



General Certificate of Secondary Education

Engineering (Double Award) 3871

Unit 3

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 Engineering Sectors.

Identify one sector of engineering in which the following are manufactured.

(i) garden machinery

1 mark for mechanical or similar

(1 mark)

(ii) electric cable

1 mark for electrical **or** electronic

(1 mark)

(iii) engine lubricating oil

1 mark for chemical **or** refining **or** process control

(1 mark)

2 This question is about investigating products.

(a) Label the five main parts of the lawnmower.

1 mark for each of the following:

- A** petrol engine / motor / power unit
- B** fuel tank (or either word on its own)
- C** handle / controls / throttle / accelerator / switch
- D** cutting blade / roller / **or** blade (on its own) **or** cutter (on its own)
- E** guard / casing / cover / drive train

(5 marks)

(b) State the purpose of each of the labelled parts B, C and E.

Statements which convey a similar meaning to the following:

Part B to hold the fuel which provides the power to drive the mower

Part C to enable the operator to control the machine safely and comfortably

Part E to cover the chain which connects the output of the engine to the driven cutter and roller

(6 marks)

(c) The petrol engine is a major component of this type of lawnmower.

(i) State one advantage and one disadvantage of this type of lawnmower.

2 marks for an advantage or disadvantage such as:

Advantage the petrol engine allows the machine to be used anywhere or has a high power output

Disadvantage it makes a lot of noise (or pollution) which is environmentally unfriendly

(4 marks)

(ii) Using notes and sketches, briefly explain how the rotating cutter is powered.

A description which includes the following marking points:

- Engine driven through clutch
- Drives cutter and roller through chain
- Operator opens throttle to make it cut and shuts to stop it
- Rotating blade feeds grass over a stationary blade to cut grass

Notes – up to **(4 marks)**

Labels **(1 mark)**

Quality of sketches **(2 marks)**

(d) Most of the components of the lawnmower on page 3 are made from low carbon steel (mild steel). Give two reasons why this material is suitable.

Up to 2 marks for reasons such as:

- low carbon steel is tough and strong and will put up with the rough use of a petrol mower (2 marks)
- low carbon steel is easily shaped into the parts for the mower (2 marks)
- low carbon steel is chemically resistant and will not be damaged by petrol or oil (2 marks)
- low cost – comparative

(4 marks)

3 This question is about investigating technology and materials within products.

- (a) Identify two ways in which new technology is used in products of this type.**

2 marks for each of 2 ways in which new technology is used such as:

- plastics materials used for the body
- powerful electric motor used to lift machine and cut
- hovercraft principle used to make it run easily over rough ground
- high speed cutters make small cuttings which do not need collecting
- safety interlocks and thermal cut outs

Up to 2 marks for each way identified

(4 marks)

- (b) Many of the materials used for the casings are plastics materials.**

- (i) State a suitable plastics material that could be used for the main body.**

1 mark for any suitable thermoplastic material identified such as PVC, polypropene, ABS, HIPS, or a similar plastics material. Allow GRP.

(1 mark)

- (ii) Give two reasons why the material you have identified is suitable for the main body.**

1 mark per reason such as:

- it is easily formed into complex shapes by injection moulding
- it will make a light weight skirt
- it will make a tough skirt
- it will not corrode easily.

(2 marks)

- (iii) State a suitable covering material to prevent the steel handle from corroding.**

1 mark for stating a suitable covering such as a paint or plated finish. Do **not** allow varnish.

(1 mark)

- (c) **This type of lawnmower can be fitted with different types of cutting blades as shown below. Describe one advantage, with the reason, for the use of each type of blade.**

Metal blade:

1 mark per advantages such as

- will cut most things
- stays sharp longer

1 mark per reason such as

- steel is tough – will not crack
- steel is hard – stays sharp

Plastics blade:

1 mark per advantages such as

- safer in use – less likely to cut
- no need to sharpen – just replace
- cannot conduct electricity

1 mark per reason such as

- safer because it is light in weight
- pivot allows it to deflect
- designed for easy replacement
- no need to resharpen

(4 marks)

- (d) **Different types of cutting blades can be used in a rotary lawnmower. Describe in detail one benefit to the manufacturer of producing plastics blades.**

Up to 2 marks for an explanation of the benefit of plastics blades to the manufacturer covering:

- unlikely to generate claims for compensation due to injury
- cheap to make
- increases income since need to buy replacements

(2 marks)

4 This question is about the stages in the engineering manufacture of a product.

(a) Identify four main stages in the manufacture of a lawnmower.

Up to 4 marks for any 4 of the following stages:

- design
- marketing
- production planning
- material supply and control
- production
- assembly and finishing
- packaging and despatch

NB these do not need to be in the correct sequence

(4 marks)

(b) Describe how a lawnmower would be manufactured by referring to what happens in each of the stages.

Up to 8 marks for points such as:

details relevant to the robot lawnmower which describe how the above stages are carried out.

2 marks per description of a relevant stage

(8 marks)

(c) Explain how modern technology is used in one of these stages during the manufacture of a lawnmower.

Up to 3 marks for explaining how modern technology is used in any one of the listed stages.

1 mark per point made, e.g. if ‘Design’ –

- can use automated design procedures, e.g. cut / copy / paste
- can test designs before making
- carry out research on materials / components via internet

(3 marks)

5 This question is about the impact of technology on manufacturing.

(a) Computers are widely used in modern manufacturing. Describe how each of the following tasks could be achieved using computer software.

(i) store details of suppliers of materials and components

use database (1 mark) – using fields to interrogate information (1 mark)

(2 marks)

(ii) show the weekly production of lawnmowers

use spreadsheet (1 mark) – to produce graph (1 mark)

(2 marks)

(iii) find new suppliers of a particular material

use internet (1mark) – search for websites of suppliers (1 mark)

(2 marks)

(b) Many stages in the manufacture of lawnmowers use computerised control systems.

(i) Identify one situation where a computer is used to control a production activity.

1 mark for identifying one situation where computer control of production is used such as:

- controlling CNC machines
- controlling injection moulding machines

(1 mark)

(ii) Describe how the computer is used in this situation.

Up to 3 marks for a description of how the computer controls the process:

1 mark each for information on how the system is controlled, including:

- input monitored
- control taken
- output measurement
- programming
- reaction to feedback
- monitoring

(3 marks)

(c)

(i) Briefly describe the Computer Aided Design (CAD) process.

Up to 2 marks for ‘computer program designed to allow drawings to be created, stored and printed’ **or** ‘computer program allowing drawings to be created, tested, saved and printed’.

(2 marks)

(ii) Briefly describe the Computer Aided Manufacturing (CAM) process.

Up to 2 marks for ‘computer programme which converts CAD drawings into machine instructions which can directly drive CNC (Computer Numeric Control) machinery’.

(2 marks)

(d) Explain how ‘CAD’ and ‘CAM’ are used within a ‘Computer Integrated Manufacturing’ (CIM) system to manufacture lawnmowers.

Up to 4 marks for a description of how CAD and CAM form parts of CIM:
Mark points include

- database of drawings
- storage of drawings
- parts and components database
- integrated system
- allows control of manufacturing remotely

1 mark for each of the above points.

(4 marks)

6 This question is about new products involving modern materials and components.

(a) Identify three ways in which modern technology is used in this robot.

2 marks for each way new technology is identified such as:

- electronic control to determine location / find docking station
- battery system to power robot
- electronic control to steer robot / manage battery
- new materials in body to withstand UV light
- sensors

(6 marks)

(b) The efficiency of the robot lawnmower depends upon a number of factors.

(i) Explain how advances in battery technology would affect the performance of the robot.

2 marks for explanation covering:

- greater capacity allowing robot to work longer between recharges
- faster recharge allowing less time off for recharging
- can be recharged more times

(2 marks)

(ii) Explain how using a solar panel could affect the efficiency of the robot.

2 marks for an explanation covering

- less energy needed from mains re-charger
- some energy converted from sunlight used
- increases efficiency / reduces running costs.

(2 marks)

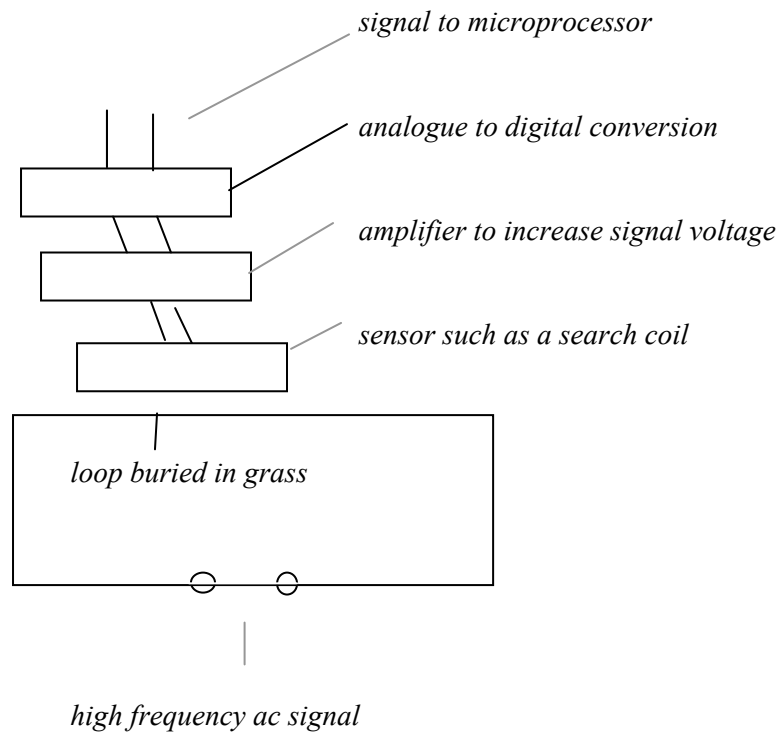
(c) **Explain, using notes and sketches, how microelectronics could be used to control the robot.**

Up to 4 marks for an explanation including the following points:

- microprocessor provides master control
- battery monitoring
- control direction of travel
- control cutting speed
- finds dock
- interconnection of sensors and controls
- control by pre produced programme

(4 marks)

Up to 3 marks for a sketch indicating relationship between processor memory sensors and control devices, such as:



Information contained in sketches **(2 marks)**
 Quality of drawing **(1 mark)**

- (d) The robot lawnmower senses the edge of the lawn by detecting a wire buried in the edge of the lawn. Explain, using notes and sketches, one technique which could be used to make this work.**

Up to 4 marks for notes including the following points:

a signal injected into buried wire
detected by sensor situated in robot
control to adjust direction of motion
control by pre-produced programme

(4 marks)

Information contained in sketches **(2 marks)**

Quality of drawing **(1 mark)**