

Periodic Trends Worksheet

Quick reference

Effective nuclear charge (Z_{eff}) increases across a period, so electrons are pulled closer.

Shielding and new energy levels increase down a group, so valence electrons are held less tightly.

Ionization energy = energy to remove an electron. **Electronegativity** = pull on shared electrons in a bond.

A Complete the trend table

8 marks

Write increases or decreases. (Questions 1–8, one mark per cell.)

Property	Across a period (left → right)	Down a group
Atomic radius		
First ionization energy		
Electronegativity		
Metallic character		

B Rank the elements

8 marks

9. Atomic radius, smallest → largest: **Na, Mg, Cl**
10. Atomic radius, smallest → largest: **K, Li, Na**
11. First ionization energy, lowest → highest: **P, Na, Al**
12. First ionization energy, lowest → highest: **Cl, Br, F**
13. Electronegativity, lowest → highest: **O, C, N**
14. Electronegativity, lowest → highest: **Mg, Ba, Ca**
15. Metallic character, least → most: **Na, Si, Al**
16. Ionic radius, smallest → largest: **Na⁺, Al³⁺, Mg²⁺**

C Which is larger? Give a reason

4 marks

17. Cl or Cl⁻
18. Na or Na⁺
19. O²⁻ or F⁻
20. K or Ca

D Explain the trend

3 marks

21. Why does atomic radius decrease from Na to Cl across period 3?

22. Why does first ionization energy decrease down Group 1 (Li → Cs)?

23. Why does each noble gas have the highest first ionization energy in its period?

E Successive ionization energies

3 marks

Element X has these ionization energies (kJ/mol):

IE ₁	IE ₂	IE ₃	IE ₄
738	1451	7733	10 543

24. How many valence electrons does element X have?

25. Which group is X in? If X is in period 3, name it.

26. Explain the large jump between IE₂ and IE₃.

F Challenge: the exceptions

2 marks

27. Aluminum is to the right of magnesium, yet its first ionization energy is lower (578 vs 738 kJ/mol). Explain.

28. Oxygen's first ionization energy is lower than nitrogen's (1314 vs 1402 kJ/mol). Explain.

G Trends and reactivity

2 marks

29. Which is more reactive, sodium or potassium? Use a trend to justify.

30. Which is more reactive, fluorine or chlorine? Use a trend to justify.

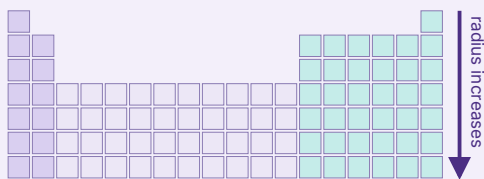
Periodic Trends Worksheet

ANSWER KEY

Name: _____

Date: _____ Score: ____ / 30

IE, electronegativity increase →



Quick reference

Effective nuclear charge (Z_{eff}) increases across a period, so electrons are pulled closer.

Shielding and new energy levels increase down a group, so valence electrons are held less tightly.

Ionization energy = energy to remove an electron. **Electronegativity** = pull on shared electrons in a bond.

A Complete the trend table

8 marks

Write increases or decreases. (Questions 1–8, one mark per cell.)

Property	Across a period (left → right)	Down a group
Atomic radius	Decreases	Increases
First ionization energy	Increases	Decreases
Electronegativity	Increases	Decreases
Metallic character	Decreases	Increases

B Rank the elements

8 marks

- | | |
|---|---|
| 9. Atomic radius, smallest → largest: Na, Mg, Cl | Cl < Mg < Na |
| 10. Atomic radius, smallest → largest: K, Li, Na | Li < Na < K |
| 11. First ionization energy, lowest → highest: P, Na, Al | Na < Al < P |
| 12. First ionization energy, lowest → highest: Cl, Br, F | Br < Cl < F |
| 13. Electronegativity, lowest → highest: O, C, N | C < N < O |
| 14. Electronegativity, lowest → highest: Mg, Ba, Ca | Ba < Ca < Mg |
| 15. Metallic character, least → most: Na, Si, Al | Si < Al < Na |
| 16. Ionic radius, smallest → largest: Na⁺, Al³⁺, Mg²⁺ | Al³⁺ < Mg²⁺ < Na⁺ |

C Which is larger? Give a reason

4 marks

- | | |
|---------------------------------------|--|
| 17. Cl or Cl ⁻ | Cl⁻: same 17 protons, one extra electron adds repulsion |
| 18. Na or Na ⁺ | Na: Na⁺ has lost its entire third energy level |
| 19. O ²⁻ or F ⁻ | O²⁻: both have 10 electrons, but O has fewer protons (8 vs 9) |
| 20. K or Ca | K: same energy level, but K has one fewer proton (lower effective nuclear charge) |

D Explain the trend

3 marks

21. Why does atomic radius decrease from Na to Cl across period 3?
Each element adds a proton, so effective nuclear charge increases. Electrons go into the same energy level with little extra shielding, so they are pulled closer to the nucleus.
22. Why does first ionization energy decrease down Group 1 (Li → Cs)?
The valence electron is in a higher energy level, farther from the nucleus and shielded by more inner electrons, so it is held less tightly and is easier to remove.
23. Why does each noble gas have the highest first ionization energy in its period?
It has the greatest effective nuclear charge in the period and a full, stable valence shell, so removing an electron takes the most energy.

E Successive ionization energies

3 marks

Element X has these ionization energies (kJ/mol):

IE ₁	IE ₂	IE ₃	IE ₄
738	1451	7733	10 543

24. How many valence electrons does element X have?
2
25. Which group is X in? If X is in period 3, name it.
Group 2; magnesium (Mg)
26. Explain the large jump between IE₂ and IE₃.
The third electron must come from a full inner energy level (n = 2), which is closer to the nucleus and less shielded.

F Challenge: the exceptions

2 marks

27. Aluminum is to the right of magnesium, yet its first ionization energy is lower (578 vs 738 kJ/mol). Explain.
Al loses a 3p electron, which is higher in energy and partly shielded by the 3s electrons, so it is easier to remove.
28. Oxygen's first ionization energy is lower than nitrogen's (1314 vs 1402 kJ/mol). Explain.
O's fourth 2p electron is paired in an orbital; repulsion between the paired electrons makes one easier to remove.

G Trends and reactivity

2 marks

29. Which is more reactive, sodium or potassium? Use a trend to justify.
Potassium: lower first ionization energy, so it loses its valence electron more easily.
30. Which is more reactive, fluorine or chlorine? Use a trend to justify.
Fluorine: smaller atom and higher electronegativity, so it gains an electron more easily.