

Electron Configuration & Orbital Diagrams

Quick reference**Filling order (Aufbau):** 1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p**Pauli:** max 2 electrons per orbital, opposite spins ($\uparrow\downarrow$)**Capacity:** s = 2 · p = 6 · d = 10 electrons**Hund:** fill each orbital in a sublevel singly before pairing**A Full electron configurations**

8 marks

1. Carbon (C) _____
2. Fluorine (F) _____
3. Aluminum (Al) _____
4. Sulfur (S) _____
5. Argon (Ar) _____
6. Potassium (K) _____
7. Iron (Fe) _____
8. Bromine (Br) _____

B Noble-gas shorthand

6 marks

9. Silicon (Si) _____
10. Calcium (Ca) _____
11. Manganese (Mn) _____
12. Zinc (Zn) _____
13. Selenium (Se) _____
14. Strontium (Sr) _____

C Orbital (box) diagrams

4 marks

Fill each box with arrows, then count the unpaired electrons.

15. Nitrogen (N)

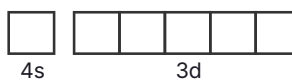
Unpaired electrons: _____

16. Oxygen (O)

Unpaired electrons: _____

17. Phosphorus (P)

Unpaired electrons: _____

18. Iron (Fe) — valence only

Unpaired electrons: _____

D Electron configurations of ions

5 marks

Cations lose electrons from the outermost level; anions gain electrons into the next open orbital.

19. Na^+ _____
20. O^{2-} _____
21. Cl^- _____
22. Ca^{2+} _____
23. Which ions in Q19–22 are isoelectronic with argon?

E Name that element

4 marks

24. $1s^2 2s^2 2p^6 3s^1$ _____
25. $[\text{Ne}] 3s^2 3p^5$ _____
26. $[\text{Ar}] 4s^2 3d^2$ _____
27. $[\text{Kr}] 5s^2 4d^{10} 5p^2$ _____

F Spot the mistake

4 marks

Name the rule each student broke and write the correct version.

28. A student writes sodium as: $1s^2 2s^2 2p^7$

Error & correction:

29. A student writes carbon as: $1s^2 2s^3 2p^1$

Error & correction:

30. A student writes titanium as: $[\text{Ne}] 3s^2 3p^6 3d^2$

Error & correction:

31. A student draws nitrogen's 2p sublevel as:



Error & correction:

G Challenge: the exceptions

2 marks

32. Write the actual configurations of chromium (Cr) and copper (Cu) in noble-gas shorthand.

33. Explain why these two elements break the Aufbau pattern.

Electron Configuration & Orbital Diagrams

Name: _____

Date: _____ Score: ____ / 33

ANSWER KEY

Quick reference

Filling order (Aufbau): 1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p

Pauli: max 2 electrons per orbital, opposite spins ($\uparrow\downarrow$)

Capacity: s = 2 · p = 6 · d = 10 electrons

Hund: fill each orbital in a sublevel singly before pairing

A Full electron configurations

8 marks

- Carbon (C) $1s^2 2s^2 2p^2$
- Fluorine (F) $1s^2 2s^2 2p^5$
- Aluminum (Al) $1s^2 2s^2 2p^6 3s^2 3p^1$
- Sulfur (S) $1s^2 2s^2 2p^6 3s^2 3p^4$
- Argon (Ar) $1s^2 2s^2 2p^6 3s^2 3p^6$
- Potassium (K) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
- Iron (Fe) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$
- Bromine (Br) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

B Noble-gas shorthand

6 marks

- Silicon (Si) $[\text{Ne}] 3s^2 3p^2$
- Calcium (Ca) $[\text{Ar}] 4s^2$
- Manganese (Mn) $[\text{Ar}] 4s^2 3d^5$
- Zinc (Zn) $[\text{Ar}] 4s^2 3d^{10}$
- Selenium (Se) $[\text{Ar}] 4s^2 3d^{10} 4p^4$
- Strontium (Sr) $[\text{Kr}] 5s^2$

C Orbital (box) diagrams

4 marks

Fill each box with arrows, then count the unpaired electrons.

15. Nitrogen (N)



Unpaired electrons: 3

16. Oxygen (O)



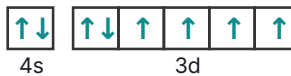
Unpaired electrons: 2

17. Phosphorus (P)



Unpaired electrons: 3

18. Iron (Fe) — valence only



Unpaired electrons: 4

D Electron configurations of ions

5 marks

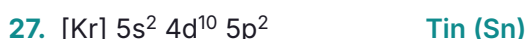
Cations lose electrons from the outermost level; anions gain electrons into the next open orbital.



23. Which ions in Q19–22 are isoelectronic with argon? Cl^- and Ca^{2+} (both 18 electrons)

E Name that element

4 marks



F Spot the mistake

4 marks

Name the rule each student broke and write the correct version.

28. A student writes sodium as: $1s^2 2s^2 2p^7$

A p sublevel holds a maximum of 6 electrons. Correct: $1s^2 2s^2 2p^6 3s^1$

29. A student writes carbon as: $1s^2 2s^3 2p^1$

An s orbital holds only 2 electrons (Pauli exclusion principle). Correct: $1s^2 2s^2 2p^2$

30. A student writes titanium as: $[\text{Ne}] 3s^2 3p^6 3d^2$

4s fills before 3d (Aufbau principle). Correct: $[\text{Ar}] 4s^2 3d^2$

31. A student draws nitrogen's 2p sublevel as:



Hund's rule: electrons occupy empty orbitals singly before pairing. Correct: one ↑ in each of the three 2p boxes.

G Challenge: the exceptions

2 marks



33. One 4s electron moves into 3d because a half-filled (d^5) or completely filled (d^{10}) d sublevel is lower in energy and more stable than the predicted arrangement.