



Unit 17 • Metals and Non-metals

Full marks 31

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. free state
2. ores
3. metalloids
4. malleable
5. ductile
6. sonorous
7. basic
8. reactivity series

K • 4

Each carries 0.5 mark.

2 Label the diagram

1. free electron (-)

2. metal ion (+)

K • 1

Each carries 0.5 mark.

3 Multiple choice

- i. b. bromine

K • 1

Bromine (Br) is a non-metal, and the only non-metal that is a liquid at room temperature. Mercury is a liquid too, but it is a metal; iron and copper are metals.

- ii. c. brittle

K • 1

Non-metals such as sulphur and coal break into pieces when hammered: they are brittle. Conducting heat, ductility and malleability are properties of metals.

- iii. d. Pb

K • 1

Pb is lead (from its Latin name, plumbum), a poisonous heavy metal. Iron (Fe), calcium (Ca) and zinc (Zn) are all needed by the body.

- iv. c. Metals contain free electrons.

U • 1

A current is a flow of charge. In a metal, the outer electrons are not tied to any atom; these free electrons drift through the metal when a cell is connected. (Metal atoms tend to lose electrons, not gain them, and their outer shells are far from full.)

- v. a. The ring contains some other, more reactive metal.

A • 1

Gold doesn't react with dilute acids at all. Bubbles of hydrogen mean some reactive metal (such as zinc or iron) is present.

4 Very short answers

- a. MARKING SCHEME

K • 1

✓ Mercury.

- b. MARKING SCHEME

K • 1

✓ Graphite.

- c. MARKING SCHEME

U • 1

✓ Metal conducts heat to the food, while wood or plastic is a bad conductor and keeps the handle cool.



5 Short answers

a. MARKING SCHEME

U • 2

- ✓ Any one difference, e.g. malleability is being beaten into thin sheets; ductility is being drawn into thin wires.
- ✓ Any second difference, e.g. malleability is shown by hammering or rolling, ductility by pulling through small holes; or an example of each (aluminium foil; copper wire).

b. MARKING SCHEME

U • 2

- ✓ In a metal, positive ions are held together by a sea of free electrons (metallic bonds).
- ✓ When it is hammered or pulled, layers of ions slide over one another but the electrons keep holding them, so it changes shape without breaking.

c. MARKING SCHEME

A • 2

- ✓ A child may bite and break the glass, which can cut the mouth.
- ✓ The mercury inside is poisonous: its vapor damages the brain, nerves and kidneys.

d. MARKING SCHEME

A • 2

- ✓ Sour foods contain acids.
- ✓ Acids react with aluminium and iron (reactive metals), spoiling the food and the pot.

6 Long answer

ANSWER

U • 4

1. Metals react with oxygen to form basic oxides: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$.
2. Reactive metals react with dilute acids to form a salt and hydrogen gas: $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$.
(Or: very reactive metals react with water to form an alkali and hydrogen: $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$.)

MARKING SCHEME

- ✓ A first chemical property, e.g. metals react with oxygen to form basic oxides.
- ✓ A correct balanced equation for it, e.g. $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$.
- ✓ A second chemical property, e.g. reactive metals react with dilute acids to give a salt and hydrogen.
- ✓ A correct balanced equation for it, e.g. $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$.

7 Complete and balance

a. MARKING SCHEME

A • 1

- ✓ $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$.

b. MARKING SCHEME

A • 1

- ✓ $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$.

c. MARKING SCHEME

A • 1

- ✓ $\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$.

d. MARKING SCHEME

A • 1

- ✓ $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2$.



8 Think

ANSWER

HA - 2

Sodium $> X > Y$. X is above hydrogen in the series but less reactive than the metals that react with water: zinc or iron, for example. Y is below hydrogen: copper, silver or gold.

MARKING SCHEME

- ✓ Sodium $> X > Y$.
- ✓ A correct example of each, e.g. X zinc or iron, Y copper or gold.

9 Activity: Will the bulb glow? (Activity 17.4)

(not marked)

WHAT STUDENTS SHOULD FIND

The bulb glows with the copper wire, the iron nail and the coin: all metals, so conductors. It doesn't glow with sulphur, coal or wood: insulators. Sulphur and carbon (coal) are non-metals.

See it at Science Playground

Exhibits and plants at the center, Bhaktapur, that go with this unit. Book a class visit at science-playground.com/booking.

- **Which Feels Cooler?** (exhibit): Touch metal and wood side by side: same temperature, but metal carries heat away faster.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	10	10	9	2	31

