General Certificate of Secondary Education

Engineering

Specimen Mark Scheme

Unit 3

The specimen assessment materials are provided to give centres a reasonable idea of the general shape and character of the planned question papers and mark schemes in advance of the first operational exams.

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.

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1 (a) State the two items of equipment which would be used in a machine shop to manufacture a batch of 100 of the bolts specified in the drawing on page 2.

Lathe. (1 mark)
The lathe would be used to turn the round parts of the spigot, and to part each one off from the round bar stock.
Lathe could be used for threading bar.
(2 marks)

Milling machine. (1 mark)
The milling machine would be used after the lathe to make the flat on the larger diameter section of the spigot.
(2 marks)

Die.
(1 mark)

Used for threading bar – manual or machine operation.
(2 marks)

Accept any two methods Lathe / milling machine or Die.

(6 marks)

(b) Explain how the following quality aspects would be achieved when manufacturing the bolt.

(i) Dimensional accuracy within tolerance.

The dimensions of the spigot would be controlled by having a stop fixed on the tool holder to limit the movement of the tool, so that it always ended up in exactly the same position for each spigot.
(2 marks)

Accept an alternative answer such as using CNC.

Simplistic answer – "measure it and cut until right" (1 mark)

(2 marks)

(ii) Good surface finish.

Correct speed / feed, tool profile and use of coolant / sharp tools.
Sufficient rigidity to avoid chatter.

1 mark per point or 2 marks for a well explained answer which shows cause and effect e.g. blunt tool = poor finish.

(2 marks)

(c) Identify two health and safety hazards which would have to be considered when manufacturing the bolt.

(i) Hazard 1

Risk of eye injury due to flying debris – swarf / chippings.

(1 mark)

Controlled using guards and safety glasses.

(1 mark)

(2 marks)

(ii) Hazard 2

Risk of injury due to touching cutting tools or revolving parts.

(1 mark)

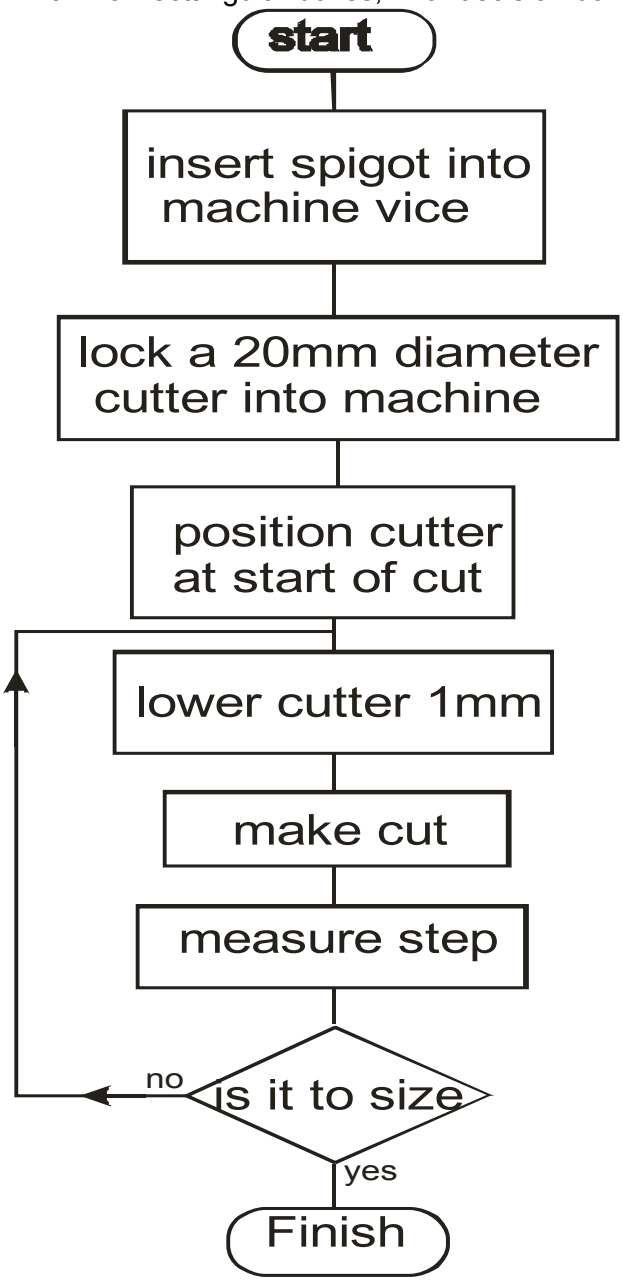
Controlled using guards to prevent human contact with cutting tools and training.
(2 marks)

(2 marks)

(14 marks)

2 **Draw a flow chart in the space below to show how the flat on the bolt in question 1 would be machined. Use standard flow chart symbols and include a method for checking how this meets the final dimensions.**

1 mark for rectangular boxes, 1 for decision box



(6 marks)

Method of checking dimension (2 marks)

Correct symbols – process, decision. (2 marks)

(10 marks)

3 (a) Engineering components which are manufactured from low carbon (mild) steel need a protective coating to prevent them from corroding. Describe one way of achieving this.

(i) Method

Suitable method: paint, plate, galvanise, plastic coat.

(1 mark)

(1 mark)

(ii) Describe the steps in the process.

E.G. Painting

- Surface of metal needs cleaning and degreasing.
- Primer coat then sprayed on in a painting booth.
- Final coat applied when primer dried.

(3 marks)

(2 marks)

(iii) State one advantage of the method you have described.

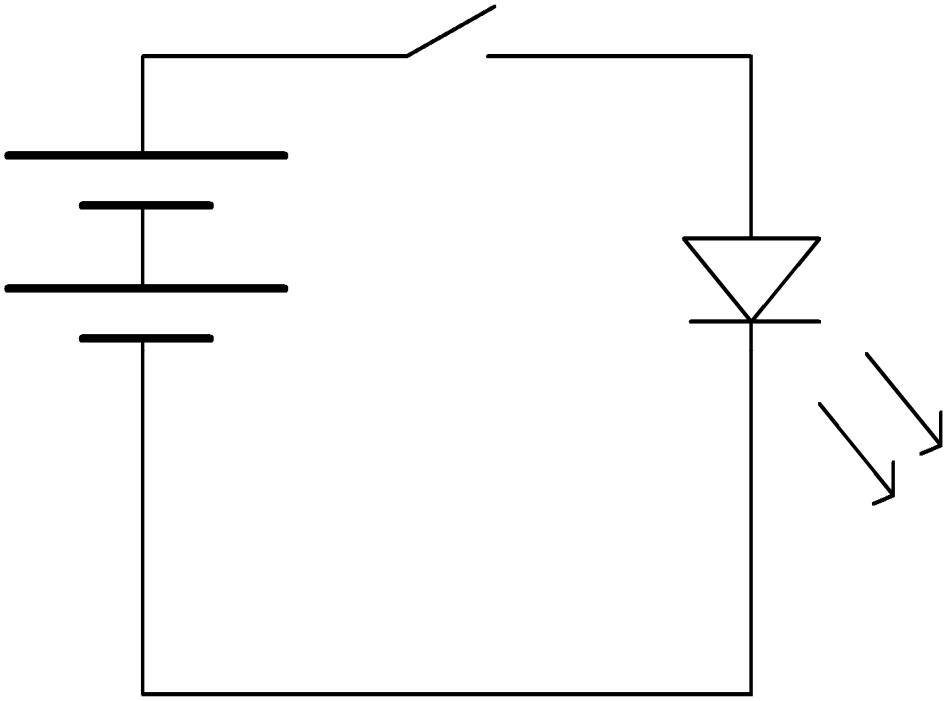
Advantage it provides a thick coat which is protects the surface well. (paint or plastic coat).
Less reactive metal – plating.

(1 mark)

(1 mark)

(5 marks)

4 **Draw a circuit diagram showing the torch circuit.**



Correct symbols, battery, switch and LED (3 marks)

Circuit correct – battery and LED with correct polarity (2 marks)

Lines neat and running horizontal or vertical (1 mark)

(6 marks)

5 (a) Give two advantages of a CNC lathe when manufacturing batches of circular components.

Advantage 1
The programme is always the same and the dimensions of the finished component will all be the same.

(2 marks)

Advantage 2
There is no need for an experienced operator to operate the machine, since the only help it needs is to take away finished components, and insert new blank materials.

(2 marks)

(4 marks)

(b) State the difference between a CNC lathe and a CNC machining centre.

A lathe can only make circular items, where as a machining centre can make circular and flat components, and even components with flat surfaces, as well as circular surfaces and holes. 1 mark for simple answer, 2 marks for a detailed answer as above.

(2 marks)

(2 marks)

(6 marks)

6 **Use the space below to work out the coordinates to which the cutter needs to go to *start* cutting, and the coordinates to which it needs to go to *finish* the cut.**

Operation	x co-ordinate	y co-ordinate	z co-ordinate
Move to start	+20	+30	+15
Plunge to depth	+20	***+30***	-6
Move to:	***+80***	+30	-6
Move to:	***+100***	***+50***	***-6***
Lift	***+100***	+50	+15
Return to origin	0	0	0

(6 marks)

(6 marks)

7 (a) Robots are used in sub assemblies when making cars. Describe why robotic systems are used to make these sub-assemblies. You must give three examples in your answer.

1 mark for each example with additional mark for description such as:
Repetitive working – robots will work with the same level of accuracy consistently – not become bored
Speed – quickness in operation, robots do not become tired ensuring system works to same
Hazardous conditions – paint fumes, spray – limited visibility, welding – eye protection limits visibility
Limited access – robots can reach into places humans would find difficult.
Lifting – heavy components – risk of injury removed (and also, therefore, of compensation issues)
Hot parts, risk of burns removed (and also, therefore, of compensation issues)

(6 marks)

(6 marks)

(b) Explain briefly the difference between Computer Aided Manufacture and Computer Integrated Manufacture.

CAM is the use of computer controlled machinery to make the components required. CIM is the interlinking of design, procurement, sales and manufacturing through computers communicating with each other.
1 mark each for explanation of CAM and CIM; 3 marks can only be attained if the difference between the two is explained.

(3 marks)

(3 marks)

(c) Explain how Computer Integrated Manufacture is used to manufacture cars of *different specification* on the *same* production line.

Candidates should note that CIM
- ensures correct parts are delivered to assembly line
- tracks bodies to ensure parts are fitted to each specification
- adjusts line to accommodate different specifications
- uses visual recognition systems to ensure correct parts are used and installed
- does not start the production process unless all parts are available – tracks stock
- orders parts for when they are needed
- forms part of a JIT system which controls deliveries by suppliers

Any four separate points made or two points well explained.
Quality of Written Communication is also assessed in this response, as follows:

Level 1 Candidates express straightforward ideas clearly, if not always fluently. Arguments stray from the point on occasion or may be weakly presented. There may be many or a number of errors of grammar, punctuation and spelling.
Level 2 Candidates express complex ideas very clearly and fluently. Sentences and paragraphs follow on from one another smoothly and logically. There may be occasional or few / no errors of grammar, punctuation and spelling. For full marks, a candidate's response must be within this band.

(4 marks)

(4 marks)

(13 marks)

8 (a) (i) Name one product which has a microcontroller within it.

Any suitable product e.g. mobile phone, car, washing machine.

(1 mark)

(1 mark)

(ii) Explain briefly why the microcontroller is used.

Candidates are expected to provide an explanation which would cover the following points (other equivalent points will also be accepted):

- the use of a microcontroller means the design can be updated more easily, reduces wiring cost by sending messages in serial form, ascertains faults by more precise testing
- for the manufacturer there are lower costs than using discrete components, can use Bluetooth communication
- notes that there are also advantages for the user, e.g. the product is able to function automatically, replacement or mending a fault can be quicker or cheaper than with products without a microcontroller.

Each point would need to be explained.

One point provided, with limited explanation – 1 mark
Two points provided, with limited explanation of each; or one well explained point – 2 marks
Three explained points provided or two points well explained points – 3 marks

(3 marks)

(3 marks)

(b) Explain how the development of electronic components has impacted upon the design of manufactured products.

As size has reduced products can be

- smaller
- more complex as more can be fitted into same space
- reducing cost can allow more features for same price or reduction in selling price

(3 marks)

(3 marks)

(7 marks)

9 (a) The increasing use of plastics for manufactured products is a current environmental problem. Explain the waste disposal issues that this causes.

Identification and explanation of any of the following; 2 marks each.

Land fill – shortage of space demands on land use.

Unsightly – found in trees, riverbanks and oceans.

Slow to degrade – can take hundreds of years.

Burning - causes pollution and releases toxic gases.

Difficult to identify type of plastics material for recycling processes.

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(4 marks)

(b) Describe in detail how applying one aspect of modern technology will help to limit damage to the environment.

Identifying chips built into products so they can be automatically sorted
Greater reliability, so less frequent replacement, reduces waste
Development of biodegradable materials
Use of alternatives to fossil fuels for energy, solar, wind, geothermal, nuclear or tidal.

One aspect identified (1 mark) and one mark for each amplifying statement or reasoned explanation (total 4)

(4 marks)

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(4 marks)

(8 marks)

Total marks for paper: (75 marks)