Version 1.0: 0106

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Design and Technology (Electronic Products) 3541

Full Course Foundation 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 This question is about identifying components

(a) Name the following components.

A	Lamp / Bulb	1 mark
B	Switch	1 mark
C	Resistor	1 mark
D	Fuse	1 mark
E	Potentiometer / Variable Resistor	1 mark
F	LDR / Light Dependant Resistor	1 mark
G	Buzzer	1 mark
H	IC / 555 / 741 or any reference "Chips"	1 mark
I	Capacitor	1 mark

(9 marks)

(b) Complete the table below by placing a tick in the appropriate column to show in which stage of the circuit each component is usually found.

A	Input	1 mark
B	Output	1 mark
C	Input	1 mark
D	Process	1 mark
E	Input	1 mark
F	Output	1 mark
G	Output	1 mark
H	Process	1 mark
I	Output	1 mark

(9 marks)

2 **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
Qualified response 2 marks
Simple statement 1 mark

(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)

3 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, such as engraving, 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)

4 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 or notes	1 mark

(2 marks)

5 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.

1 mark each

e.g. 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 programming 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 programming system

(18 marks)

6 This question is about a monostable circuit.

(a) The 555 IC is in an 8 pin DIL arrangement.
On the plan view in Figure 4:
- **clearly label pin 2 with a 2**
- **clearly label pin 7 with a 7**

marked in correct place – 1 mark each

(2 marks)

(b) Figure 5 (on page 13) shows an incomplete circuit diagram for the monostable circuit.
Complete Figure 5 by adding the following components:

(i) a fixed resistor and polarised capacitor to Pins 6 and 7 to create a timing potential divider;

Pin 6 and 7 joined together	1 mark
Fixed resistor connected between pins 6 and 7 and 9V line	1 mark
Polarised capacitor connected between pins 6 and 7 and 0V line	1 mark

(3 marks)

(ii) a 10 K fixed resistor between pin 2 and 9 V;

Labelled 10K fixed resistor	1 mark
Connected to pin 2 and to 9V line	1 mark

(2 marks)

(iii) a push to make switch between Pin 2 and 0 V;

Symbol for push to make switch	1 mark
Connected to pin 2 and to 0V line	1 mark

(2 marks)

(iv) a fixed resistor, a suitable transducer driver and a lamp to the output, Pin 3, so that it will light when Pin 3 goes high.

Fixed resistor to pin 3	1 mark
A suitable driver e.g. transistor, darlington pair, etc	1 mark
Lamp connected between driver and 9V line	1 mark

(3 marks)

Quality of drawing

Components drawn in proportion	1 mark
Straight lines with clear connections	1 mark

(2 marks)

(c) Explain why the lamp should not be connected directly to the output of the 555 IC.

Lamp requires large current 1 mark
IC can only supply small current, or other suitable response referring to the need to amplify the output 1 mark

(2 marks)

(d) Calculate the time constant for the monostable if the resistor is 470 K and the capacitor is 100 µF.

T = R x C 1 mark
T = 100 x 0.47 or alternative 1 mark
T = 47 1 mark
seconds 1 mark

(4 marks)

7 (a) Describe the advantages and disadvantages the development of electronic products has had for teenagers.

Advantages and disadvantages may not be opposites.
Advantages, e.g. more compact, greater efficiency v reliability, more discreet
Qualified advantage, or more than one advantage 2 marks
Simple statement 1 mark
Disadvantages, e.g. create 'must have' society, increased cost, increased crime
Qualified disadvantage, or more than one disadvantage 2 marks
Simple statement 1 mark

(4 marks)

(b) Most of these electronic products use batteries. Why is it important to dispose of batteries correctly to protect the environment?

Qualified response 2 marks each.
Or simple statements
e.g.
Take up land fill space 1 mark
Chemicals leak out from battery 1 mark
Pollute land by entering water table 1 mark
Get into food chain 1 mark
or other suitable response

(4 marks)