Version 1.0: 0106

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Design and Technology (Electronic Products) 3541

Full Course Higher Tier

Mark Scheme

2006 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 An advertising company has asked you to develop a small electronic torch as a promotional gift.

(a) List three things which you need to consider before you begin to design the product. Give an explanation or reason for each. An example has been given to help you.

Appropriate responses, 1 mark each. e.g. quantity, size, power source, material finish, quality, target audience, etc.

For each part up to 2 marks
Simple Statement 1 mark
Qualified response 2 marks

(6 marks)

(b) Explain what happens when the following actions are carried out in the order shown.

(i) SW1 is pressed and released.

LED lights 1 mark
Thyristor latches on (stays on) 1 mark

(2 marks)

(ii) SW2 is pressed and released.

Thyristor switched off or reset 1 mark
LED goes off 1 mark

(2 marks)

(c) The PCB layout of the circuit in Figure 1 is shown in Figure 2. It was produced using Computer Aided Design.

(i) When the circuit was built, it did not work.
On Figure 2, identify two mistakes which could be the cause of the problem by drawing a circle round each mistake.

Circle on missing track 1 mark
Circle on incomplete track 1 mark

(2 marks)

(ii) Describe the advantages of using Computer Aided Design for producing PCB layouts.

Well explained, qualified responses which includes some of the following examples:
ease of correction and / or change; easily shared electronically; neat and precise; ease of replication; ease of labelling to improve quality of making.
3-4 marks
Limited response or a few basic statements 1-2 marks

(4 marks)

2 This question is about producing a circuit on PCB.

(a) Using a production method you are familiar with, set out the stages needed when making a circuit board, prior to drilling and adding the components.

The answer can be presented in a number of different ways, using text, text + drawings, or through using a flow chart approach.

One mark for each major step in the process. For full marks some aspect of quality control must be included.

For example:
photoetching
print onto acetate
place mask face down in UV box
remove protective film from photo board and place on mask
expose
develop board
rinse
place in etching tank
regularly check the board (time in tank)
remove board from tank
thoroughly wash and dry the board

Alternative methods are acceptable

(10 marks)

(b) Health and Safety is important when making the PCB, drilling the holes and soldering the components in place.
Identify two different hazards and the precautions which need to be taken.

(i) Appropriate hazard, e.g. fumes from soldering, burns from soldering, material in eyes from drilling, clothing in machine, danger from UV light; danger of developing solution; danger of hot acid in etching tank 1 mark

Matching precaution e.g. light box sealed before switching on; use tongs, protective clothing, goggles etc 1 mark

(2 marks)

(ii) Different hazard 1 mark
Matching precaution 1 mark

(2 marks)

(c) **Identify two Quality Control checks you could make to the finished circuit after the components are soldered in place.**

1 Any appropriate response e.g. components in correct place; components in the correct way round; good quality soldered joints; no solder bridging tracks 1 mark
2 Any appropriate different response 1 mark

(2 marks)

(d) **When the circuit was first tested it failed to work.**
Describe how you would have checked that the circuit was receiving power from the battery.

Identify a suitable piece of test equipment e.g. multimeter, voltmeter, logic probe 1 mark
Appropriate description of use 1 mark

(2 marks)

3 This question is about designing the case for a product.

(a)

(i) Name a suitable material that could be used to make the case.

Plastic	1 mark
Polysterene, HIPS, acrylic, ABS, PVC	2 marks

(2 marks)

(ii) Explain, using notes and sketches, the stages in the vacuum forming process when making the case.

Need to show the **main** stages of the process
One mark each, max. 5
e.g. suitable mould in machine
clamp material/plastic
heat material
remove heat
raise mould
apply vacuum
blow air
lower mould

(5 marks)

(b) The warning light is battery powered, has an On/Off switch and four LEDs. Using notes and sketches, develop a design for the case which shows the following features:

- **the position of the four LEDs;**
- **a way of holding the LEDs in the case;**
- **the position of the On/Off switch;**
- **how the battery can be easily changed.**

7 – 9 marks
Good detailed, suitable design for vacuum forming which shows all the required features in appropriate positions.

4 – 6 marks
Design lacks detail or suitability for vacuum forming. Some of the features are unclear, or in unsuitable positions.

1 – 3 marks
Very basic design with limited annotation or notes

(9 marks)

Quality of communication

Well presented sketch or sketches with detailed annotation or notes 3 marks

Good sketch with limited annotation or notes;
or poor sketch with detailed notes 2 marks

Poorly presented sketch and limited annotation or notes 1 mark

(3 marks)

(c) Use notes and sketches to show a method of attaching the case to the bicycle.

Fully detailed design showing a suitable method of secure attachment 5-6 marks

Detailed design showing a possible method of attachment 3-4 marks

Limited response lacking detail 1-2 marks

(6 marks)

Quality of communication

Well presented sketches with detailed annotation or notes 2 marks

Poorly presented sketch with limited annotation or notes 1 mark

(2 marks)

4 This question is about microcontrollers.
The student developing the warning light from Question 3 wants the LEDs to flash on and off and is considering using a PIC.

(a) Compare the use of a PIC with a 555 Timer IC to control the LEDs.
One mark each. Max 4 marks.

Examples:
PIC allows greater control.
Pattern can be tested on PC before build
PIC can be programmed to produce different patterns
Limited output from 555 Timer IC
PIC requires fewer components
PIC more costly than 555
PIC possibly smaller PCB
PIC requires programming skills

(4 marks)

(b) Using a system you are familiar with, produce a sequence of commands which would make a set of 4 LEDs, shown in Figure 3, switch on as shown below. Next to each of the commands, explain its purpose.

12 – 14 marks
Full system including appropriate delays and repeat, along with necessary explanations if needed.

9 – 11 marks
Comprehensive system which shows all the major steps with appropriate explanations if needed.

5 – 8 marks
Only the main steps included, probably without the timings

1 –- 4 marks
Minimal commands showing lack of understanding of a programming system.

(14 marks)

5 This question is about logic gates and circuits.

(a)

(i) Complete the truth table below for the OR gate shown in Figure 4.

0	1 mark
1	1 mark
1	1 mark
1	1 mark

(4 marks)

(ii) In truth tables what does the number '1' represent?

High / On

(1 mark)

(iii) In truth tables what does the number '0' represent?

Low / Off

(1 mark)

(b) The only IC available is one which contains four NOR gates. Figure 5 shows how an OR gate can be made from two NOR gates.

(i) In Figure 5 what is the logic state at output Q when C is at logic '0'?

1

(1 mark)

(ii) The circuit diagram in Figure 6 shows the IC containing four NOR gates.
Complete the circuit diagram so that:
two NOR gates are used to make an OR gate which is connected to the inputs A and B, and the output Q;

A connected to input of a gate	1 mark
B connected to the other input of the same gate	1 mark
Output of the gate connected to input of a second gate	1 mark
Inputs of a second gate connected together	1 mark
Output of the second gate connected to Q	1 mark

(5 marks)

Pin 14 is connected to +V and Pin 7 is connected to 0V;

Pin 14 to +V	1 mark
Pin 7 to 0V	1 mark

(2 marks)

all unused inputs are connected to 0V.

Input of unused gate connected to 0V	1 mark x 4
If outputs also connected lose 1 mark each output.	

(4 marks)

Quality of drawing

Drawn with straight lines	1 mark
Clear connections / dots	1 mark
Lines well presented / clearly laid out	1 mark

(3 marks)

6 This question is about Operational Amplifiers and Potential Dividers.

A student wants to use a light sensor to act as an input trigger for a system that uses an LED.

(a) Figure 7 shows the light sensor potential divider.

(i) Component A is a

Light Dependant Resistor / LDR

(1 mark)

(ii) In bright light conditions component A has a resistance of 5K. Calculate the value of the Vs output signal.

$Vs = (R_2 / R_1 + R_2)$) x V	1 mark
Vs = (5/(10+5)) x 9 or by proportion method.	1 mark
Vs = 3	1 mark
V or volts	1 mark

(4 marks)

(iii) Explain what happens to the Vs output voltage when the light level falls.

Resistance of LDR(A) increases	1 mark
Vs increases	1 mark

(2 marks)

(b) An operational amplifier can be connected as a comparator

Complete Figure 8 by adding:

(i) the light sensing potential divider from Figure 7 to the non-inverting input to give a positive output from the amplifier when the sensor is in the dark;

Potential divider copied onto diagram	1 mark
Connected to non-inverting input (+) (PIN 3)	1 mark

(2 marks)

(ii) a potential divider connected to the inverting input to give an adjustable reference voltage;

Potential divider connected to Op-Amp input	1 mark
Includes potentiometer or variable resistor	1 mark

(2 marks)

(iii) an LED with a resistor to indicate the output is high voltage.

LED and resistor in series	1 mark	
Anode connected towards op-amp	1 mark	
Cathode connected towards 0V	1 mark	
		(3 marks)
Quality of drawing		
Clear connections drawn with straight lines	1 mark	
Correct symbols and in proportion	1 mark	
		(2 marks)

7 This question is about social and environmental issues.
The development of electronic products is having a major impact on society.

(a) Explain how electronic communication has affected people's working lives.

Qualified response considering more than one situation or going into detail about one aspect 3 marks
Limited response or simple statements about more than one aspect 2 marks
Basic statement 1 mark

(3 marks)

(b) Explain how electronic communication has affected the consumer.

Qualified response considering more than one situation or going into detail about one aspect 3 marks
Limited response or simple statements about more than one aspect 2 marks
Basic statement 1 mark

(3 marks)

(c) Describe the consequences for the environment of the development of electronic products.

Qualified response considering more than one situation or going into detail about one aspect 3 marks
Limited response or simple statements about more than one aspect 2 marks
Basic statement 1 mark

(3 marks)