d-Block Configurations: Why Chromium and Copper Break the Rule

The d-block's general configuration is $(n-1)d^{1\text{-}10}\ ns^{1\text{-}2}$, with 4s filling before 3d. Chromium ($3d^5 4s^1$) and copper ($3d^{10} 4s^1$) move one 4s electron into 3d, because 3d and 4s are very close in energy and half-filled and full d sets are extra stable.

Name: Date: Score: ____ / 15

A. Fill in the blanks

1. The general outer configuration of the d-block is $(n-1)d$____ $ns^{1\text{-}2}$.

2. The configuration of Cr is [Ar] $3d$____ $4s^1$.

3. The configuration of Cu is [Ar] $3d^{10}$ $4s$____.

4. Half-filled and completely filled d subshells are extra ____.

B. True or False

5. The 4s orbital fills before 3d. True / False

6. Copper is [Ar] $3d^9\ 4s^2$. True / False

7. 3d and 4s orbitals are very close in energy. True / False

C. Assertion and reason

8. Assertion (A): Chromium is $3d^5\ 4s^1$, not $3d^4\ 4s^2$.
Reason (R): A half-filled d set is extra stable.

(a) Both A and R are true, and R explains A
(b) Both A and R are true, but R does not explain A
(c) A is true, R is false
(d) A is false, R is true
Answer: _____

9. Assertion (A): Copper is $3d^{10}\ 4s^1$.
Reason (R): 4s is always lower in energy than 3d.

(a) Both A and R are true, and R explains A
(b) Both A and R are true, but R does not explain A
(c) A is true, R is false
(d) A is false, R is true
Answer: _____

D. Choose the correct option

10. The configuration of Cr (Z = 24):

(a) [Ar] $3d^4\ 4s^2$
(b) [Ar] $3d^5\ 4s^1$
(c) [Ar] $3d^6$
(d) [Ar] $3d^3\ 4s^2\ 4p^1$
Answer: _____

11. The configuration of Cu (Z = 29):

(a) [Ar] $3d^9\ 4s^2$
(b) [Ar] $3d^{10}\ 4s^1$
(c) [Ar] $3d^{10}$
(d) [Ar] $3d^8\ 4s^2\ 4p^1$
Answer: _____

12. Mn^{2+} is:

(a) [Ar] $3d^5$ (b) [Ar] $3d^3\ 4s^2$

(c) [Ar] $3d^4\ 4s^1$ (d) [Ar] $3d^6$

Answer: _____

E. Numerical problems

13. How many unpaired electrons does Cr ($3d^5\ 4s^1$) have?

F. Short answer questions

14. Why is copper $3d^{10}\ 4s^1$ and not $3d^9\ 4s^2$?

G. Match the columns

15. Match each item in Column A with the correct item in Column B.

Column A	Column B	Your answer
1. Cr	(a) $3d^5\ 4s^1$	1 → ____
2. Cu	(b) $3d^5\ 4s^2$	2 → ____
3. Zn	(c) $3d^{10}\ 4s^2$	3 → ____
4. Mn	(d) $3d^{10}\ 4s^1$	4 → ____

Detailed solutions

1. $^{1\text{-}10}$

2. ^{5}

3. ^{1}

4. stable

5. True. 4s is filled first in the neutral atoms of the 3d series.

6. False. It is [Ar] $3d^{10}$ $4s^{1}$.

7. True. That is why stability decides Cr and Cu.

8. (a) R explains A.

9. (c) A true; R false: 3d and 4s are very close in energy.

10. (b) [Ar] $3d^{5}$ $4s^{1}$. Half-filled d.

11. (b) [Ar] $3d^{10}$ $4s^{1}$. Full d.

12. (a) [Ar] $3d^{5}$. Both 4s electrons leave.

13. five in 3d, one in 4s. **Answer: 6**

14. 3d and 4s are very close in energy and a completely filled d^{10} set is extra stable, so one 4s electron moves to 3d.

15. 1 → (a), 2 → (d), 3 → (c), 4 → (b). Each element matches its configuration.