



Unit 14 • Classification of Elements

Full marks 30

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. atomic weight
2. atomic number
3. group
4. period
5. alkali metals
6. halogens
7. noble gases
8. Aufbau principle

K • 4

Each carries 0.5 mark.

2 Label the diagram

- | | |
|-------|-------|
| 1. 3s | 5. 2p |
| 2. 4s | 6. 3d |
| 3. 5s | 7. 4p |
| 4. 6s | 8. 4f |

U • 4

Each carries 0.5 mark.

3 Multiple choice

- i. b. transition metals

K • 1

Groups IIIB to IIB (3 to 12) sit between IIA and IIIA: the transition metals, which fill d subshells.

- ii. a. 0

K • 1

Group 0 (also called 18, or VIIIA). VIIA is the halogens.

- iii. a. fluorine

U • 1

They are all halogens. Reactivity of non-metals decreases down a group, and fluorine is at the top: the smallest atom, with the strongest pull on an incoming electron.

- iv. c. VA

A • 1

The outer shell is $2s^2 2p^3$: five valence electrons, and the last electron is in a p subshell, so it is in group VA (15). The element is nitrogen.

- v. a. $\text{Be} < \text{Mg} < \text{Ca}$

A • 1

Be, Mg and Ca go down group IIA, and reactivity of metals increases down a group. In $\text{Na} < \text{Li} < \text{K}$, lithium should come before sodium. In $\text{Mg} < \text{Al} < \text{Si}$, the order is backwards, since reactivity of metals decreases across a period (and silicon is a metalloid). C, O and N are not metals at all.

4 Very short answers

- a. MARKING SCHEME

K • 1

✓ The physical and chemical properties of elements are the periodic functions of their atomic numbers.

- b. MARKING SCHEME

K • 1

✓ 18 groups and 7 periods (both needed).

- c. MARKING SCHEME

A • 1

✓ $1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^1$ (the last electron in 4s, not 3d).



5 Short answers

a. MARKING SCHEME

U • 2

- ✓ Going down a group, each element has one more shell than the one above it.
- ✓ So the valence shell is farther from the nucleus, and the atom is bigger.

b. MARKING SCHEME

U • 2

- ✓ Fluorine (2, 7) has two shells and chlorine (2, 8, 7) three, so the fluorine atom is smaller and its nucleus pulls an incoming electron more strongly.
- ✓ Non-metals react by gaining electrons, so fluorine, which gains one most easily, is more reactive.

c. MARKING SCHEME

U • 2

- ✓ Any one difference, e.g. a group is a vertical column (18 groups); a period is a horizontal row (7 periods).
- ✓ Any second difference, e.g. the elements of a group have the same number of valence electrons; those of a period have the same number of shells.

d. MARKING SCHEME

A • 2

- ✓ i. Atomic size: $\text{Cl} < \text{S} < \text{P} < \text{Si} < \text{Al} < \text{Mg} < \text{Na}$.
- ✓ ii. Electronegativity: $\text{Na} < \text{Mg} < \text{Al} < \text{Si} < \text{P} < \text{S} < \text{Cl}$.

6 Long answer

ANSWER

A • 4

- B is in group 2 (IIA) and period 3: it is magnesium.
- A is in group 1, period 2: lithium, atomic number 3, $1s^2, 2s^1$.
- C, which is in group 17 (VIIA), the halogens (it is iodine): non-metals form acidic oxides.
- D, in group 18 (0), the noble gases: its outermost shell is full ($ns^2 np^6$), so it doesn't need to lose, gain or share electrons.

MARKING SCHEME

- ✓ i. Group 2 (IIA), period 3.
- ✓ ii. $1s^2, 2s^1$ (lithium).
- ✓ iii. C, because it is a non-metal (a halogen, group 17), and non-metals form acidic oxides.
- ✓ iv. D, because it is a noble gas with a full outermost shell.

7 Think

ANSWER

HA • 2

Period 7 is full, so element 119 will start **period 8** and go in **group 1**, under francium: its last electron should go into a new **8s** subshell, giving the configuration ending $8s^1$. It should be an alkali metal, though at that size, with electrons moving close to the speed of light, chemists expect it to be less reactive than cesium. As of 2025, laboratories in Japan, the USA, Russia and China were trying to make it, but none had succeeded. Then come element 120 (group 2), and, chemists predict, a brand-new **g block** after that.

MARKING SCHEME

- ✓ Period 7 is full, so element 119 starts period 8, in group 1 (IA), under francium; its last electron goes into a new 8s subshell ($8s^1$).
- ✓ With one valence electron, it should be an alkali metal.



8 Activity: Across period 3 (Activity 14.7)

(not marked)

WHAT STUDENTS SHOULD FIND

Na 11, $1s^2, 2s^2 2p^6, 3s^1$, 1 valence electron, valency 1, metal; Mg 12, $...3s^2$, 2, 2, metal; Al 13, $...3s^2 3p^1$, 3, 3, metal; Si 14, $...3s^2 3p^2$, 4, 4, metalloid; P 15, $...3s^2 3p^3$, 5, 3, non-metal; S 16, $...3s^2 3p^4$, 6, 2, non-metal; Cl 17, $...3s^2 3p^5$, 7, 1, non-metal; Ar 18, $...3s^2 3p^6$, 8, 0, non-metal (a noble gas). All have three shells. The atomic size decreases from sodium to argon (more protons pull the same shell in); the valency rises from 1 to 4 and falls back to 0.

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.

- **The Giant Periodic Table (exhibit):** Walk along a periodic table 4 meters long: atomic number rises step by step.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	8	11	9	2	30

