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# Design & Technology
# Eduqas GCSE

# Systems: factors influencing selection

## 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 of these is an environmental factor when choosing components?

**A** Using an LED instead of a filament lamp

**B** Using red for danger

**C** Getting a bulk discount

**Q2**. Which of these is a limitation of a relay?

**A** It needs programming

**B** Its moving parts wear, it is slow and it clicks

**C** It cannot switch high power

**Q3**. What is miniaturisation?

**A** Making products bigger so they are easier to repair

**B** Using larger components to reduce heat

**C** Making control systems smaller by using smaller or fewer components

**Q4**. Which regulations require lead-free solder?

**A** WEEE

**B** RoHS

**C** E12

**Q5**. Using red for danger and green for go on a product is an example of which factor?

**A** Cultural

**B** Cost

**C** Availability

**Q6**. Which of these is a disadvantage of miniaturisation?

**A** Lower power use

**B** Uses fewer materials

**C** Products are harder to repair and often thrown away

**Q7**. A mini fridge holds a single drinks can and uses an electronic circuit with a thermistor to control the temperature. Explain one cost factor that will affect the choice of components for the mini fridge. **(2 marks)**

**Q8**. A bicycle light that can also be used as a torch meets the requirements of the Restriction of Hazardous Substances (RoHS) Directive. Explain two advantages of manufacturing the bicycle light to meet the requirements of the RoHS Directive. **(4 marks)**

**Q9**. A solar powered garden light uses solar cells that contain scarce elements. Explain two availability factors that could result in scarce elements becoming even more difficult to source. **(4 marks)**

**Q10**. A steady hand game is supplied with a written instruction booklet that is in colour. Explain one way that the manufacturer can avoid causing offence to potential users of the instruction booklet in different countries. **(2 marks)**

**Q11**. An LED strip light is made from a strip of LEDs and resistors inside a polymer casing with a polymer lens.

**Q11a.** Manufacturing the strip light using LEDs is cost effective. Explain one other benefit of manufacturing the strip light using LEDs. **(2 marks)**

**Q11b.** Explain one advantage of using surface mount technology (SMT) for the LEDs. **(3 marks)**

**Q12**. A pressure sensor alarm system has an alarm unit with a loudspeaker, a volume setting and a voice alarm setting. Explain two reasons for using a loudspeaker in the alarm unit. **(4 marks)**

**Q13**. Circuit boards for a product are manufactured in an economically developing country. Analyse how a designer can ensure that the circuit boards are manufactured in an ethical and environmentally friendly way. **(5 marks)**

**Q14**. Discuss how designers can improve and extend the life of electronic products to lessen their impact on our environment. **(6 marks)**

**Answers**

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

**Q7.**

A cost factor (1) and a linked justification (1). For example:

- The quality or performance of the component (1) affects its lifespan and its price (1)
- Bulk buying standard components (1) reduces the unit cost (1)
- Where the components come from and their availability (1), e.g. China or the UK (1)

**Q8.**

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

- Manufacturers are restricted in the amount or type of harmful substances they can use (1), reducing the risk of damage to the environment or the user (1)
- The product can be marked as RoHS compliant (1), which widens its market appeal and lets customers make informed choices (1)
- Workers, recyclers and users are safer and healthier (1), as they have less contact with dangerous substances (1)
- The product can be sold in Europe (1), giving access to a larger market and more sales (1)

**Q9.**

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

- Many scarce elements come from places that are politically unstable, far away or emerging economies (1), so supplies could be interrupted by

political tensions, sanctions or tariffs, or those countries may keep them for their own industries (1)

- Many elements come from a single geographical source (1), so there may be no other supplier to turn to (1)
- Sales of electronic products are increasing in emerging markets (1), putting more pressure on limited supplies (1)

**Q10.**

A way (1) and a linked justification (1). For example:

- Think carefully about the colours used in the booklet (1), as colours stand for different things in some countries or can be linked with bad luck (1)
- Think carefully about the language and images used (1), as some words or images have very different meanings in different countries, and a range of languages may be needed (1)

**Q11a.**

A benefit (1) and a linked justification (1). For example:

- LEDs are available from a wide range of suppliers (1), so components will always be available (1)
- LEDs come in a range of colours (1), so the strip light can be varied to meet customer needs (1)
- LEDs are small, thin, low profile components (1), so the strip light can be very slim (1)
- LEDs have a long lifespan (1), so the lights will not need replacing often (1)
- LEDs use only a small amount of power (1), so the strip lights are energy efficient for consumers (1)
- LEDs do not get hot (1), which reduces the chance of fire or the casing distorting (1)

**Q11b.**

An advantage (1) plus two linked justifications (1) + (1). For example:

- Fewer processes are needed (1) because no through holes have to be drilled (1), reducing the time to make the strip lights (1)

- Components are smaller and can be placed closer together (1), so the circuit board can be smaller (1), reducing the overall size of the strip light (1)
- Surface mount components are cheaper than through hole ones (1), so manufacturing costs are lower (1), making the company more profitable or the product more competitive (1)

**Q12.**

Two reasons (1 mark each), each with a linked justification (1 mark each). Do not credit "they are loud" on its own. For example:

- Loudspeakers can produce sounds at a range of volume levels (1), so the alarm can be heard over other noises, deter intruders or alert several people (1)
- The volume can be controlled (1), so the alarm can be turned down if it is used at night (1)
- Loudspeakers can produce a wide range of sounds, including speech (1), so the alarm can make different noises in different situations (1)

**Q13. (5 marks)**

To reach Band 3, answers must cover both ethical and environmental points. Indicative content:

**Environmental**

- Plan the PCB design and layout at the start to prevent material waste when cutting
- Use lead-free solder or adhesives instead of lead-based solder
- Use press-fit components that do not need solder
- Recycle components from older circuit boards
- Make the circuit board smaller, so it uses less material and energy
- Choose local factories to reduce pollution from transport
- Make good quality circuit boards so they work well and last a long time

**Ethical**

- Follow the WEEE Directive to reduce electronic waste going to landfill
- Protect the health and well-being of workers
- Fair pay, acceptable hours with breaks, and well ventilated, healthy workplaces

- Contracts that give workers a regular income; no child labour or exploitation
- Ethically sourced raw materials

| Band | Marks | Descriptor |
|---|---|---|
| 3 | 4 to 5 | Covers both ethical and environmental areas. A coherent answer with detailed, relevant knowledge and understanding of how the designer can make sure the circuit boards are produced in an ethical and environmentally friendly way. 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. |

**Q14. (6 marks)**

Indicative content:

- Remove or reduce harmful substances, e.g. replace lead solder with a tin, silver and copper alloy
- Include power management features such as low-power standby and auto power saving
- Use solar power, or harvest energy from body movement for wearables
- Design smaller products that use fewer materials and create less waste at the end of their life
- Replace hard to recycle plastics with durable materials such as aluminium that are more valuable to recycle
- Design for reusable, long-life (rechargeable) batteries instead of single-use batteries
- Use fewer screws and screw types, and more snap-fit parts, so products are quicker to take apart
- Offer part updates (e.g. only replace the camera on a smartphone) instead of a whole new product
- Plan for repair so one small fault does not mean the whole product is thrown away

**However:**

- Users may not be prepared to pay more for sustainable electronic products, and may prefer cheaper options
- There are risks in trying new materials and approaches, and it may be hard to make money from longer-life products
- Changing manufacturing systems is expensive, and a lack of public knowledge and demand slows progress

| Band | Marks | Descriptor |
|---|---|---|
| 3 | 5 to 6 | A coherent answer with detailed, relevant knowledge and understanding of how designers can extend the life of electronic products to lessen their impact on the environment. 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. |