks)*

15 marks

1 (b) Block diagram completed

To include:

INPUT	or input device	1 mark	
PROCESS	or circuit	1 mark	
OUTPUT	or output device	1 mark	*(3 marks)*

Related to block diagram above the explanation will refer to the block diagram

Possible related commentary:
Switching
Current
Decision
Signal
Level

Or components referred to

Well explained related to diagram clear understanding
Input Devices

1	(c)		Input Device 1	1 mark	
			Input device 2	1 mark	
			Detection input sensor devices:		
			Float switch Reed Moisture Microswitch Slotted optical Reflective optical Variable resistor Tilt switch		
			Other responses are possible may require some justification		
			Advantages: Any two for device 1 Any two for device 2 Remote Lightweight Waterproof Reliable Mechanical Digital output Analogue output Low power Adjustable	2 x 2 marks	*(6 marks)*
1	(d)	(i)	One-off material:		
			Foamex Acrylic PVC Polystyrene Resin Cast	1 mark	
			One-off Process:		
			Vacuum form Blow mould Press form Line bend Laser cut Fold/bend	1 mark	

			Reason:		
			Low cost Simple/ easy Quick/rapid Prototype so limited need for – eg surface detail	1 mark	
			Detailed reason	2 marks	*(4 marks)*
1	(d)	(ii)	Batch of 5000 material:		
			Polythene Polystyrene Nylon Polyurethane Polypropylene	1 mark	
			Batch of 5000 process:		
			Injection mould Rotational cast Cast Press formed	1 mark	
			Reason for material and process choice for 5000:		
			Low cost Accurate Complex shape Easy to reproduce Surface detail	1 mark	*(4 marks)*
			Detailed reason	2 marks	
				Section Total	**32 marks**

Section B

2	(a)		Ohms Law stated		
			4v / 20 mA stated		
			Use of values / powers		
			Calculation	3 x 1 mark	
			Correct value 200Ω +-10%	1 mark	*(4 marks)*
2	(b)	(i)	Correctly identify Cathode (short lead)	1 mark	
			and Anode (long lead)	1 mark	*(2 marks)*
2	(b)	(ii)	Two advantages or features		
			Advantage 1	1mark	
			Advantage 2	1 mark	
			Disadvantage	1 mark	
			Detailed response	2 marks	
				OR	
			less detailed	1 mark	
			one word response	0 mark	
			From list below : low cost		
			reliability		
			size / SMD		
			consumption		
			fast response		
			poor brightness		
			more than one required		
			additional limiting resistor required directional output		
			colour range limited		*(5 marks)*
					11 marks

3	(a)	Cell symbol	1 mark	
		3 cells for 4.5 volts minimum **or 4 (6V)**	1 mark	
		Connected in series	1 mark	*(3 marks)*
3	(b)	Environmental harm – pollution/ heavy metals		
		Detailed response from below:		
		Limited detail Single word correct response Cost in ££ Corrosion / leakage Environmental consumption Product cannot be recharged Limited output voltage on each cell (eg compared with zinc / carbon cells)	3 x 1 mark	*(3 marks)*
3	(c)	7805		
		To drop a supply voltage To maintain a constant voltage To replace batteries in power consuming circuits		
		Detailed response	2 marks	
		Short / one word correct response	1 mark	*(2 marks)*
				8 marks

4	(a)	(electrolytic) Capacitor	1 mark	
		Resistor	1 mark	*(2 marks)*
4	(b)	Variable resistor	1 mark	*(1 mark)*
4	(c)	Resistor	1 mark	
		Switch (PTM push to make only)	1 mark	
		Resistor correctly connected to 6 v supply rail and 0 PTM volt rail	2 marks	
		Resistor to keep input voltage high/ hold high	1 mark	
		PTM to pull down voltage / pulse / invert / negative / spike	1 mark	*(6 marks)*
4	(d)	180 seconds	1 mark	
		T=RxC 180K with tolerance 10% and **or** T/C=R	2 marks	
		Correct calculation	1 mark	*(4 marks)*
4	(e)	Tolerances: Capacitor, resistor Leakage: Capacitor Calculation (time constant)(1.1)	Any two for 2 marks	*(2 marks)*

4	(f)	PIC allows pre-programming		
		PIC allows programme revisions / changes / updates		
		More outputs and inputs available		
		Sleep modes, lower current consumption, test routine, smaller PCB footprint		
		More reliable switching		
		Faster or shorter sequences		
		Fewer components required	1 mark for each aspect covered	*(6 marks)*
				21 marks

5	(a)			Compare the difference on each input		
				Calculating the difference / differential amplifier	2 x 1 mark	*(2 marks)*
5	(b)			Compare the difference on each input		
				Mention of inverting and non inverting		
				Output switching positive (high) for negative input total		
				Output switching negative (low) for positive input total		
				Inverting amplifier		
				Calculating the difference / differential amplifier		
				Mention of feedback – or to inverting terminal	2 x 1 mark	*(2 marks)*
5	(c)	(i)	R3	Described as a bias resistor / bridge	1 mark	
			VR1	Described as a preset or calibration or fine tune	1 mark	*(2 marks)*
5	(c)	(ii)		Correctly drawn thermistor in the box	1 mark	*(1 mark)*
5	(c)	(iii)		Correctly named thermistor	1 mark	*(1 mark)*
						8 marks

6	(a)	**Product application**		
		Any device or solenoid device or alarm output or relay output described with a Light sensitive response	1 mark	
		Mention of: Bridge or Potential divider resistor R2 LDR / input R3 base or Bias resistor / limiting gain	2 x 1 mark	
		TR1 Transistor / NPN / Electronic switch / Current Amplifier (correlate with responses above)	2 x 1 mark	(5 marks)
6	(b)	each leg labelled correctly Base / b Emitter / e Collector / c	2 x 1 mark	*(2 marks)*
6	(c)	Purpose and configuration: Bootstrap Darlington Pair Circuit needs a higher gain Low input current High current load Voltage Sensitive Load requires high current TR1 provides gain TR2 provides higher power Any two responses 2 marks Detailed description of function 3 marks	3 x 1 mark	*(3 marks)*
				10 marks

7	(a)	Suitable specification to include: size, output, weight, attachment methods, power, impact strength, construction, lifespan, visibility angles/distance as likely response areas Qualified responses for 4 criteria		*(4 marks)*
7	(b)	Responses could include : Reference to ABCD LEDs On / off or High / Low or 1 / 0 Sequence 1 and 2 Chasing A, B, C, D Or any combination eg DCBA Alternates AB, CD, AB etc All four ABCD High then Low Could refer to increasing / decreasing brightness (look for understanding of alternatives/ options)	1 x 2 mark	*(2 marks)*
7	(c)	**About PIC commands** Diagram and labels and words to describe this **simple routine** Schematic table flow diagram use of correct shapes or blocks (Not a decision block) Correctly labelled (wait / goto / start / high / lo / gosub / repeat In correct sequence Or With a loop (sub-routine) for each turn repeated	1 mark 3 marks 1 mark	*(5 marks)*

7	(d)	Eloquent qualified paragraph that uses the space available with good grammar and punctuation. Will include some reference to some of these key words: Testing. Field testing, bench-testing, destruction testing, consumer feedback, market research, performance against specification, battery life, exposure to elements, use on various rucksacks, visual test, field of view, range, User, visibility at night test, waterproof test, shockproof test.		
		Good coverage with no obvious grammatical error	5 - 6 marks	
		Coverage with some significant error	3 - 4 marks	
		Poor coverage with significant error	1 - 2 marks	*(6 marks)*
				17 marks
8	(a)	Correctly identify: Increasing track width Increasing pad size where possible Creating a wider earth plane on supply tracks Creating a hole for leads to run through or strain relief Use a terminal block for battery leads Suggest reducing PCB board size		
		Any 3 of the above	3 x 1 mark	*(3 marks)*

8	(b)	Using text and diagram or flow chart as presented:		
		Draw / Print / layout Photo etch Print to acetate Mask and UV box Expose Develop Rinse Etch Wash		
		For short coverage but correct terms	1 - 2 marks	
		For fullest details	3 - 4 marks	
		Alternatively		
		CAD Schematic Test PCB / Autoroute CNC CAM file CNC Route CNC Drill		
		Perhaps solder resist / through plate		
		For short coverage but correct terms	1 - 2 marks	
		Full good diagram or description but missing key stage	3 - 4 marks	
		For fullest detail	5 - 6 marks	*(6 marks)*
8	(c)	2 Instruments or tests could include:		
		Multimeter or DVM meter Test probe Continuity lamp/battery Moving coil ohmmeter	2 x 1 mark	(2 marks)

8	(d)	Any 2 safety hazards described to include: Sharp edges Sharps from side cutter (eg. component tails) Solder fumes Solder heat Drilling safety / goggles / fixing / snapping drill Residual chemicals on PCB Possibly shorting out supply leads (leading to overheating) Fume extraction	2 x 1 mark	(*2 marks*)

13 marks

Paper Total 120 marks