DTBase©

Design & Technology
Eduqas GCSE

Systems: scales of production

Materials required for questions

- Pencil
- Rubber
- Calculator

Instructions

- Use black ink or ball-point pen
- Try answer all questions
- Use the space provided to answer questions
- Calculators can be used if necessary
- For the multiple choice questions, circle your answer

Advice

- Marks for each question are in brackets
- Read each question fully
- Try to answer every question
- Don’t spend too much time on one question

Good luck!

Q1. Which scale of production has the highest unit cost?

A One-off

B Batch

C Mass

Q2. Continuous production runs:

A Only at weekends

B 24/7 without stopping

C For one customer at a time

Q3. What is just in time (JIT) manufacturing?

A Components arrive exactly when they are needed on the production line

B Large amounts of stock are kept in warehouses

C Products are made one at a time by hand

Q4. Which of these is a disadvantage of using a jig?

A It needs a lot of skill to use

B It slows production down

C It is only suited to the one part it was made for

Q5. Which machine places tiny surface mount components onto PCBs?

A A flow soldering machine

B A pick and place robot

C A laser cutter

Q6. Which of these is a disadvantage of mass production?

A Very low unit costs

B It is highly automated

C It is inflexible and cannot respond to market trends

Q7. A batch of 80 circuit boards is manufactured in school. Explain the importance of using a jig to help the drilling process. **(2 marks)**

Q8. A template is used to mark out the chassis of a robotic lawnmower. Explain two advantages of using a template to mark out the chassis when manufacturing in large quantities. **(4 marks)**

Q9. A printed circuit board (PCB) manufacturer owns 25 CNC (computer numerical control) machines. Each machine takes 5 minutes to manufacture a PCB. Calculate how many PCBs would be cut in an 8-hour shift using all 25 CNC machines. Show all workings. **(5 marks)**

Q10. Explain two ways that just in time (JIT) production can help manufacturers improve efficiency. **(4 marks)**

Q11. A speed sensing road sign uses photo etched circuit boards for its electronic circuitry. Explain two reasons for etching the circuit boards for the road signs. **(4 marks)**

Q12. LED strip lights are made with LEDs and resistors on a circuit board. Explain two ways that pick and place technology can be used to aid the manufacture of the LED strip lights. **(4 marks)**

Q13. A robotic vacuum cleaner is manufactured in a factory that uses a batch production system. Evaluate the benefits of this method of production. **(6 marks)**

Q14. Analyse the benefits of using automated machinery to manufacture printed circuit boards compared to printed circuit boards made by hand. **(5 marks)**

Q15. A designer is developing the circuit for a portable speaker. Evaluate the reasons the designer uses CAD software to model the speaker circuit compared to physically making the circuit. **(6 marks)**

Answers

Q1. A
Q2. B
Q3. A
Q4. C
Q5. B
Q6. C

Q7.

Any two (1 mark each):

- The jig holds each circuit board in the same position (1)
- The jig lets the holes be drilled accurately through all 80 circuit boards (1)
- The jig makes sure the holes are consistent on every circuit board (1)
- The jig makes the drilling repeatable (1)

Q8.

Two advantages (1 mark each), each with a linked justification (1 mark each). For example:

- They can be quickly drawn or traced around (1), saving time and speeding up production (1)
- Each part marked out will be identical (1), so every part will line up with the others (1)
- The template can also mark out features such as holes and fixing points (1), so all the other parts fit correctly into place (1)
- They need little skill to use (1), so they can be used by workers with limited skill or technical knowledge (1)

Q9.

1 hour = 60 minutes (1). 8 × 60 = 480 minutes (1). 480 ÷ 5 = 96 PCBs per machine (1). 96 × 25 (1) = 2400 PCBs in 8 hours (1). Credit any other appropriate method.

Q10.

1 mark for each point of explanation. One point explained in more detail, e.g. with an example, is worth 2 marks. Do not credit repeating "just in time" or "improve efficiency". For example:

- No factory space is needed to store materials, so more space can be used for production (1)
- Materials and components do not become old or out of date (1), reducing costs and waste (2)
- Money is not tied up in unused stock (1)
- Less time and resources are wasted ordering, moving and storing unused materials, making the manufacturer more competitive (2)
- No need for large storage buildings, reducing construction and maintenance costs (2)

Q11.

Two reasons (1 mark each), each with a linked justification (1 mark each). For example:

- Photo etching gives a high quality, high definition image, which can be CAD generated (1), so a high quality image is transferred to the board (1)
- The image or mask can be used again and again (1), so identical boards can be made for batch or mass production (1)
- Photo etch masks and files can be saved electronically (1), so they can be used at any time to make a one-off or a new batch if the customer wants more (1)

Q12.

Two ways (1 mark each), each with a linked justification (1 mark each). For example:

- Pick and place machines are very flexible (1), so the same machine can place both the resistors and the LEDs (1)
- They have high levels of precision (1), so components are placed in the correct position every time (1)
- They reduce the number of workers needed on the production line (1), improving safety and reducing the chance of burns from soldering (1)
- They move components using a vacuum (1), so there is less chance of static (electrostatic) damage (1)

Q13. (6 marks)

Indicative content:

- It is cheaper to make a whole batch than single products, and machines are used more effectively
- It is more accurate and consistent, as machines repeat exactly the same product, so there are fewer faulty products
- It is flexible enough to make different versions of the product, giving customers more choice and more sales
- The company lowers its risk by making a variety of products rather than just one
- Materials can be bought in bulk, which reduces cost
- It works well for small production runs, and is ideal for custom, seasonal or trial runs of new products
- It reduces the amount of stock held, which matters when space is limited
- Workers can specialise and use specialist machinery

Band	Marks	Descriptor
3	5 to 6	A coherent answer with detailed, relevant knowledge and understanding of the benefits of batch production. Relevant examples and well-developed, substantiated judgements in a logically structured response.
2	3 to 4	Some coherence, with partial knowledge and understanding. Mostly relevant examples and partly substantiated judgements in a generally well structured response.
1	1 to 2	Basic knowledge and understanding. Limited relevant examples or judgements, with little structure.
0	0	Incorrect or irrelevant answers.

Q14. (5 marks)

Answers must compare automated machinery with making PCBs by hand to access the full 5 marks. Indicative content:

Benefits of automated PCB manufacture

- Minimal errors: computer programs run most processes, so every board meets the set standards
- Fewer errors also mean lower production costs

- Miniaturisation: smaller components can be placed in the smallest spaces
- Fast and efficient, so tight deadlines and mass production can be met
- Higher, more consistent quality and accuracy than hand assembly
- Fewer workers are needed, lowering the cost of production
- Several stages can be completed at the same time

Where hand manufacture is still useful

- Cost effective for low volume and prototype work
- Allows unusual components to be placed, or late components to be fitted
- Hidden parts can be inspected and cleaned, and technicians can repair faults that machines cannot

Band	Marks	Descriptor
3	4 to 5	A coherent answer with detailed, relevant knowledge and understanding of the benefits of automated machinery compared to making PCBs by hand. Relevant examples and a well-developed, logical chain of reasoning, sustained throughout.
2	2 to 3	Some coherence, with partial knowledge and understanding. Mostly relevant examples and a logical chain of reasoning that may not be sustained throughout.
1	1	Basic knowledge and understanding. Limited relevant examples or logical chain of reasoning.
0	0	Incorrect or irrelevant answers.

Q15. (6 marks)

Answers must compare CAD modelling with physically making the circuit. Indicative content:

Advantages of CAD modelling

- Saves time: a better, more efficient circuit can be designed more quickly
- Easy to edit: errors can be fixed and drawings changed easily
- Fewer errors than making the circuit by hand
- Easy to save, store, reuse and share files
- Improved accuracy
- Virtual modelling lets the circuit be tested at different voltages and currents

Disadvantages of CAD modelling

- Work can be lost if the computer breaks down, or affected by viruses or hacking
- It takes time to learn the software, and it needs regular updates

Advantages of physically making the circuit

- The designer can test the circuit works before production, reducing the risk of failure
- Confirms component values, layout and functions match the specification
- Shows practical problems such as loose connections, short circuits or wrong polarity
- Seeing the circuit working can inspire further design development

Disadvantages of physically making the circuit

- Takes time, limiting the number of prototypes
- Components cost money and can be damaged or wasted
- Wiring errors, damaged components or poor soldering can make the circuit fail
- Needs practical skills, and only one version of the circuit can be tested at a time

Band	Marks	Descriptor
3	5 to 6	A coherent answer with detailed, relevant knowledge and understanding of the reasons for using CAD software to model the circuit compared to physically making it. Relevant examples and well-developed, substantiated judgements in a logically structured response.
2	3 to 4	Some coherence, with partial knowledge and understanding. Mostly relevant examples and partly substantiated judgements in a generally well structured response.
1	1 to 2	Basic knowledge and understanding. Limited relevant examples or judgements, with little structure.
0	0	Incorrect or irrelevant answers.