

2.4 Structure of Metals and Alloys

Name: _____ Class: _____ Date: _____

Total: 12 marks

KEY WORDS alloy 合金 • delocalized 离域 • sea of delocalized electrons 离域电子
• metallic bond 金属键 • lattice 晶格

Objective

Build the skills to answer exam questions on the **structure of metals and alloys**.

You must be able to:

- describe metallic bonding as cations in a **sea of delocalized electrons** 离域电子
- explain metallic properties (conductive, malleable, ductile) from this model
- describe **interstitial** and **substitutional** alloys

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ The electron-sea model

A metal is a lattice of **cations** immersed in a “sea” of **delocalized** valence electrons that move freely throughout the whole solid.

■ Properties from the model

- **Conducts electricity and heat** — the mobile electrons carry charge and energy.
- **Malleable and ductile** — layers of cations slide past one another while the electron sea keeps holding them together, so the metal bends rather than shatters.
- **Lustrous** — the free electrons reflect light.

■ Alloys

An **alloy** 合金 mixes a metal with other elements:

- **Substitutional** — similar-sized atoms replace some of the host atoms (e.g. brass: zinc in copper).
- **Interstitial** — small atoms fit in the **gaps** between the metal atoms (e.g. carbon in iron → steel).

■ Why alloys are often harder

The different-sized atoms disrupt the regular layers, so they no longer slide easily — the alloy is **harder** and stronger than the pure metal.

2 Practice

Now apply the methods above.

2.1 What carries the electric current in a metal? [1]

2.2 Explain why metals are malleable. [2]

2.3 Name the two types of alloy. [2]

3 Exam-style questions

3.1 Metallic bonding is best described as [1]

- | | |
|---|---|
| A | B |
| C | D |
- A** shared pairs of electrons between two atoms
B transfer of electrons to form ions
C cations in a sea of delocalized electrons
D no electron interaction

3.2 Steel is an alloy of iron and a small amount of carbon.

(a) State whether it is interstitial or substitutional, with a reason. [2]

(b) Explain why steel is harder than pure iron. [2]

3.3 Explain why metals conduct electricity in both the solid and molten states, unlike ionic compounds. [2]