Version 1.0

GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Design and Technology: Systems and Control Technology
(Subject Code 3546/Higher)

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.

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The answers given in the following mark schemes are neither exhaustive nor exclusive. Candidates whose answers do not appear directly on the mark scheme, but who have demonstrated knowledge, understanding, or skills relevant to the question will receive appropriate credit for their answers.

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ASSESSMENT & QUALIFICATIONS ALLIANCE

GENERAL CERTIFICATE OF SECONDARY EDUCATION

June Examination 2004

Design and Technology: Systems and Control Technology

Higher Tier – Section A Mechanisms Focus

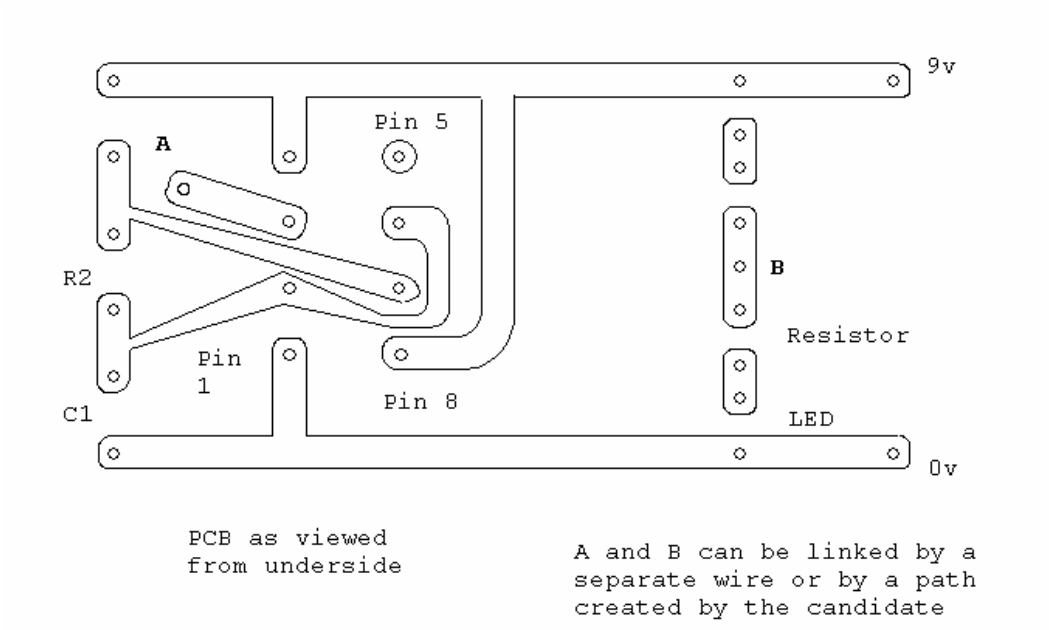
Question 1 Solution

(a) (i)	Transistor	1 mark
	Switching current/amplify current	1 mark
(ii)	Capacitor	1 mark
	Storing or discharging current	1 mark
(iii)	Resistor	1 mark
	Limiting or reducing current	1 mark
(iv)	Resistor and capacitor OR B & C	2 marks

8 marks

(b) Correct connections drawn from:

Pin 2	1 mark
Pin 6 – joined to 2	1 mark
Pin 7	1 mark
0v to capacitor to track 2, 6	1 mark
correct positioning of LED & resistor	1 mark
quality of tracks and pads	1 mark



6 marks

Total 14 marks

Question 2

(a) The process of **injecting molten plastic** into a **mould** to produce an artefact (generic term accepted) 2 marks

(b) Low melting point OR ductile OR malleable and easily worked OR strong and light 1 mark

(c) Quality of communication 2 marks
Quality of notes 2 marks
Method of locating the components 5 marks
- Circuit board 2 – no glue gun
- LED 2 mounting clips
- Battery 1

Method of fixing the unit to the parcel shelf 1 marks
No problem if a captive – using nut

Total 13 marks

Question 3

(a) 1 mark correct identification of a crank and slider
2 marks for execution of drawing

0 marks for question if high quality drawing but wrongly identified (e.g. rack and pinion) 3 marks

(b) 1 mark correct identification of a cam and follower
2 marks for execution of drawing 3 marks

0 marks for question if high quality drawing but wrongly identified

6 marks

(c) Locating mechanism on door – if rack and pinion here mark it
- Crank located on back of wall (suitable location rack)
- Slider located with pivot on back of door (suitable location of pinion)
- Quality of drawing (1 mark if high standard only) 3 marks

Free movement of door
- Appropriate tracking applied for sliding or other technique
- Slider connected at furthest edge away from crank to allow full range of movement 3 marks
- Well drawn (1 mark if high standard only)

Attaching motor to the mechanism
- Positioning of motor
- Appropriate fastening method
- Quality of communication (1 mark if high standard only) 3 marks

9 marks

(d) Use of formula 1 mark
100 * 50 = 25 * X

100 * 50 = 25 * X 1 mark

5000 / 25 = X
X = 200N – correct answer 1 mark

3 marks

18 marks

Question 4

(a) Keypad logic check solenoid

1 for each in the correct position **3 marks**

(b) (i) Protection diode 1 mark
Protects the transistor 1 mark
from back emf/voltage 2 marks
4 marks

(c) Correct use of existing centres 1 mark
Use of a correct reduction gear – large to small – 2 marks if a large difference between gear sizes 2 marks
Workable gear system 2 marks

Quality of drawing A very good attempt 2
Understandable 1 2 marks
7 marks

(d) (i) Working out 2 2 marks

Correct answer 300:60 / 150:30 or 60:300 30:150 1 mark
5:1 or 1:5 2 marks

4 marks

(ii) Higher torque/force 1 mark
Non-slip 1 mark
Durability
Less space

Explained for maximum
2 marks

20 marks

Question 5

(a) Correct identification of rack and pinion 1 1 mark
Quality of communication excellent 3
Good attempt or schematic 2
Poor attempt 1 3 marks

Max mark if incorrectly identified but very well drawn 2
4 marks

(b) Microswitch – or suitable sensing component. NOT moisture **1 mark**
Push to make/Push to break/Reed Switch/LDR

(c) Potentiometer or variable resistor **1 mark**

(d) Appropriate positioning of microswitch or suitable idea 1 mark
Use of a sketch or statement to show cut off position 1 mark
Quality of drawing and/or annotation: Very good 3; Reasonable 2; Poor 1 — 3 marks

5 marks

(e) Correct LDR 1 mark
Correct resistor (variable) – or fixed 1 mark
Correct orientation – correct symbols only 1 mark
Quality of execution (1 mark if very good symbols drawn) 1 mark

4 marks

15 marks

Question 6

(a) (i) Ability to try out circuit prior to assembly – prototyping
Feature and reason it is useful for 2 marks **2 marks**

(ii) Automatic production of mask from circuit design
Feature and reason it is useful for 2 marks **2 marks**

Or other appropriate in each case

(b) Diagram illustrating the use of etch resist to leave tracks (max 2) OR
Diagram showing a CNC machine 2 marks

Key points etching:		Key Points CAD/CAM		
Photosensitive board used	1	Attach copper board to machine table	1	1 mark
Use acetate in light box –timed exposure	1	Activate program	1	1 mark
Place in etching tank	1	Remove from table	1	1 mark
Clean up finished board and drill	1	Clean up finished board and drill	1	1 mark

(if photosensitive and acetate replaced by two suitable stages accept)

6 marks

(c) (i) Does not use harmful chemicals **1 mark**

(ii) Quick to modify and already predrilled/reliable, repeatable **1 mark**

(d) (i)	Choice of 1K5	1 mark
	Choice of 1K8	1 mark
	Use of the + operator	1 mark
		3 marks
(ii)	In series	**1 mark**
(iii)	Choice of 1K5	1 mark
	Choice of 1K5	1 mark
	Use of the 1/1K5 + 1/1K5	1 mark
		3 marks
(iv)	In parallel	**1 mark**
		20 marks

Question 7

Key points to look for:

Starting lock operation -	Sensing approaching boat	1 mark
	Correct flow chart symbol (diamond)	1 mark
		2 marks
Opening entrance gate -	Open gate command	1 mark
	Correct flow chart symbol (rectangle)	1 mark
	Correct position (after decision)	1 mark
		3 marks

Changing water level and exit sequence

Sense boat in the lock	1 mark
Close gate	1 mark
Open valve	1 mark
When water levels match	1 mark
Correct flow chart symbol (diamond)	1 mark
Open gate	1 mark
	6 marks

Presentation of flow chart

Correct start and end symbols	1 mark
Quality of response	
Largely correct and workable solution (2)	
Partially correct (one functioning subsystem) (1)	2 marks
Quality of drawing	1 mark
	4 marks
	15 marks

Question 8

(a) (i) Polarity check - Are the components the correct way around to function – e.g. LED

(ii) Continuity check - Does current pass through the circuit
Loose components – potential failures/damaged broken

Or any other suitable check with reason 2 * 2 **4 marks**

(b) Purchase resistors with an accurate tolerance – gold band 1 mark

(c) (i) Leaving a circuit running for a period of time 1 mark

(ii) Testing a thermostat circuit or any other relevant circuit 1 mark

(d) Resistance – voltage – continuity or other suitable **2 marks**

(e) Less to replace if part of the product fails – easier to upgrade **1 mark**

10 marks

Paper total

Total 125 marks

Section B Pneumatics

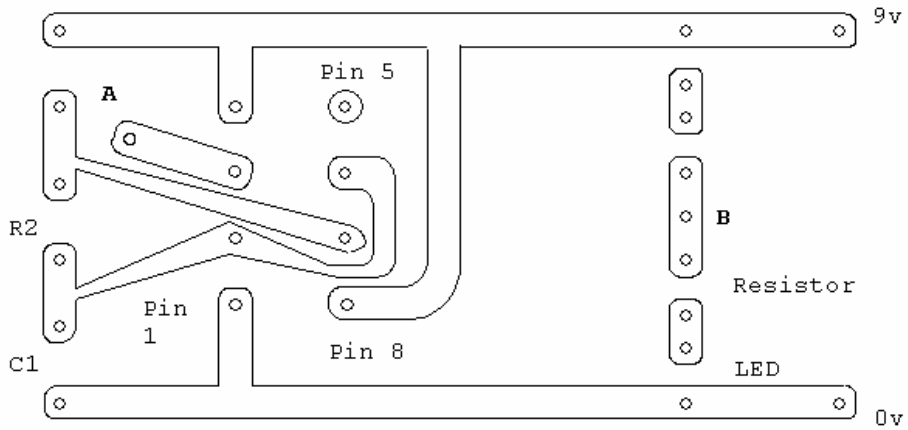
Question 1

(a) (i)	Transistor		1 mark
		Switching current/amplify current	1 mark
(ii)	Capacitor		1 mark
		Storing or discharging current	1 mark
(iii)	Resistor		1 mark
		Limiting or reducing current	1 mark
(iv)			
	Resistor and capacitor OR B & C		2 marks

8 marks

(b) Correct connections drawn from:

Pin 2	1 mark
Pin 6 – joined to 2	1 mark
Pin 7	1 mark
0v to capacitor to track 2, 6	1 mark
correct positioning of LED & resistor	1 mark
quality of tracks and pads	1 mark



PCB as viewed from underside

A and B can be linked by a separate wire or by a path created by the candidate

6 marks

Question 2

(a) The process of **injecting molten plastic** into a **mould** to produce an artifact (generic term accepted) 2 marks

(b)
Low melting point OR ductile OR malleable OR strong and light 1 mark

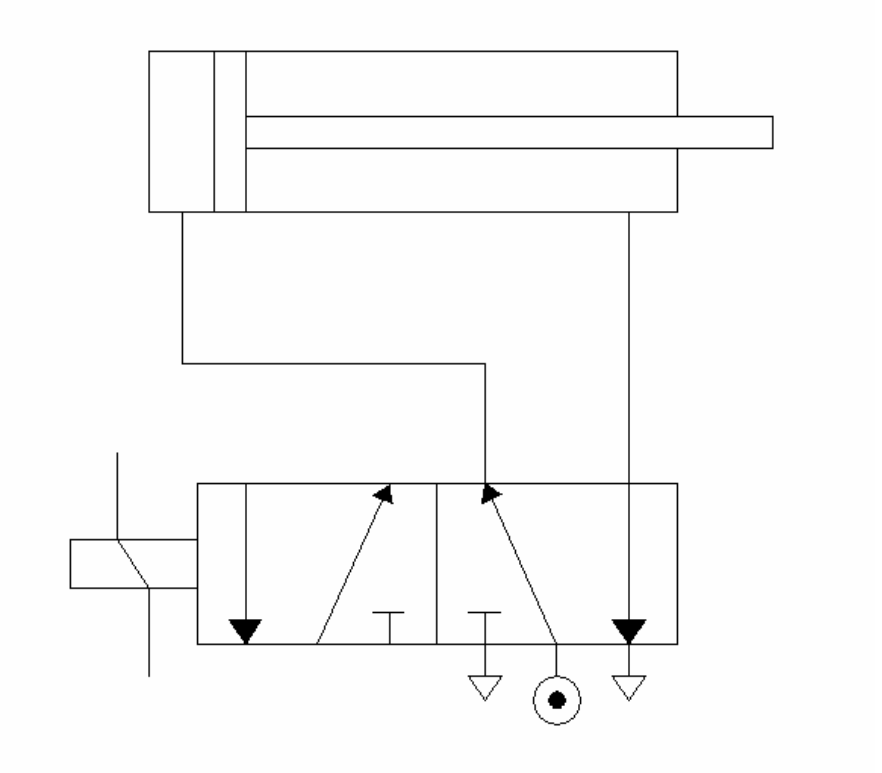
(c) Quality of communication 2 marks
Quality of notes 2 marks
Method of locating the PCB 5 marks
Circuit board 2 – no glue gun
LED 2 mounting clips
Battery 1
Method of fixing the unit to the parcel shelf 1 mark
No problem if captive – using nut

13 marks

Question 3

(a) 1 mark correct diagram of 5 port valve
1 mark correct diagram of double acting cylinder 2 marks
1 mark for solenoid
Generally correct connections on 5 port valve 1 mark 2 marks

2 mark for execution of drawing – if good quality
1 mark for average 2 marks
0 marks for question if high quality drawing but wrongly identified components

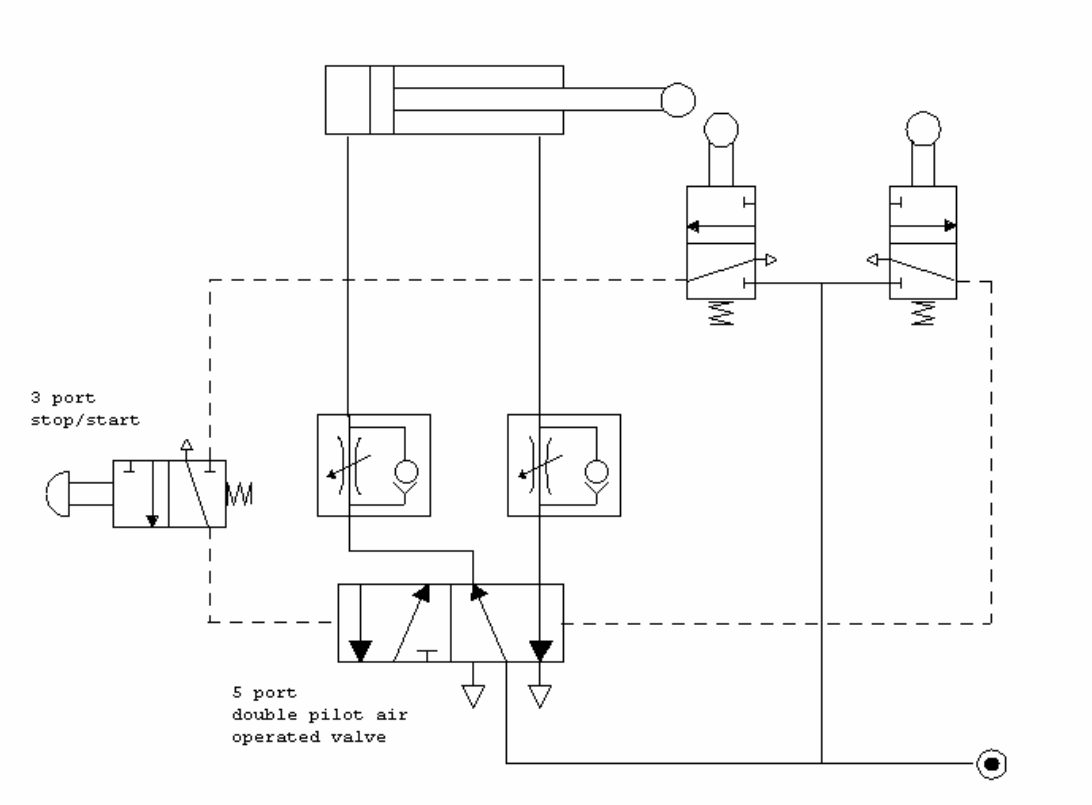


6 marks

(b) Correct connections
5 port valves to flow control restrictors
flow control restrictors to DAC
correct flow control valves 3 marks

Completion of valves
Correct orientation of control restrictors
Correct control lines on 3 port button operate valve
Generally correct completion of 5 port valve 3 marks

Correct use of roller valves
Correctly identify roller valve
Correctly draw 3 port valve Figure 4
Correct position for automatic operation of piston 3 marks



9 marks

(c) Use of formula 1 mark
100 * 50 = 25 * X

100 * 50 = 25 * X 1 mark

5000 / 25 = X
X = 200N – correct answer 1 mark

3 marks
Total 18 marks

Question 4

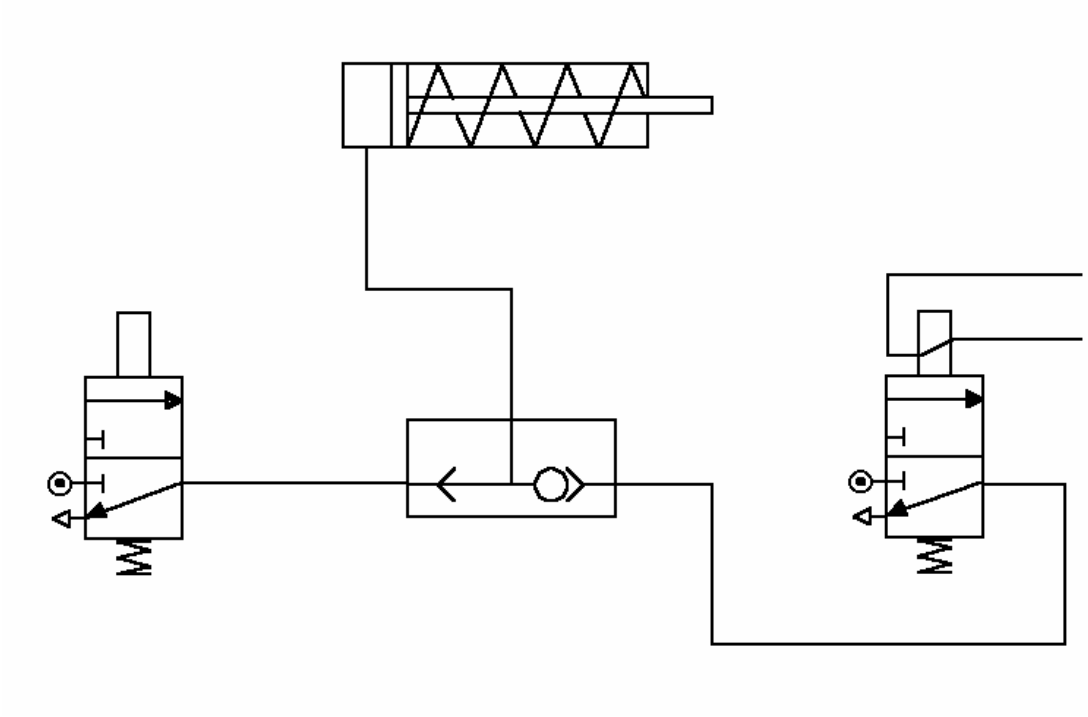
(a) Keypad logic check solenoid

1 for each in the correct position **3 marks**

(b) (i) Protection diode 1 mark
Protects the transistor 1 mark
from back emf/voltage 2 mark

4 marks

(c) Correct identification of single acting cylinder with return spring 1 mark
Quality of drawing – zero if contains more than 2 errors or unintelligible 1 mark
Correct identification of shuttle valve 1 mark
Quality of drawing– zero if contains more than 2 errors or unintelligible 1 mark
Correct drawing of 3 port valve 1 mark
Correct use of solenoid operation 1 mark
Drawing the relevant lines 2 marks



8 marks

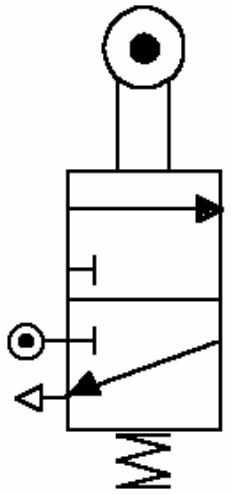
(d) Correct formula - Force produced = air pressure * surface area 1 mark
Correct formula - Area of piston = PI * rad * rad 1 mark
3.142 * 25 * 25
1963.75 mm^2 (units required for mark) 1 mark
Force = pressure * area 1 mark
0.75 * 1963.75 1 mark
1472.81 Newtons (units required for mark)
5 marks

20 marks

Question 5

(a) Roller operated 1 mark
Three port valve 1 mark
Normally closed or spring return 1 mark
3 marks

(b) Correct alignment of ports for normally closed 1 mark
Correct roller end 1 mark
Quality of drawing 1 mark



3 marks

(c) Appropriate positioning of 3PV 1 mark
Use of a sketch or statement to show cut off position 1 mark
Quality of drawing and/or annotation Very good 3
Reasonable 2
Poor 1 3 marks
5 marks

(d) Correct LDR 1 mark
Correct resistor (variable) – or fixed 1 mark
Correct orientation – correct symbols only 1 mark
Quality of execution (1 mark if very good symbols drawn) 1 mark

4 marks

Total 15 marks

Question 6

(a) (i) Ability to try out circuit prior to assembly – prototyping
Feature and reason it is useful for 2 marks **2 marks**

(ii) Automatic production of mask from circuit design
Feature and reason it is useful for 2 marks **2 marks**

Or other appropriate in each case

(b) Diagram illustrating the use of etch resist to leave tracks (max 2) OR
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(if photosensitive and acetate replaced by two suitable stages accept)

6 marks

(c)(i) Does not use harmful chemicals **1 mark**

(ii) Quick to modify and already predrilled/reliable, repeatable **1 mark**

(d) (i) Choice of 1K5 1 mark
Choice of 1K8 1 mark
Use of the + operator 1 mark
3 marks

(ii) In series **1 mark**

(iii) Choice of 1K5 1 mark
Choice of 1K5 1 mark
Use of the 1/1K5 + 1/1K5 1 mark
3 marks

(iv) In parallel **1 mark**

Total 20 marks

Question 7

Key points to look for:

Starting lock operation -	Sensing approaching boat	1 mark
	Correct flow chart symbol (diamond)	1 mark
Opening entrance gate -	Open gate command	1 mark
	Correct flow chart symbol (rectangle)	1 mark
	Correct position (after decision)	1 mark
Changing water level and exit sequence		
	Sense boat in the lock	1 mark
	Close gate	1 mark
	Open valve	1 mark
	When water levels match	1 mark
	Correct flow chart symbol (diamond)	1 mark
	Open gate	1 mark
Presentation of flow chart		
	Correct start and end symbols	1 mark
	Quality of response	
	Largely correct and workable solution (2)	
	Partially correct (one functioning subsystem) (1)	2 marks
	Quality of drawing	1 mark
		15 marks

Question 8

(a) (i) & (ii)	Polarity check - Are the components the correct way around to function – e.g. LED Continuity check - Does current pass through the circuit Loose components – potential failures		**4 marks**
	Or any other suitable check with reason 2 * 2		**1 mark**
(b	Purchase resistors with an accurate tolerance – gold band		
(c) (i)	Leaving a circuit running for a period of time	1 mark	
(ii)	Testing a thermostat circuit or any other relevant circuit	1 mark	**2 marks**
			2 marks
(d)	Resistance – voltage – continuity or other suitable		
(e)	Less to replace if part of the product fails – easier to upgrade		**1 mark**
			Total 10 marks
	Paper total		**125**