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Design & Technology
AQA A-Level

Metal enhancement

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. What is the primary purpose of case hardening?

A To soften the entire metal component

B To create a hard, wear-resistant surface

C To increase electrical conductivity

Q2. What is the key outcome of tempering after hardening a metal?

A Reduced brittleness and improved toughness

B Increased brittleness

C Enhanced magnetic properties

Q3. Which process involves reheating hardened steel to a specific temperature and then cooling it slowly?

A Case hardening

B Tempering

C Quenching

Q4. Case hardening is commonly used for which type of components?

A Electrical wiring

B Decorative metal artwork

C Gear teeth or engine parts

Q5. State two reasons why a low carbon steel component may be case hardened **(2 marks)**

Q6. Name a ferrous metal and give two reasons why hardening has been used to improve its function in a specific product **(4 marks)**

Q7. Steel is sometimes treated in order to improve its working properties. Describe, using annotated sketches, the process of case hardening a one-off product in a school workshop **(6 marks)**

Answers

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

Q5.

- increases the hardness and carbon content of the outer surface of the metal which in turn improves the metal's resistance to wear and corrosion.
- only increases the hardness of the outer surface of the metal, therefore helping to maintain the toughness of the component
- increases the hardness of the outer surface of the metal which in turn improves the metal's resistance to indentation
- is used due to low carbon content which prevents alternative hardening methods from being used.

Q6.

1 mark for a ferrous metal which could be treated by hardening accept: medium and high carbon steel (do not accept low carbon steel unless case hardening is referred to).

1 mark for a relevant product: accept any appropriate product, such as screwdriver blades, chisels, drill bits, saw blades etc.

Two marks for reasons:

- reference to need to keep a sharp edge when working with the product
- resisting wear from abrasion.

Q7.

Sketch with the following notes/annotations

- Tongs / PPE are used for health and safety / to prevent burns
- Mild steel is rapidly heated to cherry red colour / 800 to 900˚C
- Hot steel is dipped into carbon powder
- Allowed to soak/cool to absorb carbon powder
- Process is repeated two or three times
- Steel is reheated to cherry red colour
- Steel is quenched in water to cause rapid cooling (1)