DTBase©

Design & Technology
Eduqas GCSE

Systems: specialist techniques and processes

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 tool is used to mark the centre of a hole on metal before drilling?

A Centre punch

B Tin snips

C Side cutters

Q2. When soldering, how long should the iron heat the pad and the component leg before solder is fed in?

A 10 to 15 seconds

B 1 to 2 seconds

C Less than a tenth of a second

Q3. Which of these is a temporary joint?

A A pop rivet

B A soldered joint

C Nuts and bolts

Q4. Which material must never be cut on a laser cutter because it gives off toxic gas?

A Acrylic

B PVC

C HIPS

Q5. What does a washer do?

A Spreads the load under a nut or screw head and stops it loosening

B Joins acrylic to acrylic

C Cuts excess component legs

Q6. Which of these is a disadvantage of 3D printing?

A Low material waste

B Good for prototyping

C Slow for large or solid items

Q7. A steady hand game has a pre-drilled printed circuit board (PCB) that is populated with components.

Q7a. State the correct name of the hand-held equipment used to remove the excess wire (component legs) from a populated circuit board. **(1 mark)**

Q7b. Precise soldering is important when populating the PCB. Use words and sketches to show how a resistor would be soldered onto the circuit board precisely and securely. **(4 marks)**

Q8. The circuit board for a portable speaker is cut using a guillotine. Describe one advantage of using a guillotine to cut the circuit board. **(2 marks)**

Q9. The aerial of a remote-control toy is connected to the circuit using insulated wires. Name the specific type of tool used during assembly to remove the insulation from the ends of the wires. **(1 mark)**

Q10. A circuit board needs a 5 mm hole drilled in each of its four corners so that it can be fixed directly to a polymer case. Use notes and sketches to show how to drill a 5 mm hole in one of the corners of the circuit board using a pillar drilling machine. **(4 marks)**

Q11. The polymer base of a steady hand game is made from 3 mm thick acrylic. It measures 80 mm × 100 mm and has four screw holes. Use notes and sketches to show how a single polymer base would be cut using a CNC laser cutter. **(4 marks)**

Q12. The internal fixing case for a building alarm system is vacuum formed from high impact polystyrene (HIPS). Use notes and sketches to show how the internal fixing case would be manufactured using the vacuum forming process. **(4 marks)**

Q13. The polymer case of a steady hand game is a hollow box shape, open at the bottom, that houses the circuit and buzzer. Give two different methods that could be used to manufacture the polymer case. Explain one reason for using each manufacturing method. **(6 marks)**

Q14. The hexagonal lens of a bicycle light is made from 3 mm acrylic sheet. The lens is to be produced in a batch of 1000. Name two different techniques that could be used to batch produce the lens. Explain one advantage of using each technique. **(6 marks)**

Q15. Visual inspections detect faults when populating and soldering components onto a printed circuit board (PCB). Analyse a range of possible faults that could occur when populating and soldering components, and suggest how they can be overcome. **(5 marks)**

Q16. Parts of a metal structure are joined using three different methods: a nut and bolt, a countersunk rivet and a welded joint. Give one different reason for using each method. **(3 marks)**

Answers

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

Q7a.

Side cutters or wire cutters (1). These are the only acceptable answers.

Q7b.

Up to 4 marks for a clear understanding of the stages. A maximum of 2 marks for clear sketches if the written explanation is missing. For example:

- Mount the component: push the resistor legs through the holes in the circuit board (1)
- Turn the PCB over and heat the joint: hold the hot soldering iron on the pad and the leg to heat them both (1)
- Apply solder to the joint while still heating the pad and leg, until a cone (pyramid) shape forms (1)
- Remove the iron, let the solder cool, then snip off the extra wire from the legs (1)

Q8.

1 mark for an advantage and 1 mark for a description. For example: cutting with a guillotine avoids the rough edges left by a band saw. Other answers:

- Cutting a circuit board with a band saw makes dust that can irritate the skin; a guillotine avoids harmful dust
- A manual saw can easily scratch the photoresist coating
- A guillotine gives a clean edge to the circuit board
- Band saw or circular saw blades go blunt very quickly when cutting circuit board

Q9.

Wire strippers (1).

Q10.

Notes and sketches that include (1 mark each, up to 4):

- Mark out the position of the hole (1)
- Clamp the board to the machine table or hold it in a machine vice (1)
- Put the drill bit into the chuck (1)
- Wear PPE to protect the eyes (1)
- Turn the machine on and lower the drill bit into the circuit board (1)

For example: the circuit board is clamped onto a piece of scrap wood, to prevent break out and protect the machine table.

Q11.

Cap at 3 marks if there are no sketches, or sketches with no notes. Notes and sketches that include:

- Load a piece of polymer sheet of a suitable size onto the laser cutter bed (1)
- Make sure the sheet is flat and the bed is clear of debris (1)
- Load or convert the electronic (CAD) file (1)
- Set suitable speed and power, or enter the material type and thickness (1)
- Focus the laser, adjust the axes or position the laser head (1)

Q12.

Cap at 3 marks if there are no sketches, or sketches with no notes. Notes and sketches that show how to:

- Clamp the polymer sheet above the mould (1)
- Heat the polymer sheet until it goes soft (1)
- Blow the sheet up, or raise the table (platen) with the mould into the soft sheet (1)
- Turn on the vacuum pump to remove the air, so the sheet forms over the mould (1)
- Remove the cooled, formed sheet from the mould (1)

Q13.

Two methods (1 mark each), each with two linked justifications (1) + (1). Do not accept laser cutting as a method. For example:

- Vacuum forming (1): the case is formed in a single operation (1), which gives a consistent result with no seams or joints (1)
- 3D printing (1): it can be linked to 3D CAD software (1), so extra design features can all be made at once (1)
- Fabrication using hand tools (1): the case can be made with simple workshop tools (1), so the sides can be cut from offcuts, saving material (1)
- Injection moulding (1): complex moulds can be made (1), so all the design features such as ribs and holes are included (1)

Q14.

Two techniques (1 mark each), each with two linked justifications (1) + (1). For example:

- CNC router (1): it can repeat the cut (1), making identical parts quickly (1)
- Cutting jigs (1): they can be used to cut shapes or parts to size (1), needing little or no marking out (1)
- Laser cutter (1): it gives a very narrow, precise and accurate cut, so the parts are identical (1) with very little waste (1); or it suits high production rates (1) because acrylic can be cut at high speed (1)

Q15.

Answers must only relate to faults when assembling a PCB and how to overcome them. 1 mark for each fault with its solution, up to 5. For example:

- Component fitted backwards: check the drawing on the PCB for the correct position (1)
- Wrong components, or components in the wrong place: check the circuit design or assembly instructions (1)
- A joint without enough solder that does not make good electrical contact: reheat the joint and add more solder (1)
- Legs left too long, which could cause short circuits: trim all legs just above the solder joint (1)

- Solder bridge joining two joints: drag the hot iron tip between the joints, or remove the extra solder with a solder sucker or solder wick (1)
- Lifted pad, often from desoldering or overheating the joint: fold the leg over to a copper track that is still attached and solder it (1)
- Stray solder splashes held by sticky flux, which can cause short circuits: remove with the tip of a knife or tweezers (1)

Q16.

One reason for each (1 mark each):

- Nut and bolt: a temporary fastening that can be removed or adjusted if needed (1)
- Countersunk rivet: a permanent method that keeps the surfaces clean and flush (1)
- Welded joint: a permanent method; the joint is strong and resists compression, tension and torsion, gives a flush surface and needs no extra materials (1)