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General Certificate of Secondary Education June 2010

Design and Technology (Systems and Control Technology) 45651

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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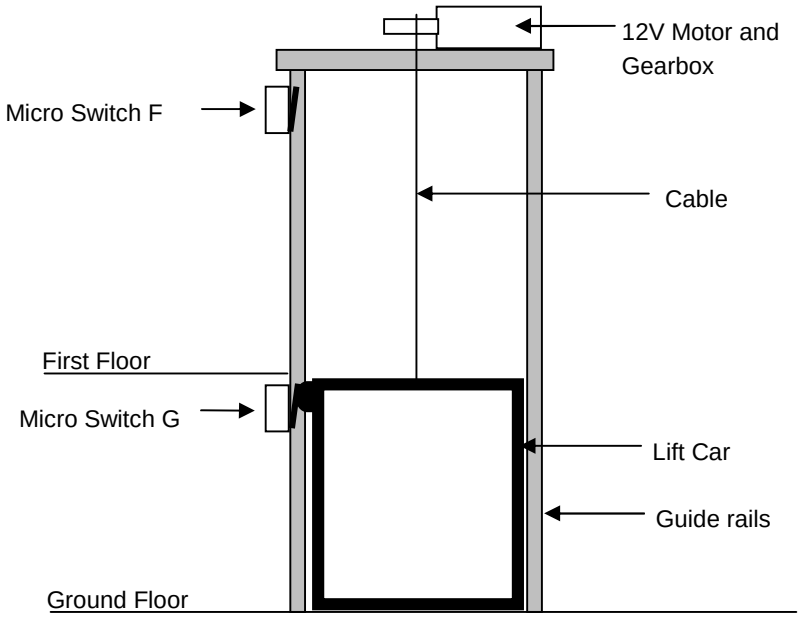
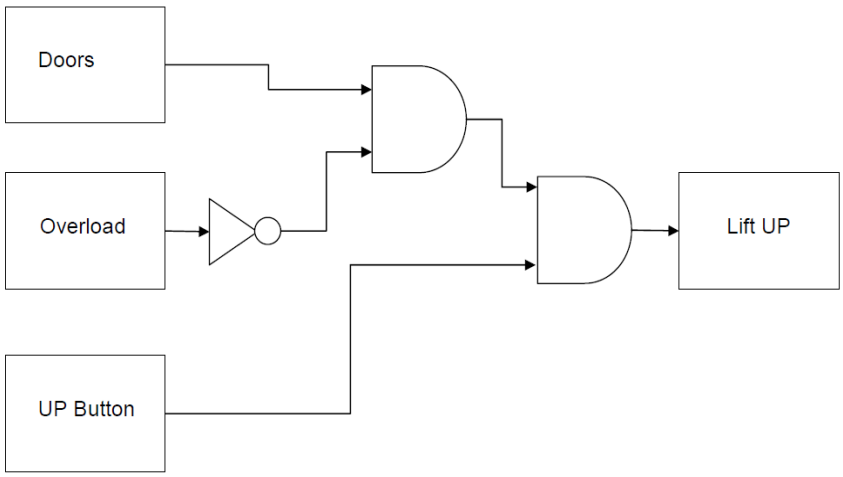
Section A

Question	Part	Sub Part	Marking Guidance	Marks
1	a		(a) 3 issues which need to be considered before designing the Lift Model. Consideration (1) **3x(1)** Explanation (1) **3x(1)** 3 statements for the Design Specification for the answers above Single word / weak statement (1) Full sentence (2) **3x(2)** e.g. Consideration 1 Power source (1) Explanation 1 The available power sources available in the classrooms (1) Statement 1 The lift must run on 12 Volts DC (2) Consideration 2 Overall size (1) Explanation 2 The overall size of the lift model so that it can be stored (1) Statement 2 The lift must fit in a box 200 x 200 x 800 mm (2) Consideration 3 Materials (1) Explanation 3 The available materials and processes to construct it from (1) Statement 3 The lift must be made from aluminium extrusion. (2) Or Consideration 3 Colour (1) Explanation 3 It should be pretty (0) Statement 3 The lift should be pink (1)	12 marks

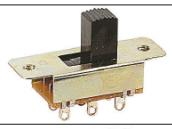
1	b		A design idea to show how the lift car could be raised and lowered. Marks will be awarded for; • A recognizable system 1 • Moving the lift 1 • Moving the lift between the ground and first floor 1 • Sensing when the lift is at the ground floor 1 • Sensing when the lift is at the first floor 1 • Powering the system 1 • Clear sketches 1 • All components labelled 1  	8 marks

Section B

2			Marks will be awarded for • Logic Gates symbols 3 • Inputs to gates 5 • Output to Lift 1 • Clarity. 1 e.g.  	10 marks

3 a

The Component Name and which electronic building block it would be used, for the following electronic components

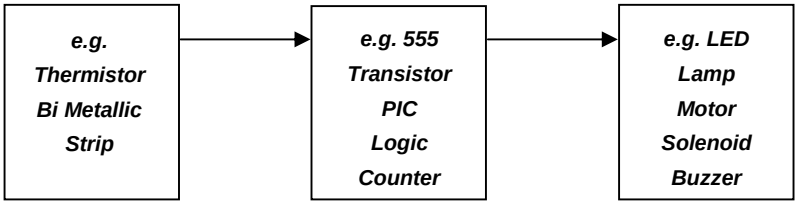
No.	Photo	Component Name	Electronic building block
1		Bulb or Lamp	Output
2		Transistor	Process
3		DPDT Switch or Slide Switch	Input
4		Chip or IC	Process
5		LED	Output

1 mark per answer

10 marks

3 b

Suitable example components for each electronic building block in the boxes below;



3 marks

3 c i

LDR or Light Dependent Resistor (1)

1 mark

3 c ii

Variable resistor or Preset resistor (1)

1 mark

3 c iii

Calculate the Output Voltage (V out) when R1 is 1K and R2 is 2K

Formula - Voltage = $\frac{R2}{R1 + R2}$ x Supply Voltage (1)

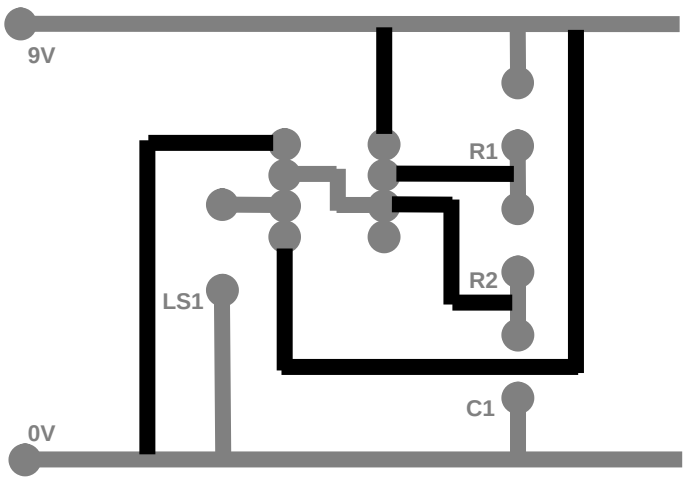
Working - Voltage = $\frac{2K}{1K + 2K}$ x 9V = $\frac{2}{3}$ x 9V (1)

Answer 6 (1)

Units V or Volts (1)

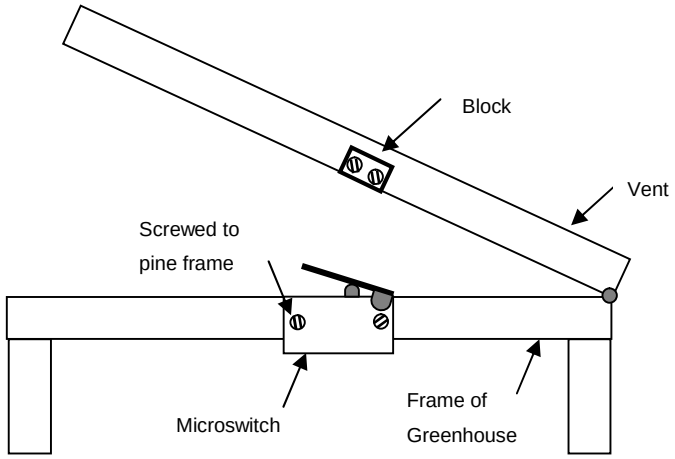
4 marks

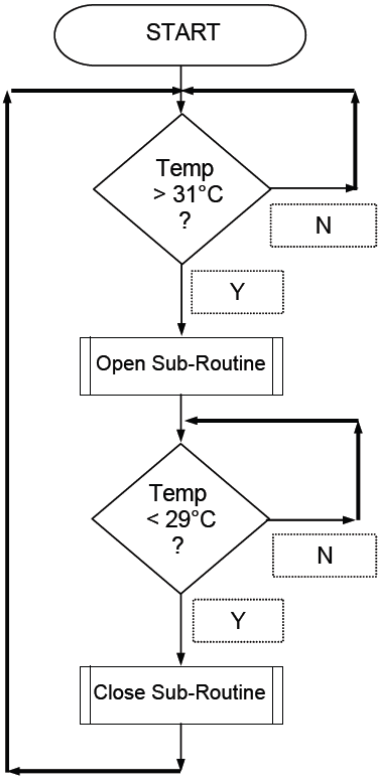
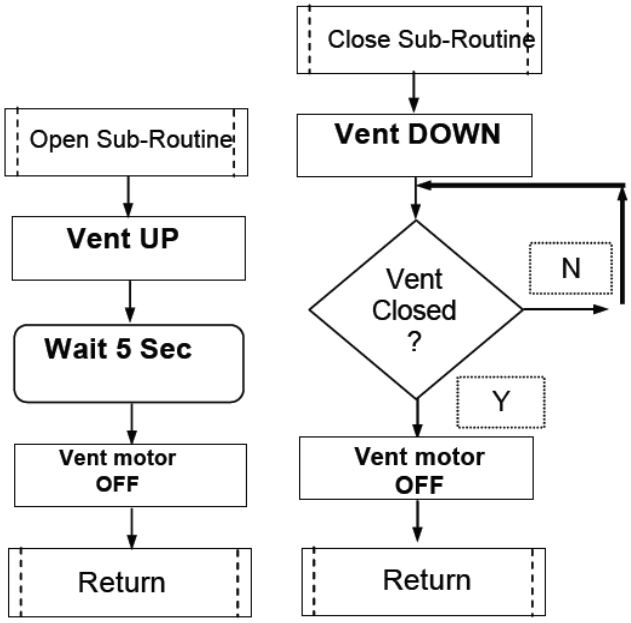
4	a		One method to test that a circuit will work before building a PCB. Recognisable method (1) Outline description (2) Fully described (3) e.g. The circuit could be built on breadboard / stripboard / computer simulation. This is a board that the components can be placed in to connect them together without soldering.	3 marks

4	b		Circuit Diagram One mark for each track correctly connected without crossing (5) Well drawn (1)  	6 marks
4	c		Two advantages for using CAD to design PCBs. Recognisable advantage (1) Well explained (2) 2x(2) e.g. Advantage 1 –Quicker as all components are stored in the system (2) Advantage 2 –Easier to edit, share, archive as electronic medium (2) Advantage 1 – Quicker to use (1) Advantage 2 – Easier to edit. (1) Not – “Easier”, “Neat”	4 marks

4	d	i	Explanation of a PCB production process. Marks for; Listing 4 of the main stages 4x1 e.g. Expose UV Light box Develop Etch Rinse Drill Holes e.g. Draw in CAD Mount board in CNC Mill CAM - Mill out gaps CAM - Drill holes	4 marks

4	d	ii	Description of process 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; Convert the artwork from the printer to an acetate sheet. Place under a piece of photo etch copper board the correct way around. Place in a UV Light box for about 60 seconds Place board in the Developer Tank for about 2 minutes Rinse off developer under water rinse. Place board in the Etchant Tank for about 3 minutes. Ensure that the tank is heated and bubbling. Take board out, rinse, dry. Clean off ink with a PCB eraser. Drill all holes for components.	8 marks

5	a	i	Suggest a suitable specific material for the greenhouse frame Generic material e.g. wood, metal (1) Specific material e.g. pine, aluminium (2)	2 marks
5	a	ii	Explain why the material that you have selected is suitable one word answer e.g. Cheap (1) Full response e.g. Readily available and easily formed (2)	2 marks
5	a	iii	A suitable component to sense that the roof vent was closed e.g. Switch (1) Microswitch, LDR, Reed switch (2)	2 marks
5	a	iv	Sketch how this component would sense that the roof vent was closed Award Marks for; • Component mounted correctly (1) • Able to Sense that the vent was closed (1) • A good quality labelled sketch of the component (2) e.g. The microswitch is screwed to the wood frame with wood screws There is a block fitted to the vent to hit the switch  	4 marks
5	a	v	Description of how the system in 5a(iv) works Weak response e.g. The vent hits the switch (1) Medium response e.g. The block on the lid operates the microswitch (2) Full response e.g. The block on the side of vent hits the microswitch (3) When the vent closes the switch is pressed. When the vent opens the switch is released.	3 marks

5	b		Each correct output state of the decision boxes (6) Use 1 for Yes and 0 for No The following statements to the correct Process Boxes (5) ▪ Vent motor OFF ▪ Vent motor OFF ▪ Vent DOWN ▪ Vent UP ▪ Wait 5 Seconds Each correct connecting line, there are 4 missing lines (4)  	15 marks

6	a		Two potential problems with this system and how it could be improved. (2 x 3=6) Recognisable problem (1) Problem described and understood (2) Above plus workable improvement suggested (3) e.g. Timer would not take account of cloud cover or summer and winter. A light sensor would be a better input as it would close the curtains when it was dark The PIC would not operate the motor as it requires more current. The PIC could operate a transistor which could operate the motor or a relay	6 marks
6	b		Discuss two improvements to the drive system and possible modifications to allow the existing motor to be used. (2x2) Recognisable error (1) Improvement given (1) e.g. Improvement 1 Stop the belt slipping Modification 1 Replaced belt with a gear drive Improvement 2 Give the motor more torque Modification 2 Add a compound gear box between the motor and the curtains	4 marks
6	c	i	Discuss the impact on the environment of using electrically powered curtains. Recognisable issue (1) Problem described (2) Problem described and related to the environment (3) e.g. Electrically powered curtains use electricity which traditional manual curtains don't. More electricity will be used. The majority of the UK electricity is generated from a finite source of fossil fuel.	3 marks
6	c	ii	Two environmentally friendly sources of mains electricity. (2x1) e.g. Wind turbine, Solar, Tidal barrage, Geothermal	2 marks

6	c	iii	Give three advantages of environmentally friendly energy sources 1 mark for each correct answer. e.g. They do not run out / sustainable (1) They are more aesthetically pleasing than Power Stations (1) They do not release CO^2 into the atmosphere. (1) In the long term they can work out cheaper than fossil fuels (1)	3 marks