Exercise walk-through

Electrostatics with Conductors ▪ 10.1

eXercise

You must be able to

- explain why the **electric field is zero** inside a conductor in electrostatic equilibrium
- show that excess charge resides on the **outer surface 外表面**
- describe how the field just outside is **perpendicular** to the surface
- explain why a conductor is an **equipotential 等势体**

Method — A conductor in equilibrium

- The field **inside** is zero (free charges would move until it is).
- Any **excess charge** sits on the outer surface.
- Just **outside**, the field is **perpendicular** to the surface.
- The whole conductor is a single **equipotential**.

Method — Surface field

$E = \dfrac{\sigma}{\varepsilon_0}$ just outside. Charge crowds onto sharply curved regions (points), giving the strongest field there — the idea behind a lightning rod.

Practice 2.1 ▪ 1 mark

State the electric field inside a conductor in electrostatic equilibrium.

Solution 2.1

Method: A conductor in equilibrium

Worked steps

zero **B1**.

Practice 2.2 ▪ 1 mark

State where excess charge sits on a solid conductor.

Solution 2.2

Method: A conductor in equilibrium

Worked steps

on its outer surface **B1**.

Practice 2.3 ▪ 1 mark

State the direction of the field just outside a charged conductor's surface.

Solution 2.3

Method: A conductor in equilibrium

Worked steps

perpendicular to the surface **B1**.

Exam-style 3.1 ▪ 1 mark

Inside a conductor in electrostatic equilibrium, the field is

- **A** σ/ε_0
- **B** zero
- **C** at its maximum
- **D** kq/r^2

Solution 3.1

Method: A conductor in equilibrium

A σ/ε_0

B zero ✓

C at its maximum

D kq/r^2

Worked steps

B.

Exam-style 3.2 ▪ 1 mark

A conductor in electrostatic equilibrium is

- **A** an equipotential
- **B** at a varying potential
- **C** an insulator
- **D** charged throughout its volume

Solution 3.2

Method: A conductor in equilibrium

A an equipotential ✓

B at a varying potential

C an insulator

D charged throughout its volume

Worked steps

A.

Exam-style 3.3 ▪ 1 mark

A hollow metal sphere carries a charge $+Q$.
(a) State the field inside the metal.
(b) State where the charge sits.
(c) Explain why the field just outside the surface is perpendicular to it.

Solution 3.3

Method: A conductor in equilibrium

Worked steps

(a) zero **B1**. (b) on the outer surface **B1**. (c) any component along the surface would push the surface charges until it vanished, so at equilibrium only the perpendicular component remains **B1** **B1**.