GCSE

Design and Technology Systems and Control Technology

Paper 1

Mark scheme

45651
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.

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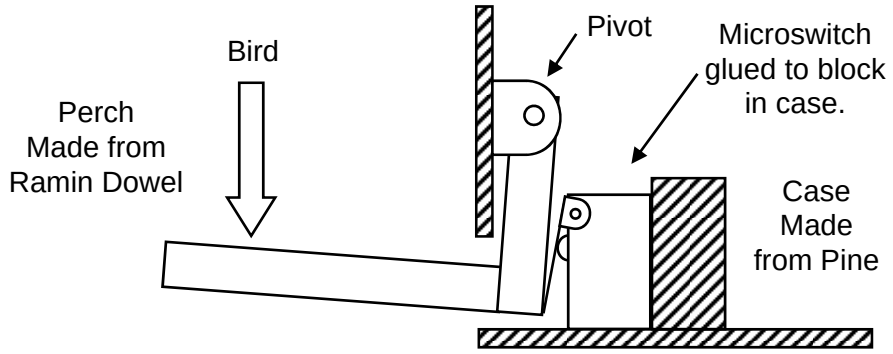
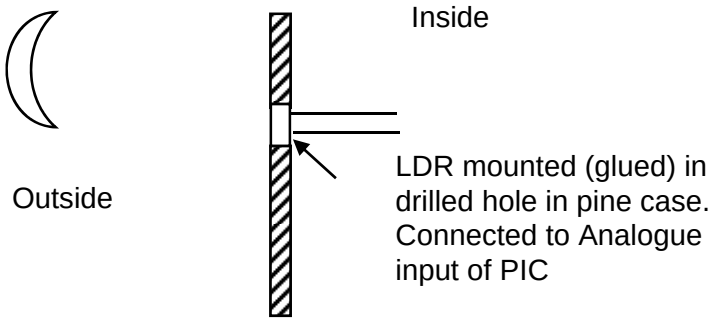
COMPONENT NUMBER: 45651

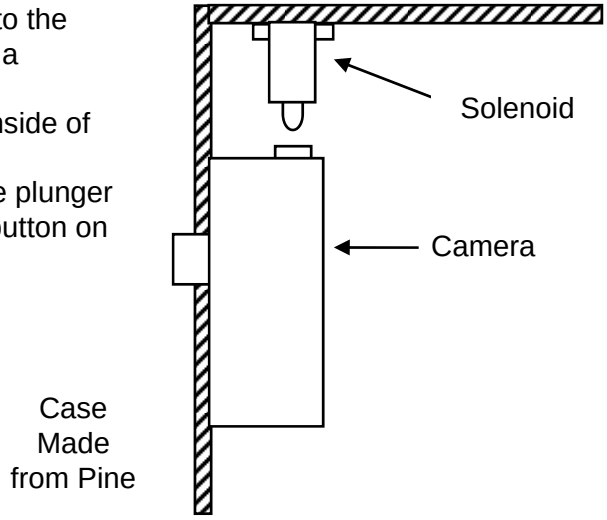
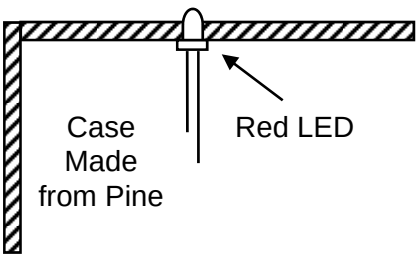
COMPONENT NAME:
GCSE Design and Technology (System and Control Technology)

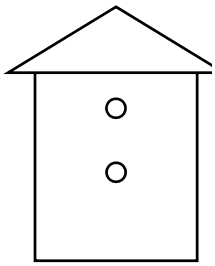
FOR EXAMINERS – PLEASE NOTE THAT IF YOU ARE UNSURE HOW TO AWARD A RESPONSE FROM A CANDIDATE, PLEASE SEEK CLARIFICATION OR ADVICE FROM YOUR TEAM LEADER OR THE PRINCIPAL EXAMINER.

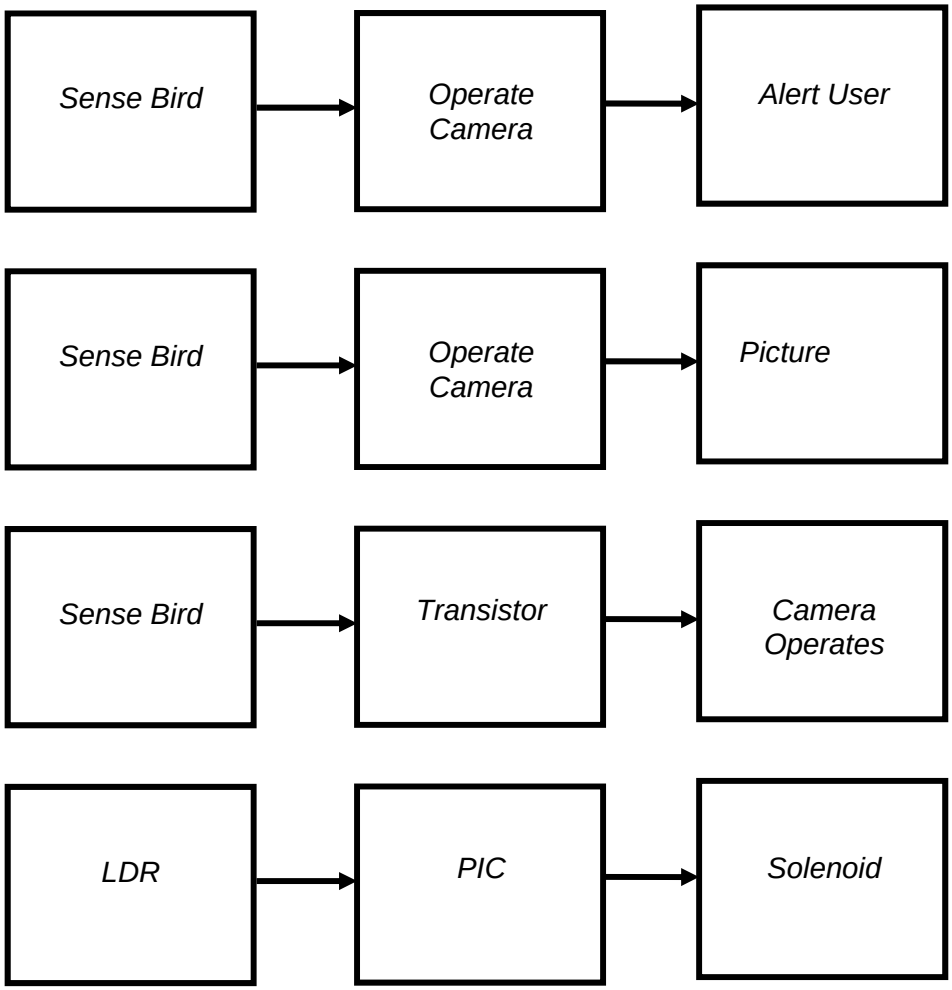
Section A

Qu.	Part	Sub Part	Marking Guidance	Marks
1	(a)		For each of the following specification points, give an example of an issue you will need to consider. You should explain your answer. An example response has been given to you. *Functional Specification point – The system must be waterproof to prevent rain damage.* 3 x (2 marks) Weak response 1 mark Full response with reason 2 marks *e.g.* *1. Safety Specification point* *The system must have no sharp edges so that does not injure the bird,.* *2. Power Supply Specification point* *The system must not be mains powered so that it can work away from the house.* *3. Aesthetic Specification point* *The system should look attractive so that customers want it in the garden.*	Total (6 marks)

Qu.	Part	Sub Part	Marking Guidance	Marks
1	(b)	(i)	Using notes and sketches design a product, in the box below that meets each of the criteria The system can sense that a bird is present Weak attempt to sense that a bird is present (1 mark) Good attempt to sense that a bird is present (2 marks) Good attempt with materials / components identified (3 marks) e.g.  	Total (3 marks)
1	(b)	(ii)	The system can sense that it is not completely dark Weak attempt to sense that it is not dark (1 mark) Good attempt to sense that it is not dark (2 marks) Good attempt with materials / components identified (3 marks) Note - Do not penalise responses with an LDR shown in an incorrect circuit diagram as a circuit was not asked for. E.g.  	Total (3 marks)

Qu.	Part	Sub Part	Marking Guidance	Marks
1	(b)	(iii)	The system can operate the camera. Weak attempt to operate the camera. (1 mark) Good attempt to operate the camera. (2 marks) Good attempt with materials / components identified (3 marks) E.g. Solenoid connected to the output of the PIC via a transistor. It is screwed to the inside of the case. When it operates, the plunger presses the shutter button on the camera.  	Total (3 marks)
1	(b)	(iv)	The system can let the bird watcher know that the camera has taken a picture Weak attempt to alert user (1 mark) Good attempt to alert user (2 marks) Good attempt with materials / components identified (3 marks) Give credit for any potentially functional system, e.g. Bluetooth E.g. Red LED connected to the output of the PIC. It flashes to show the user that a picture has been taken.  	Total (3 marks)

Qu.	Part	Sub Part	Marking Guidance	Marks
1	(b)	(v)	The system is suitable for use outside in the rain Weak attempt to make weatherproof (1 mark) Good attempt to make weatherproof (2 marks) Good attempt with materials / components identified (3 marks) E.g.  The pine case is coated in wood preservative before the components are added. The roof is made from slate to protect the pine from the rain.	Total (3 marks)

Qu.	Part	Sub Part	Marking Guidance	Marks
1	(c)		Complete the block diagram below. 1 mark for each correct response, i.e. Input, Process, Output Note – A correct response can be for the whole system or part of the system. Actions or Components are acceptable Eg.  	Total (3 marks)

Qu.	Part	Sub Part	Marking Guidance	Marks
1	(d)		State two suitable output devices that could be used to alert the user that a picture had been taken on the automatic bird camera. Give a suitable design advantage for each. Recognisable suitable output device (1 mark) x 2 Weak suitable design advantage (1 mark) Good suitable design advantage (2 marks) x 2 *e.g.* *Flashing Red LED* *The user would see this from the house and low current so battery would last* *Buzzer* *The user would hear this and not need to be looking at the device.*	Total (6 marks)
1	(e)		The case for the system is to be manufactured in a batch of 20 000. State a suitable material and process for the manufacture of 20 000 cases for the system you have designed. Give the reason for your choice. Specific Suitable Material (1 mark) Specific Suitable Process (1 mark) Weak Reason (1 mark) Good Reason well explained (2 marks) *e.g, Material Pine, Steel, Aluminium, HIP, Nylon, Polyethylene, ABS, Polystyrene* *NOT - plastic, wood, metal, Thermosetting Plastic, Hard Wood, Ferrous Metal, etc.* *Process* *Saw and Glue, Vacuum Forming, Cut and Weld, Injection moulding.* *NOT – Batch, Mass* *Reason* *High production rates* *Design flexibility* *Repeatability within tolerances* *Can process a wide range of materials* *Relatively low labour*	Total (4 marks)

Section B

<table>
<tr><th>Qu.</th><th>Part</th><th>Sub Part</th><th>Marking Guidance</th><th>Marks</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td>1 mark for each correct advantage
1 mark for each correct disadvantage
1 mark for a good example product

Eg,

<table>
<tr><th>Drive system</th><th>Advantage</th><th>Disadvantage</th><th>Example</th></tr>
<tr><td>Gears</td><td>No slip</td><td>Expensive, noisy</td><td>Food mixer</td></tr>
<tr><td>Belt and Pulley</td><td>Can span distances</td><td>Can slip, stretch, break</td><td>Lathe</td></tr>
<tr><td>Drive Shaft</td><td>Strong</td><td>Cannot alter speed</td><td>Truck</td></tr>
</table>
</td><td>Total
(9 marks)</td></tr>
<tr><td>2</td><td>(b)</td><td></td><td>Describe a system where friction is an advantage

Weak practical example (1 mark)
Good practical example (2 marks)

e.g. In a car clutch or brake system, allows drive to be transmitted or the wheel to be stopped.

Describe a system where friction is a disadvantage
Weak practical example (1 mark)
Good practical example (2 marks)

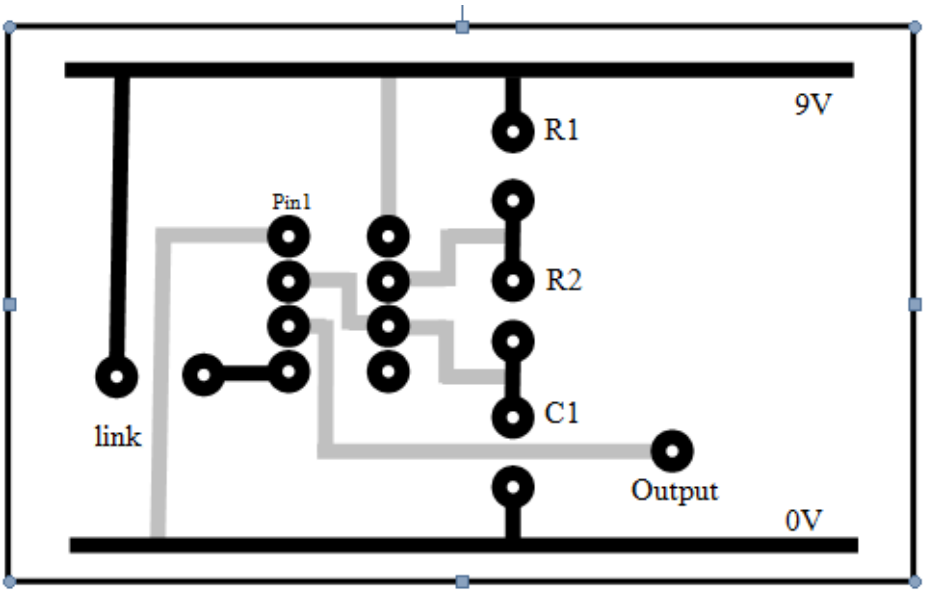
e.g. In a car engine or gearbox, causes drag and waste heat</td><td>Total
(4 marks)</td></tr>
<tr><td>2</td><td>(c)</td><td></td><td>Calculate the Gear Ratio

Correct Formula (1 mark)
Correctly inserting the values (1 mark)
Correct value (1 mark)

Gear ratio = $\frac{\text{Number of teeth on driven gear}}{\text{Number of teeth on driver gear}}$
Gear ratio = $\frac{32}{16}$
Gear ratio = $\frac{2}{1}$ or 2:1 or 2</td><td>Total
(3 marks)</td></tr>
</table>

Qu.	Part	Sub Part	Marking Guidance	Marks
2	**(d)**		Calculate the Velocity Ratio Correct Formula (1 mark) Correctly inserting the values (1 mark) Correct value (1 mark) Velocity Ratio = Diameter of driven pulley / Diameter of driver pulley Velocity Ratio = 45 / 15 Velocity Ratio = 3 or 3:1 or 3 / 1	Total (3 marks)
2	**(e)**		Calculate the Output Speed of the pulley system above if the input speed is 1000 rpm Note – Do not penalise if 2(e) incorrect but correct when based upon an incorrect VR from 2(d). Correct Formula (1 mark) Correctly inserting the values (1 mark) Correct value and **units** (1 mark) Output speed = Input speed / Velocity ratio Output speed = 1000 / 3 Output speed = 333 **rpm** or 333.3 **rpm** etc.	Total (3 marks)

Qu.	Part	Sub Part	Marking Guidance	Marks
3	(a)		Suggest **two** reasons for using a PCB in a commercial electronic product Weak reason (1 mark) Good reason (2 marks) e.g. Reason 1 PCB has a small footprint and draws less current. Reason 2 Give good reliability for a long life cycle.	Total (4 marks)
3	(b)		State **two** hazards and **two** relevant safety precautions to be taken when soldering components to a PCB. Good hazard (1 mark) Good safety precaution (1 mark) x 2 Do not accept Protective Clothing as not a Safety Precaution, e.g. gloves, apron e.g. Hazard 1 Toxic fumes from hot solder Safety precaution 1 Use fume extraction when soldering to prevent inhalation of fumes Hazard 2 Solder can spit and get in your eyes Safety precaution 2 ear safety glasses when soldering to protect eyes from hot solder	Total (4 marks)

Qu.	Part	Sub Part	Marking Guidance	Marks
3	(c)		1 mark for each track correctly connected at both ends and not joined to anything else. • Pin 1 – 0V • Pin 2 – Pin 6 • Pin 3 – Output pad • Pin 6 – Between R2 pad and C1 pad • Pin 7 – Between R1 pad and R2 pad • Pin 8 – 9V Do not penalise for tracks that lightly brush pads or tracks as this can be due to the scanning process.  	Total (6 marks)

Qu.	Part	Sub Part	Marking Guidance	Marks
4	**(a)**		A company is considering purchasing robots to manufacture their products. Explain an advantage and a disadvantage of using robots in manufacturing. Weak advantage (1 mark) Good advantage or 2 Weak advantages (2 marks) *e.g.* *Advantage* • *Quality – They are more accurate and rarely make mistakes,* • *Production – They do take breaks, go sick or have holiday* • *Safety – The humans are moved away from dangerous processes* • *Save money – Do not take a wage, need a pension and create less waste* Weak disadvantage (1 mark) Good disadvantage or 2 Weak disadvantages (2 marks) *e.g.* *Disadvantage* • *Expense – They have to be purchased and require maintenance* • *Return on Investment – This can be long and the market may change* • *Expertise – The workforce needs to 'skill up' to operate and maintain them* • *Safety – They can injure personnel if not operated correctly*	Total (4 marks)
4	**(b)**		A UK company is considering moving the manufacturing its products to China. Explain the benefits for the company of manufacturing products in. China 1 Weak benefit (1 mark) 1 Good benefit or 2 Weak benefits (2 marks) 1 Good and 1 weak benefit (3 marks) 2 Good benefits well explained (4 marks) *e.g.* *Benefits* • *A cheaper product price as wages are lower* • *Lower H&S practices so easier to produce goods* • *An available workforce at short notice* • *A way into trade with the East*	Total (4 marks)

Qu.	Part	Sub Part	Marking Guidance	Marks
4	**(c)**		A multinational company is using a production process that is legal to use in some countries but is considered too dangerous to be used legally in the UK. Discuss whether or not the company should use this production process in those countries where it is legal to do so. Give reasons for your answer. 1 Weak reason (1 mark) 1 Good reason or 2 Weak reasons (2 marks) 1 Good reason explained or 3 weak reason (3 marks) 2 Good reasons well explained (4 marks) *e.g.* *The company should not use this process, even if it is not illegal abroad as it is unethical and immoral. There is obviously a risk with the process as it cannot be used in the UK; it therefore should not be used abroad as it could endanger workers lives. If there was an accident it would be bad for the foreign workers but also for the company as it could affect brand image and share price.*	Total (4 marks)

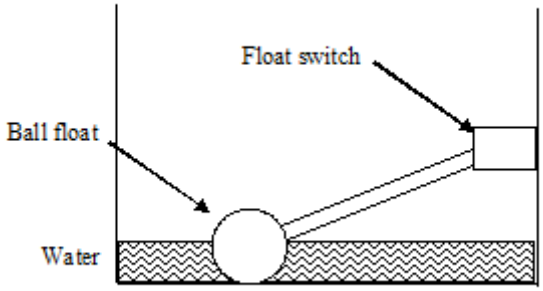
Qu.	Part	Sub Part	Marking Guidance	Marks
4	**(d)**		Explain how manufacturers can design sustainability into a product. Give examples in your answer. A high level response with a full and comprehensive explanation of all aspects of a suitable process. Response well structured with good use of appropriate design and technology terminology and showing a good grasp of grammar, punctuation and spelling. - (7 - 8 marks) A medium level response with a good explanation of a suitable process, however with some aspects of the process omitted. Response fairly well structured with some use of design and technology terminology with a small number of errors in grammar, punctuation. (5 - 6 marks) A low level response with a limited explanation of one part of the process with several errors. Response poorly structured with little or no use of design and technology terminology and with several errors in grammar, punctuation and spelling. (3 - 4 marks) An attempt at a response, no relevant description presented. No use of design and technology terminology and multiple errors in grammar, punctuation and spelling. (1 - 2 marks) *e.g. An 8 Mark response;* *A vacuum cleaner manufacturer can design sustainability into their products by making it simple for the user / owner to replace parts that may wear out before the whole unit is scrap (belts, filters, bags, etc.)* *By having access panels and removable covers that can be safely opened / removed, the user can swap them without them coming to harm.* *They must ensure that there are clear instructions on how to replace these parts.* *They should also ensure that the spare parts are easily identifiable and readily available to buy on the High Street or the Internet.* *They could make 1 part fit many models to make it simpler to stock and identify.* *Another angle on sustainability is fashion. If the manufacturer did not regularly change the design of the product, the users would not feel the need to scrap their existing cleaner before the end of its working life, just to trade up to a newer, more fashionable model.*	Total (8 marks)

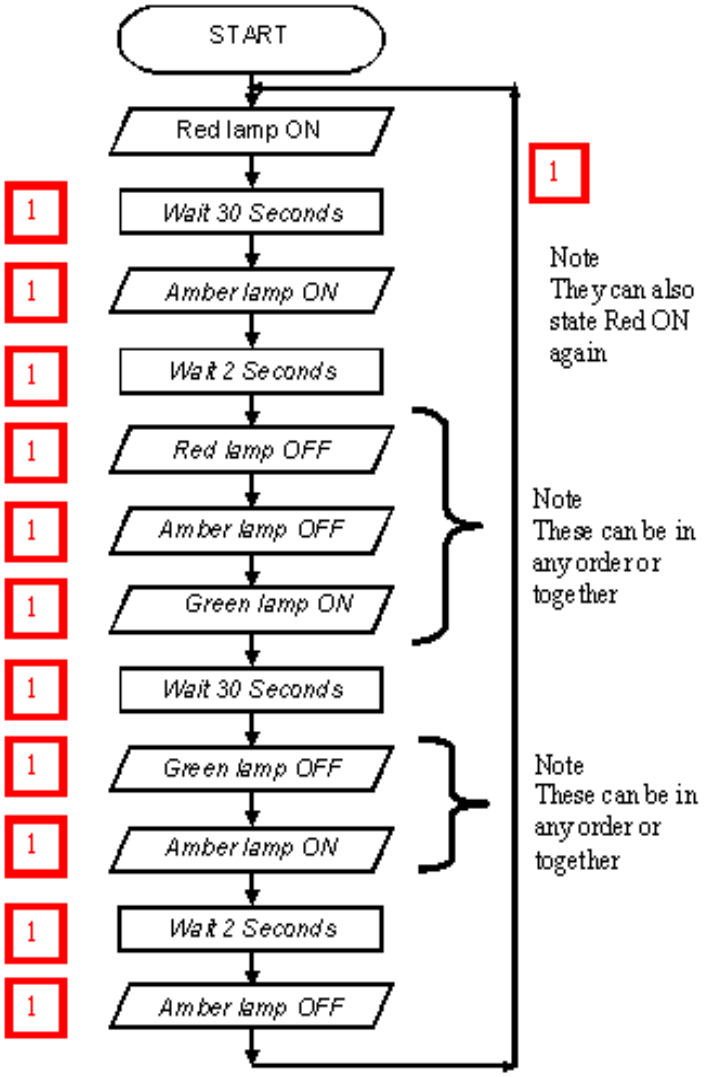
<table>
<tr><th>Qu.</th><th>Part</th><th>Sub Part</th><th>Marking Guidance</th><th>Marks</th></tr>
<tr><td>5</td><td>(a)</td><td></td><td>Name the Gates used in the logic circuit above

<table><tr><td>Gate 1</td><td>OR</td><td>1 mark</td></tr><tr><td>Gate 2</td><td>NOT / Invertor</td><td>1 mark</td></tr><tr><td>Gate 3</td><td>AND</td><td>1 mark</td></tr></table></td><td>Total
(3 marks)</td></tr>
<tr><td>5</td><td>(b)</td><td></td><td>Complete the following Truth Table for the logic circuit above.

<table><tr><td colspan="3">Inputs</td><td colspan="2">Process</td><td>Output</td></tr><tr><td>Water Sensor 1</td><td>Water Sensor 2</td><td>Safety Door Switch</td><td>Point A</td><td>Point B</td><td>Pump ON</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td></tr></table>
All 8 states of Point A and Point B (1 mark)

1 mark for each state of Pump ON column (3 marks)</td><td>Total
(4 marks)</td></tr>
</table>

Qu.	Part	Sub Part	Marking Guidance	Marks
5	(c)		Use notes and sketches to show a suitable sensor for sensing that water is present in a room. A recognisable system for sensing water (1 mark) A weak system that would work but with errors (2 marks) A good system that would work (3 marks) A good working system, explained with notes and sketches (4 marks) E.g.  As the compartment fills with water, the ball float on the Float switch starts to float. This operates the switch. The switch is the input to the system and starts the process.	Total (4 marks)
5	(d)		Suggest **two** advantages of using a Microcontroller (PIC) rather than discrete Logic Integrated Circuits (IC's) in a commercial electronic product. Weak advantage (1 mark) Good advantage (2 marks) x 2 e.g. *Advantage 1 It has more features and can more easily be changed* *Advantage 2 It takes less space and probably is cheaper*	Total (4 marks)

Qu.	Part	Sub Part	Marking Guidance	Marks
6	(a)		Complete the flowchart to show how this would be programmed. Each correct command in the correct order (1 mark) There are no marks for box shape as not asked for. The return arrow correctly drawn with arrowhead (1 mark) Fully working flowchart (12 marks) e.g.  	Total (12 marks)

Qu.	Part	Sub Part	Marking Guidance	Marks
6	**(b)**		Fully explain why Light Emitting Diodes (LEDs) are replacing lamps in modern traffic lights. Weak explanation (1 mark) Good explanation (2 marks) Good explanation with reasoning (3 marks) *e.g.* *LED's use less current so the traffic light would cost less to run* *LED's have a longer life span so the traffic light would cost less to run as they would not need to be replaced as often* *LED's are more vandal resistant then bulbs which is safer and cheaper to run.* *LED's are used in multiples and will continue to work if one breaks*	Total (3 marks)