**Design & Technology**

**AQA A-Level** Logo

Description automatically generated with low confidence

**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)