

Design and Technology

General Certificate of Secondary Education

Unit **A514/01** Electronics: Technical Aspects of Designing and Making

Mark Scheme for June 2011

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Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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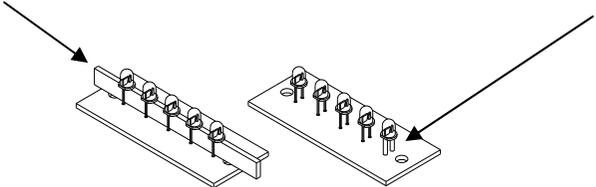
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| Question | | | Expected Answer | Mark | Rationale |
|----------|-----|------|--|------|---|
| 1 | (a) | (i) | Property given must refer to the thermoplastic nature of the plastics used, accept will melt with heat, re-melt etc. | [1] | |
| | | (ii) | Benefits of injection moulding will include: <ul style="list-style-type: none"> • Repeatable process • Suitable for large volume production • Low cost per unit in volume production • Accurate • Easy to change colour of case • Can use recycled materials. 1 mark for each benefit, 2 x 1. | [2] | 'Quick' or reference to speed must be qualified. Cost must be qualified – do not accept 'cheap'. |
| | (b) | | Items of help to user are: <ul style="list-style-type: none"> • Type of battery • CE symbol to show compliance with a standard • Voltage of battery • Number of batteries • Polarity of battery when inserting • Do not place in bin/household rubbish or should be recycled. 1 mark for each item, 2 x 1. | [2] | Allow reference to 'testing'. |
| | (c) | | Explanation should include reference to: <ul style="list-style-type: none"> • Compact size • Disposable low cost item so does not need replacing • Lower assembly costs – no soldering required • Connections protected from damage • Cannot be assembled incorrectly. 2 x 1 marks for giving benefits of COB IC 1 mark for referring to other types of IC in explanation. | [3] | Allow two marks for one well justified point. 'Cost' must be qualified. |

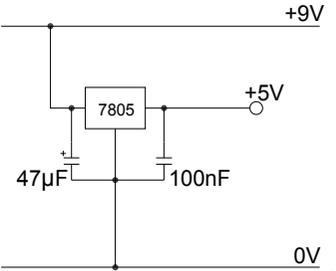
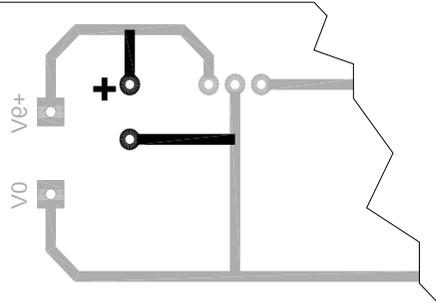
| Question | | Expected Answer | Mark | Rationale |
|--------------|-----|--|-------------|-----------------------------|
| 1 | (d) | Suitable components for detecting light: <ul style="list-style-type: none"> • LDR – accept CSd sensor • Phototransistor • Photovoltaic cell/solar panel • Photodiode. 2 x 1 marks. | [2] | No mark for 'light sensor'. |
| | (e) | Tests for ergonomic suitability could include: <ul style="list-style-type: none"> • Comparison of toy size to anthropometric data • Test with children of different age/size • Ease of using slide switch • Choke test for safety with small children • Safety checks for sharp edges on case moulding. 1 mark each for two points mentioned 2 x 1. 2 marks for a single point well justified. | [2] | |
| Total | | | [12] | |

| Question | | Expected Answer | Mark | Rationale |
|----------|---------|--|------|---|
| 2 | (a) | Checks on soldering iron to include: <ul style="list-style-type: none"> • Cable for burns/splits • Plug for cracks/other insulation damage eg handle • Cable gripped on entry into plug • Soldering iron bit securely attached. • PAT testing. 1 mark for each valid safety check, 2 x 1. | [2] | |
| | (b) | <ul style="list-style-type: none"> • The screw on the wire strippers should be adjusted, 1 mark • Method of adjustment eg moved until it does not quite close/hold up to light to see gap, 1 mark • When adjusted carry out a test on a spare piece of wire, 1 mark. 2 x 1 marks. | [2] | Allow 1 mark for reduced pressure on handles. |
| | (c) (i) | Caliper should be fully closed and zeroed before use, 1 mark Check against test piece Choice of units. | [1] | Allow reference to calibration. |
| | (ii) | Alternative tool for measurement could be: micrometer, drill plate, outside caliper. vernier gauge. | [1] | No mark for ruler. No mark for manual/analogue calipers. |
| | (iii) | Cathode to be identified using <ul style="list-style-type: none"> • Band around diode body at cathode end • Multimeter on diode check or resistance setting (allow 'multimeter'). Do not allow trial and error methods 1 mark for suitable method. | [1] | No mark for leg length. |
| | (d) (i) | Reason for solder not flowing is dirt/oxide on pad or soldering iron not touching both leg and pad at the same time. | [1] | Allow 'soldering iron not tinned'. |
| | (ii) | <ul style="list-style-type: none"> • Pad should be cleaned by scratching with fine wire brush. Allow abrasive rubber, scalpel or similar tool to expose clean metal, Add flux, Clean and tin soldering iron • Resolder joint • 2 x 1 mark – 1 mark for suitable method, 1 mark for resolder joint. | [2] | Allow 'reheat component leg and pad'. |

| Question | | Expected Answer | Mark | Rationale |
|----------|-----|--|-----------|-----------|
| | (e) | <p>Either a clear description of using a multimeter on resistance/voltage setting, 1 mark. Reading of zero/close to zero indicates good joint; high reading indicates faulty joint, 1 mark.</p> <p>or</p> <p>Sketch to show multimeter with probes connected either side of a joint, 1 mark. Reading shown to indicated good joint/faulty joint, 1 mark. Clear combination of notes/sketches, 2 marks.</p> | [2] | |
| | | Total | 12 | |

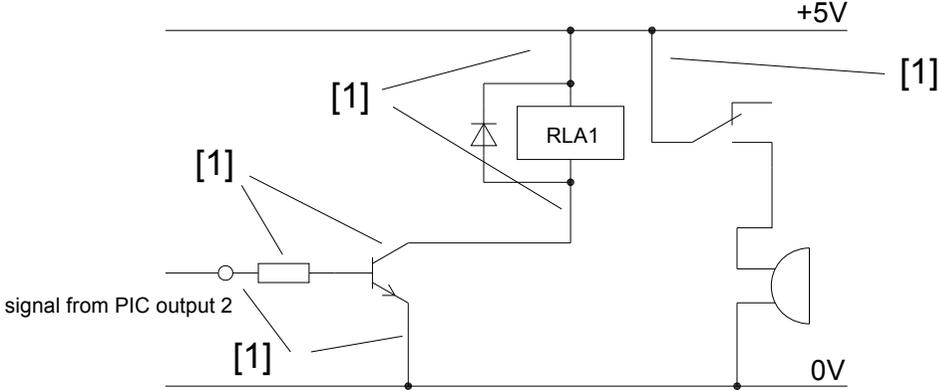
| Question | Expected Answer | Mark | Rationale |
|----------|--|------|---|
| 3 (a) | <p>Component A is a preset, used for varying resistance when circuit is being set up, could be for setting sensitivity level on a sensor. Allow any use that requires a particular resistance setting which cannot easily be achieved using a fixed resistor. [1]</p> <p>Component B is a microswitch, used as a switch with a sensitive action due to the lever which actuates the switch. Possible uses include sensing movement of parts in a machine, alarm systems, any use requiring changeover contacts. [1]</p> <p>The name of the component is not needed for the mark.</p> | [2] | <p>Allow 'calibration of circuit'.</p> <p>Allow use in safety circuits or counter circuits.</p> <p>Accept descriptions of use in a product.</p> |
| (b) | <p>Benefit of toggle switch could be:</p> <ul style="list-style-type: none"> • Securely fastened to case • Fits from inside the case • Round hole is easy to cut in case • Positive action of switch/easy to operate. <p>1 mark.</p> <p>Benefit of rocker switch could be:</p> <ul style="list-style-type: none"> • ON/OFF positions marked clearly • Does not stick out from case • Push fit into case. <p>1 mark.</p> | [2] | |
| (c) | <p>Allow any method that will hold LEDs at a set height, this could be a spacer that slides between the LED legs or sleeves fitted to individual legs.</p>  <p>1 mark for principle used, 1 mark for functional solution.</p> | [2] | <p>Allow 1 mark for measuring height on each LED.</p> |

| Question | Expected Answer | Mark | Rationale |
|----------|---|-------------|--|
| 3 (d*) | <p>Benefits for using lead free solder could include:</p> <ul style="list-style-type: none"> • Less damage to the environment when recycling • Less risk of contamination for workers involved in recycling • Safer for workers coming into contact with solder – reduction in long term health risk. <p>Difficulties could include:</p> <ul style="list-style-type: none"> • Problems with enforcement • Disposal of old stocks of solder • Higher temperature soldering irons needed • Higher cost of solder • Poor quality soldered joints. <p>Level 1 (0-2 marks) Shows limited understanding of the issues involved with lead free solder. 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>Level 2 (3-4 marks) Shows some understanding of the issues involved with lead free solder, some analysis of the issues involved. There will be some use of specialist terms although theses 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 3 (5-6 marks) Shows detailed understanding of the issues involved with lead free solder and analyses most of the issues involved. 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> | [6] | Allow reference to energy costs in extra heating needed. |
| | Total | [12] | |

| Question | Expected Answer | Mark | Rationale |
|-----------|---|------|---|
| 4 (a) (i) | Heatsink may be needed to keep the voltage regulator cool if the load on output is high. Allow mark for understanding shown. | [1] | Allow any reference to reduction of heat/temperature in IC or reduction of damage to IC. Must refer to overheating. |
| | (ii) Suitable materials; aluminium or copper . Do not allow steel. | [1] | |
| (b) (i) | Correct symbol and value for 47 μ F capacitor, 1 mark. Correct symbol and value for 100nF capacitor, 1 mark.  | [2] | Mark can be awarded if polarity and correct symbol are used to indicate the different capacitors but no values are stated. |
| | (ii) Suitable position for pads and tracks, 1 mark. Indication of polarity, '+' next to positive connection, 1 mark.  | [2] | Polarity mark can be given even if capacitor negative track is incorrect (positive track must be connected to positive rail). |

| Question | Expected Answer | Mark | Rationale |
|--------------|-----------------|---|---|
| 4 | (c*) | <p>Points for comparison could include:</p> <ul style="list-style-type: none"> • Voltages available • Disposable/rechargeable batteries • Power output • Safety • Environmental concerns with battery disposal • Falling level of voltage on batteries • Portability • Cost – must be qualified • Physical size. <p>Level 1 (0-2 marks) Shows limited understanding of the issues when comparing batteries and mains powered adaptors. 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>Level 2 (3-4 marks) Shows some understanding of the issues when comparing batteries and mains powered adaptors; some analysis of the issues involved. There will be some use of specialist terms although theses 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 3 (5-6 marks) Shows detailed understanding of the issues when comparing batteries and mains powered adaptors and analyses most of the issues involved. 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> | Maximum of 2 marks for short bullet point list. |
| Total | | [12] | |

| Question | | Expected Answer | Mark | Rationale | | | | | | | | | |
|-----------|----------|---|------|---|----------|-----------|---|---|---------|---|---|-----|---|
| 5 | (a) | <p>Choice of correct value for thermistor - 13.82kΩ / 13K82, 1 mark.</p> <p>Substitution into formula $V_{out} = \frac{15000 \times 5}{13820 + 15000}$ 1 mark</p> <p>Correct result $V_{out} = \frac{75000}{28820} = 2.60V$, 1 mark.</p> | [3] | Accept 2.60235947258 or any rounded value. Correct result with no working = 3 marks. | | | | | | | | | |
| | (b) (i) | <p>Alternative method could be an op-amp or comparator circuit. Allow mark for potential divider set to switch a transistor at required temperature.</p> | [1] | | | | | | | | | | |
| | (ii) | <p>An analogue value is a variable value between given limits, in this case between 0V and +5V. A digital value is a binary value made up of 0s and 1s Allow mark for understanding shown.</p> | [1] | Allow 'on and off' for binary values. | | | | | | | | | |
| | (c) (i) | <p>Green LED outputs correct, 1 mark. Red LED outputs correct 1 mark.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;">output 0</td> <td style="text-align: center;">output 1</td> </tr> <tr> <td style="padding-right: 5px;">green LED</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="padding-right: 5px;">red LED</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> </table> | | output 0 | output 1 | green LED | 1 | 0 | red LED | 0 | 1 | [2] | Allow tick or cross to indicate high/low. |
| | output 0 | output 1 | | | | | | | | | | | |
| green LED | 1 | 0 | | | | | | | | | | | |
| red LED | 0 | 1 | | | | | | | | | | | |
| | (ii) | <p>The delay is needed to avoid the LEDs/sounder going on and off rapidly when the temperature is near to the switching point (hunting). Explanation to include both cause and effect for both marks. Cause of problem, temperature level near switching point, 1 mark. Effect – rapid on/off switching, 1 mark.</p> | [2] | | | | | | | | | | |

| Question | Expected Answer | Mark | Rationale |
|--------------|---|-------------|--|
| <p>5 (d)</p> | <p>Addition of resistor and transistor or resistor and Darlington Pair, 1 mark. Correct connection of resistor/transistor(s) to signal from PIC output 2, 1 mark. Both relay coil connections correct, positive rail and collector, 1 mark. Relay contact common connected to power, 1 mark. Allow any three correct for marks, 1 x 3.</p>  | <p>[3]</p> | <p>The protective resistor must be between the output from Pin 2 and the base connection to gain either mark available for the transistor.</p> <p>Negative side of relay coil must be open connection or to collector on the transistor.</p> |
| Total | | [12] | |

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