DTBase©

Design & Technology
Eduqas GCSE

Metals: 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 metal has a warm reddish colour and develops a green patina outdoors?

A Brass

B Aluminium

C Copper

Q2. Which metal can be polished or anodised in different colours, e.g. for a laptop casing?

A Aluminium

B Mild steel

C Cast iron

Q3. Which metal has a bright gold colour, polishes well and is used for door handles and instruments?

A Bronze

B Brass

C Pewter

Q4. When estimating the true cost of a product, how is the labour cost worked out?

A Time × hourly rate

B Material cost + waste allowance

C Energy + overheads

Q5. How can a designer reduce the harm that using metals does to biodiversity?

A Always choose the cheapest supplier

B Use metal straight from new mines

C Use recycled metal to reduce the need for new mines

Q6. A batch of 20 steel brackets costs £90 to make in total. What is the cost of one bracket before profit?

A £9.00

B £4.50

C £1.80

Q7. A candle holder with a handle, a lid and side panels is made from sustainable metals.

Q7a. Explain two advantages of manufacturing the candle holder from sustainable metals. **(4 marks)**

Q7b. Explain one reason for using different metals for different parts of the candle holder. **(2 marks)**

Q8. A set of cutlery is to be made from steel. Explain one cost factor that will affect the choice of steel for the cutlery. **(2 marks)**

Q9. A table lamp is cut from a single piece of brass. Its two side pieces are bent outwards into curves and held in place by a small top part. Explain two working properties of brass that make it an ideal material for the table lamp. **(4 marks)**

Q10. A holder for salt and pepper pots used in cafes and restaurants is made from stainless steel. Explain one benefit of manufacturing the holder from stainless steel. **(2 marks)**

Q11. A teaching aid for use in schools has number wheels that children turn by hand. It is made from aluminium. Explain two physical characteristics of aluminium that make it an ideal material from which to make the teaching aid. **(4 marks)**

Q12. A desk tidy has a front panel, sides and dividers made from folded mild steel sheet. Explain two reasons for using mild steel for the desk tidy. **(4 marks)**

Q13. The hollow section used to make a gravel bicycle frame costs the manufacturer £12.50 per metre. Each frame needs 6.2 metres.

Q13a. Calculate the cost of the metal needed to manufacture a batch of 750 gravel bicycle frames. Show all workings. **(2 marks)**

Q13b. The selling price of the gravel bicycle is 360% of the cost of the material for one frame. Calculate the selling price of one gravel bicycle. **(1 mark)**

Q13c. The frame is scaled down for a child's gravel bicycle, which reduces the cost of the material by one third. Calculate the new material cost of one child's frame to 2 decimal places. Show all workings. **(2 marks)**

Q14. A low-cost mild steel toolbox is manufactured in an economically developing country. Analyse how a designer can ensure the toolbox is produced in an ethical and environmentally friendly way. **(5 marks)**

Q15. Analyse the characteristics and properties of appropriate metals that make them suitable for gravel bicycle frame manufacture. **(5 marks)**

Answers

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

Q7a.

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

- Less ore needs to be mined (1), because sustainable metal comes from reclaimed or recycled sources (1)
- Less energy is needed to process the metal (1), reducing the cost, carbon footprint and emissions of making the candle holder (1)
- Less waste metal is sent to landfill (1), reducing the overall environmental impact of the material (1)
- It keeps natural resources (1) for future generations (1)
- It can be marketed or branded as sustainable (1), appealing to a wider audience and letting customers make informed choices (1)

Q7b.

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

- Metals have different properties (1), so each can be matched to the part of the candle holder it suits (1)
- Different metals have different colours, finishes or textures (1), so they can highlight different features and make it more appealing (1)
- Metals are available in different forms (1), so the most suitable size or shape can be used for each part (1)
- Non-ferrous metals do not rust or oxidise as quickly as ferrous metals (1), so less surface finishing is needed (1)

Q8.

An effect (1) and a linked impact (1). For example:

- Steel is made from a range of commodities (1), so the cost depends on the amount of each one in the steel (1)
- Rising commodity prices or demand increase the cost of steel (1), giving lower profit margins or a higher retail price (1)
- Retail prices may need to rise (1), reducing the potential market for the cutlery (1)
- The quality and performance of the cutlery (1) depend on the grade or hardness of the steel chosen (1)
- Where the steel and its raw materials come from (1) affects the transport costs (1)

Q9.

Two working properties (1 mark each), each with a linked justification (1 mark each):

- Brass has some elasticity or is malleable (1), so it can be bent or flexed to make the open shape of the lamp (1)
- Brass has good hardness (1), so the surface of the lamp body will not be damaged or scratched over time (1)
- Brass has good compressive strength (1), so the small top part will not distort under pressure from the two sides (1)

Q10.

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

- It does not react with water or salt, and resists corrosion and oxidation (1), so it can be cleaned, is hygienic in use and will not tarnish (1)
- It has a self-healing outer layer (1), so the holder does not need an extra surface finish (1)
- Stainless steel is hard (1), so it will stand up to use and abuse (1)

Q11.

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

- Aluminium has a low density (1), so it is light and safe for children to use and turn the number wheels (1)
- It is non-toxic (1), so children are safe if they put it in their mouths (1)
- It is ductile (1), so it can be made into large round bars or billets (1)
- It has good fluidity (1), so it can be cast into a round shape (1)
- It is tough (1), so it can withstand knocks or being dropped without damage (1)
- It finishes well (1), giving a smooth surface that can be painted, plated or anodised to improve its life span (1)

Q12.

Two reasons (1 mark each), each with a linked justification (1 mark each). Do not credit "cheap", "lightweight" or "durable" on their own. For example:

- Mild steel is stable and rigid when folded (1), so it keeps its shape (1)
- It is available in large sheets (1), so pieces do not need joining to make panels big enough (1)
- It is a plain grey colour and can be finished in many ways (1), so it can be customised in colours to appeal to a wider audience and increase sales (1)
- It is relatively cheap and cost effective (1), keeping the overall cost of the product down (1)
- It is easily machined, formed and malleable (1), so the dividers can be cut accurately and bent to the correct angle (1)
- It is readily available (1), so it can be bought in large volumes for mass production (1)
- It can be joined by a range of permanent methods (1), so the sides and dividers will not come apart in use (1)

Q13a.

6.2 m × £12.50 = £77.50 per frame (1). 750 × £77.50 = £58,125 (1).

Q13b.

£77.50 ÷ 100 × 360 = £279.00 (1).

Q13c.

£77.50 ÷ 3 = £25.83 (1). £77.50 − £25.83 = £51.67 (accept £51.66) (1). Credit any other appropriate method.

Q14. (5 marks)

To reach Band 3, answers must cover both ethical and environmental considerations. Indicative content (not all needed):

Environmental considerations

- Use metal that is recyclable or has been recycled before
- Make sure the metal (iron ore) comes from a sustainable source or a managed mine or quarry
- Use finishes that are natural or non-toxic, and dispose of waste correctly and safely
- Use factories powered by renewable energy such as solar power
- Use lay planning to reduce wasted material when cutting
- Manufacture locally, or process raw materials in the same country, to cut transport costs and pollution; consider the fuel used for transport
- Reduce packaging or make it recyclable
- Make sure the toolbox is needed and well made so it lasts and is not thrown away; use life cycle analysis and a circular economy approach

Ethical considerations

- Respect local cultures and practices
- Protect the health and wellbeing of workers, from miners to machinists
- Fair pay, acceptable hours, breaks and well ventilated, healthy workplaces; contracts that give a regular income
- No child labour or exploitation of workers; fair trade so no producer is disadvantaged
- Ethically sourced raw materials

Band	Marks	Descriptor
3	4 to 5	A coherent answer with detailed, relevant knowledge and understanding of how a designer can ensure the toolbox is produced in an environmental and ethical 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.

Q15. (5 marks)

Answers must analyse more than one suitable metal to get the full 5 marks. Credit answers that explain the difference between ferrous and non-ferrous metals, e.g. mild steel contains iron so it will rust, while aluminium contains no iron so it does not rust.

Mild steel

- Strong and can withstand impact in use
- Can be welded, so frames can be made from it
- Available in lots of different sections, and available locally
- Can be painted to protect it from the weather; can be recycled and reused
- But: it is ferrous so it will rust, especially if the paint is damaged
- But: it is heavy, which is tiring for the rider, so less distance can be cycled

Aluminium

- Strong and impact resistant in use; can be joined by TIG or MIG welding
- Can be cast into shapes for other bike parts such as pedals and brake parts
- Available in lots of different sections
- Not magnetic and contains no iron, so it does not rust
- Lightweight, so it suits racing bike frames; can be recycled and reused
- Can be coloured or anodised to give different finishes
- But: it is hard to get a high quality finish on aluminium welds

- But: it is more expensive than steel, so the purchase price and production costs go up
- But: it is less dense and less durable than steel

Band	Marks	Descriptor
3	4 to 5	A coherent answer with detailed, relevant knowledge and understanding of the characteristics and properties of suitable metals. Relevant examples and a well-developed, logical chain of reasoning, sustained throughout.
2	2 to 3	Some coherence, with partial knowledge and understanding of the characteristics and properties of suitable metals. 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.