Version 1.0

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Design and Technology: Electronic Products 3541

Full Course Higher Tier

Mark Scheme

2005 examination - June series

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.

1 **Figure 1 shows a block diagram of a fire alarm.**

(a) **State which block represents**

(i) **the final output stage**

Loudspeaker.

(1 mark)

(ii) **an input stage**

Temperature/smoke.

(1 mark)

(iii) **an astable.**

Pulse generator.

(1 mark)

(b) **State the block in which you would find**

(i) **an op-amp**

Comparator.

(1 mark)

(ii) **a thermistor**

Temp sensor.

(1 mark)

(iii) **the control of the frequency of the sound.**

Pulse generator.

(1 mark)

(c) **Figure 2 shows a pulse generator circuit used as part of the system.**

Component C1 helps control the frequency of the circuit.

(i) **Circle the two components, other than C1 in Figure 2, that control the frequency of the circuit.**

R1 1 mark)

R2 (1 mark)

(2 marks)

(ii) **Explain the effect on the sound from the loudspeaker if the value of C1 was increased.**

Basic statement

e.g. as frequency changes, sounds different. (1 mark)

Qualified statement

e.g. lower pitch sound, deeper dot, dot, dot.

Lower frequency any other suitable response. (2 marks)

(2 marks)

(d) **The final circuit could be constructed using either veroboard (stripboard) or on a PCB.**

(i) **Compare the use of veroboard as opposed to a PCB for producing the circuit.**

Veroboard has tracks already, spacing set for ICs – PCB needs designing and drawing.
Joins made by wire connection from track to track – all joins built into PCB design.
Track cut with small drill – no breaks needed.
Small set space in between track – track spacing can be varied.
Any comparison.

(2 x 1 mark)
(2 marks)

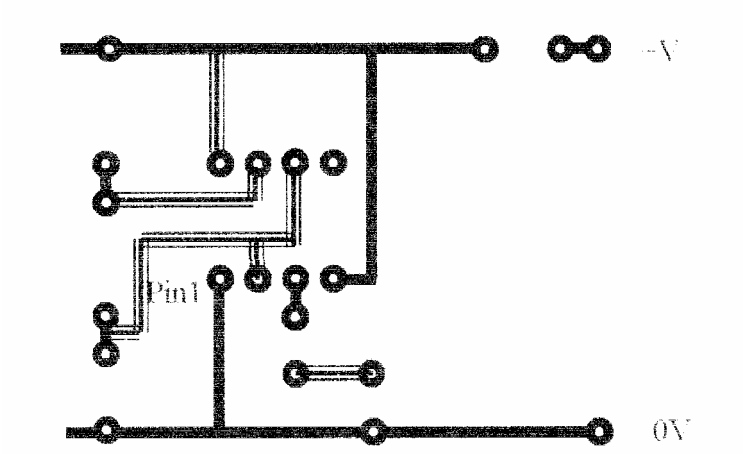
(ii) **It is decided that the PCB method will be used.**

Figure 3 shows the incomplete PCB design of the pulse generator stage of the circuit.

The pulse generator circuit is shown in Figure 2.

Complete Figure 3 by adding five tracks to the PCB so that:

- **pin 8 is joined to the +V rail;**
- **pin 7 is joined between R1 and R2;**
- **pin 6 is joined to pin 2;**
- **pins 6 and 2 are joined between R2 and C1;**
- **C2 is joined to the loudspeaker.**



Pin 8 joined to the +9V rail. (1 mark)
Pin 7 joined between R1 and R2. (1 mark) (1 mark)
Pin 6 joined to pin 2. (1 mark) (1 mark)
Pins 6 and 2 are joined between R2 and C1. (1 mark) (1 mark)
C2 joined to the loudspeaker. (1 mark) (5 marks) (1 mark)
(Marks to be awarded if any 'links' annotated) ***(5 marks)***

Quality of drawing.
Straight lines (1 mark) (1 mark)
Accuracy of connection (1 mark) (1 mark)
(2 marks)

2 **You have been asked to design an electronic dice to be used by children when playing games.**

(a) **List two things that you should think about when designing the electronic dice.**

Limited response e.g. number of people, age of people, sight of people. (2 x 1 mark)

A response which supports the statement, e.g. age range of the people expected to use it.
What range of number need to be on view.
Type of power supply.

(2 x 2 marks)
(4 marks)

The layout of a research plan for the electronic dice is shown in Figure 4.

(b) **Complete Figure 4 by adding suitable research sources and stating the information that you would hope to find.**

Hands and finger sizes – max/min sizes to make distance in between switches/ability for all ages to use case. (2 marks)

Existing product analysis – to see what people buy now/to find out what people think of current ideas. (2 marks)

Another suitable source – electronics components catalogue. (1 mark)

Information expected from this other suitable source. (2 marks)
(7 marks)

(c) **Describe how the information from the analysis and research may affect the final design.**

Clear statement of intended use of information. (2 marks)
Some intended use of information. (1 mark)
(2 marks)

(d) **Give four specification points for the electronic dice. Two of the points should be about the casing and two about the electronics. Examples have been given.**

(i) **Casing specifications**

Any suitable qualified response. (2 x 2 marks)
Limited responses.
e.g. Corners of casing rounded off to prevent scratching. (2 x 1 mark).
Good surface finish to make the dice look attractive.
(4 marks)

(ii) **Electronic specifications**

Any suitable qualified response. (2 x 2 marks)
Limited responses.
e.g. To be powered by a 9V battery. (2 x 1 mark)
Able to be switched off when not in use.
(4 marks)

3 **This question is about designing, making and evaluating the electronic dice.**

(a)

(i) **Use notes and sketches to show:**

- **a design for the basing of the dice;**
- **how the dice is switched on and activated.**

Drawings and annotation that show details of the case with dice display.	(3-4 marks)
Drawings and annotation that show a 'functional' case.	(1-2 marks)
	(4 marks)

Detail of two switches or clearly identified.	(2 marks)
Detail of one switch or poorly drawn two switches.	(1 mark)
	(2 marks)

Clear sketches and annotation or basic sketch with detailed annotation.	(2 marks)
Some sketches and annotation.	(1 mark)
	(2 marks)

(ii) **Give the name of a suitable material from which the casing could be made.**

Acrylic, HIPS, ABS, MDF or any other suitable specific material.

(1 mark)

(iii) **Use notes and sketches to show:**

- **a suitable method of fitting an LED into the case;**
- **how the circuit is securely held in place in the casing.**

Clear view of LED fixed in LED holder in case or similar.	(2 marks)
Some evidence of preparation of material or poor detail (1 mark)	(1 mark)
	(2 marks)

Clear view of suitable method used to hold circuit in place.	(3 marks)
Clear view of a reasonable method used to hold circuit in place	(2 marks)
Some fixing of circuit in place	(1 mark)
	(3 marks)

(b) **List two situations where health and safety hazards might be an issue whilst making the casing and give the precaution that you would need to take.**

Situations related to the construction of the case. (2 x 1 mark)
Appropriate precautions. (2 x 1 mark)

(4 marks)

(c) **Explain two methods of evaluating the finished dice.**

Detailed testing with feedback. (2 x 2 marks)
eg. Test it a 100 times to see if it has a bias
let end users test it and complete a questionnaire

Detailed testing with no feedback. (2 x 1 mark)

(4 marks)

(d) **Give two reasons why quality checks need to be made during the making of electronic products.**

Qualified responses (2 x 2 marks)
Non-qualified response
e.g. no mistakes on PCB (2 x 1 mark)
avoid waste
e.g. Reference to prevention of cost of waste materials/components.
Public confidence in companies and future purchases.

(4 marks)

4 **The lift in a department store is controlled using logic gates.**

The lift will only operate if

- **a person has requested the lift from another floor**
- **a floor has been chosen by a person in the lift**
- **the doorway is not obstructed.**

Figure 5 shows the logic diagram for the system.

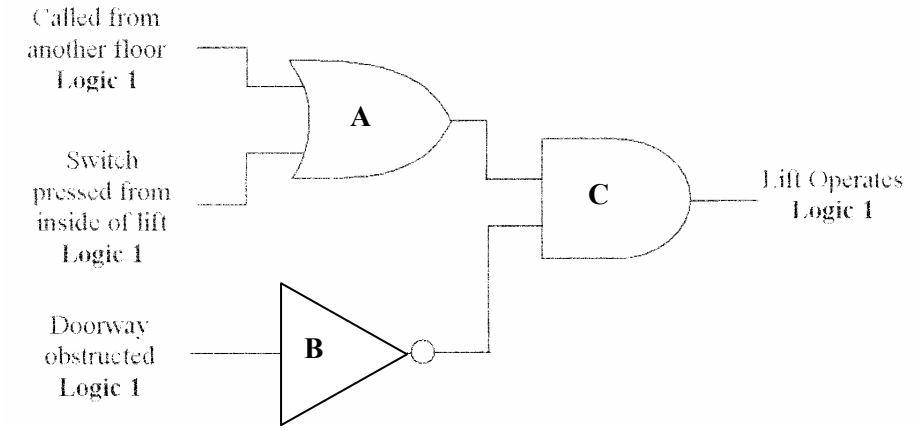


Figure 5

(a) **Name the three logic gates shown in Figure 5.**
A – OR
B – NOT (accept inverter)
C – AND

(3 marks)

(b) **When designing a logic circuit it is possible to use a single IC which contains a number of identical logic gates.**

Give two advantages of using this type of IC.
Suitable responses eg.
Uses much less space on a PCB.
Cost less due to less chips being used.
Chips can be bought in bulk,
with some qualification (2 x 1 mark)

(2 marks)

(c) **Figure 6 shows a NAND gate and its incomplete truth table.**

(i) **Complete Figure 6 by adding the output states of the truth table.**
1
1
1
0
(1 mark for each correct response)

(4 marks)

(ii) **Complete Figure 7 to show how the logic diagram in Figure 5 can be constructed using six NAND gates.**

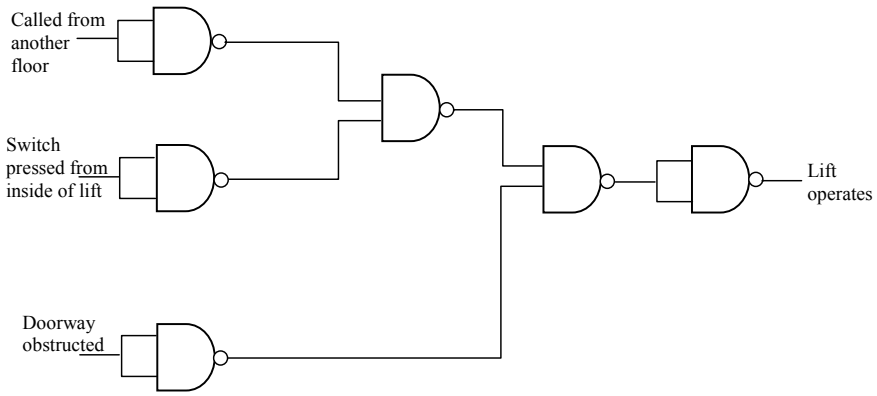
1 mark for each "gate" correctly connected. (6 marks)

(6 marks)

Quality of drawing, straight lines drawn and connections made. (1 mark)

Gates placed logically and connections drawn with straight lines (2 marks)

(2 marks)



5 **The owner of the company who manufactures the lift in Question 4 is considering replacing the logic system of lift control with a PIC microprocessor control system.**

(a) **Explain one advantage and one disadvantage of installing a PIC system compared to the present system which uses a number of logic gates.**

Advantages

Simple statement (1 mark) (1 mark)

e.g. Less space taken up, or smaller PCB.

Less cost of components.

Qualified statement (2 marks) (2 marks) (2 marks)

e.g. Program can be changed to perform other functions easily if necessary.

(2 marks)

Disadvantages

Simple statement (1 mark)

e.g. High cost

Qualified statement (2 marks)

e.g. High initial cost of buying programmer/software etc.

Need PC to download and to learn programming skills.

(2 marks)

Figure 8 shows a drawing of a lift with its doors open at the ground floor.

The lift will only operate when a person has requested the lift from another floor or a floor has been chosen by a person in the lift and the doorway is not obstructed.

(b) **Complete Figure 9 by designing a flow chart to illustrate the lift operating sequence from when the lift starts at the ground floor with its doors open and is called to the first floor where its doors open.**

This is a quality of response questions.

Level 3 Response 7 – 10 marks

Clearly presented set of commands which display correct sequencing and appropriate feedback and decisions, whilst also taking into account all the questions within the question.
See examples 1, 2 and 5. Note: to access these marks it is not necessary for them to be in the correct boxes! (7-10 marks)

Level 2 Response 4 – 6 marks

Commands are sequenced correctly with little or no feedback.
Some evidence of decisions evident, whilst also taking into account the restraints in the question.
See example 3. (4-6 marks)

Level 1 Response 1 – 3 marks

Some idea of a command sequence;
only a few aspects of the issues in the question considered.
See example 4. (1-3 marks)

No recognisable attempt. (0 marks)

(10 marks)

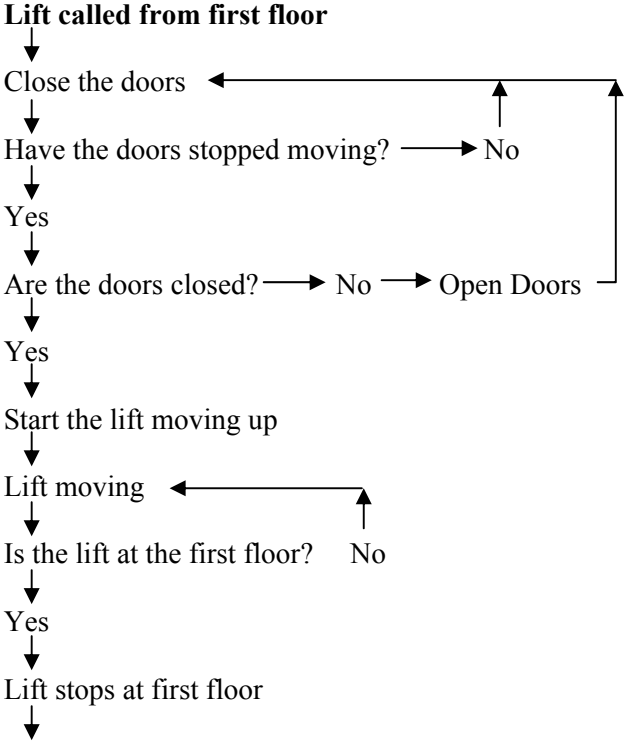
Quality of Drawing
Flowchart is well presented and clearly shows the sequence of events. (2 marks)
Flowchart lacks clarity. (1 mark)

(2 marks)

See the following example pages which show a range of possible solutions.

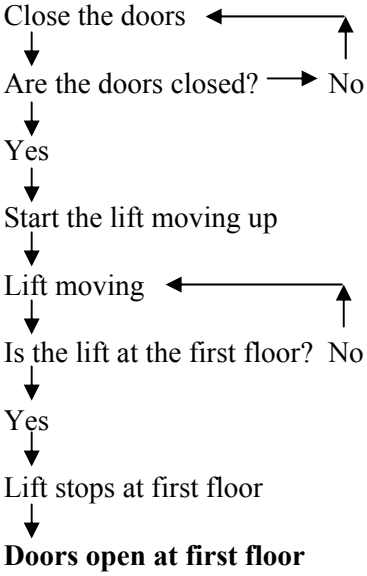
Example 1 (8, 2)

Lift called from first floor



Example 2 (7, 2)

Lift called from first floor



Example 3 (5, 1)

Lift called from first floor

Doors close

Are the doors closed?

Start the lift moving up

Lift moving

Is the lift at the first floor?

Lift stops at first floor

Doors open at first floor

Example 4 (3, 1)

Lift called from first floor

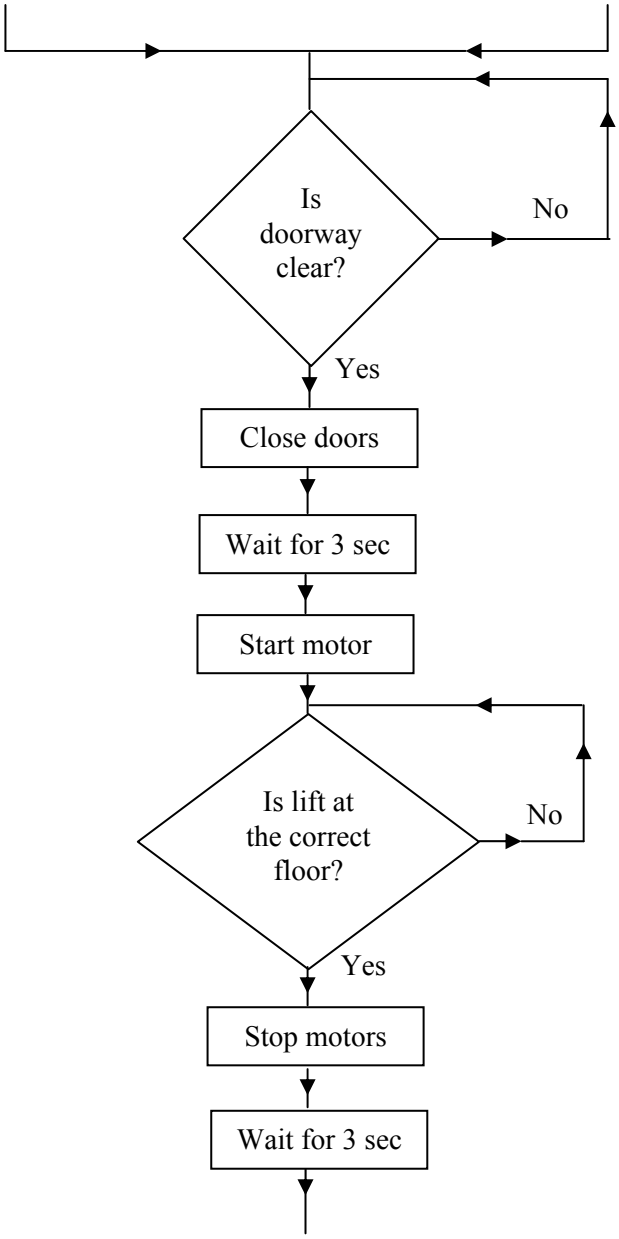
Doors close

Lift moves to first floor

Lift stops at first floor

Doors open at first floor

Example 5 (10, 2)



6 **Figure 10 shows an incomplete circuit that is to switch on the 24V cooling fan when the temperature gets warm.**

(a)

(i) **Give the name of the type of relay shown in Figure 10.**

Single pole. (1 mark)
Double throw. (1 mark)
(2 marks)

(ii) **Explain the reason for the need to include the relay in the circuit.**

Suitable qualified answer for 2 marks.
e.g. To interface between a low voltage circuit and high voltage device.
Low voltage primary circuit connected to higher voltage secondary circuit.
(2 marks)

(b)

(i) **Complete Figure 10 by adding**

- **a method of producing a reference voltage of 4.5 v at pin 2 including the value of any components used;**
- **a potential divider that includes a thermistor and a means of adjusting the voltage connected on Pin 3 of the op amp that will cause pin 6 to go high when the temperature rises.**

Two resistors creating a potential divider reference voltage at pin 2. (1 mark)
Resistors are shown as having equal value. (1 mark) (2 marks) (1 mark)
(2 marks)

Variable resistor or potentiometer drawn using correct symbol. (1 mark)
Thermistor drawn using correct symbol (1 mark)
Variable resistor or potentiometer, and thermistor correctly connected to pin 3. (1 mark)
Thermistor in top (R1) position. (1 mark)
(4 marks)

Quality of drawing
Components neatly drawn and in proportion. (1 mark)
Quality of circuit layout. (1 mark)
(2 marks)

(ii) **Suggest a suitable voltage at pin 3 which will cause pin 6 to go high.**

Any voltage greater than 4.5V other than 9V (2 marks)
9V (1 mark)
(2 marks)

(iii) **Explain the reason for the voltage that you suggested.**

Small value needed to be above 4.5 as gain is so high or other suitable response. (2 marks)
Gain is high (1 mark)
(2 marks)

(c) **The thermistor has a value of 10K at 25°C.**

Calculate the voltage of pin 3 when the room temperature reaches 25°C and the means of adjusting the voltage is set at 5K.

$$V2 = \frac{R2}{R1 + R2} \times 9$$ (1 mark)

$$= \frac{5}{10 + 5} \times 9$$ (1 mark)

$$= 3$$ (1 mark)

$$= 3V$$ (1 mark)

NB Possible consequential error from the thermistor position in (a).

(4 marks)

7 **During the past twenty years the use of ICT and electronic control systems have revolutionised manufacturing.**

Explain one advantage and on disadvantage that these developments have had for the environment.
Responses can reflect the wider meanings of environment.

Advantages
Detailed response. (3 marks)
Statement with some qualification. (2 marks)
Simple statement only. (1 mark)

E.g.
3 marks – Better control of materials during manufacture resulting in less waste and less pollution.
2 marks – Improved systems control the making processes better.
1 mark – Consistent quality products.

(3 marks)

Disadvantages
Detailed response. (3 marks)
Statement with some qualification. (2 marks)
Simple statement only. (1 mark)

E.g.
3 marks – Easily obtained, more sophisticated products are always becoming available resulting in a throw away society, which in turn causes an increase in waste and pollution.
2 marks – More products which cause increased waste and pollution.
1 mark – Increased waste and pollution.

(3 marks)