Class:- 8 (Foundation Plus)

7. Rules and Principles

Teaching Task

JEE Main level

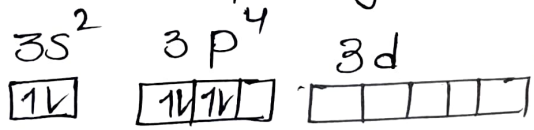
Q1) Ans:- B.

Solution:- $Cr = 24 = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

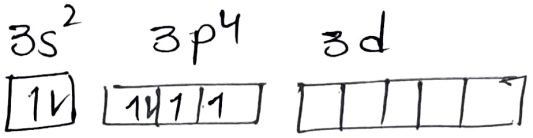
Ground State Electronic Configuration.

Q2) Ans:- C

Solution:- Hund's rule states that electrons within a subshell should occupy each available orbital singly before pairing up.



→ Incorrect



→ Correct

Q3) Ans:- B.

Solution:- A) $Cr^{3+} = 24-3 = 21e^-$, $Fe^{3+} = 26-3 = 23e^-$

B) $Fe^{3+} = 26-3 = 23e^-$, $Mn^{2+} = 25-2 = 23e^-$

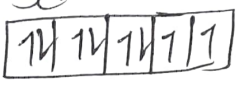
C) $Fe^{3+} = 26-3 = 23e^-$, $Co^{3+} = 27-3 = 24e^-$

D) $Se^{3+} = 34-3 = 31e^-$, $Cr^{3+} = 24-3 = 21e^-$

Q4) Ans:- B

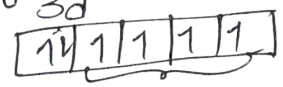
Solution:-

A) $Zn^{2+} = 30-2 = 28e^- \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^8$



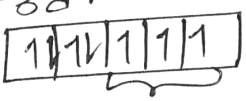
Unpaired electrons = 2.

B) $Fe^{2+} = 26-2 = 24e^- \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$



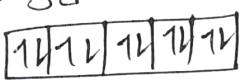
Unpaired electrons = 4.

C) $Ni^{3+} = 28-3 = 25e^- \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^7$



Unpaired electrons = 3

D) $Cu^{+} = 29-1 = 28e^- \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$



Unpaired electrons = 0.

Q5) Ans:- D

Solution:- $Cu\ (Z=29) = [Ar]\ 4s^1 3d^{10}$.

$Cu^{+2} = [Ar]\ 3d^9$.

Q6) Ans:- A, B.

Solution:- $Cr\ [Z=24] \rightarrow [Ar]\ 4s^1 3d^5$ ✓

→ Magnetic Quantum numbers may range from $-l$ to $+l$.

→ Silver $[Z=47] \longrightarrow$ 24 electron have one spin &
23 electrons have opposite spins

Q7) Ans:- B

Solution:- In Mn, 5 electrons are arranged in 3d according to hund's rule.

(Q8) Ans:- A

Solution:-

A) $Na^+ \rightarrow 1s^2 2s^2 2p^6$

Ultimate electrons = $8e^-$, Penultimate electrons = $2e^-$

B) $K^+ \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6$

Ultimate electrons = 8, Penultimate electrons = $8e^-$

C) $Cl^- \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6$

Ultimate electrons = 8, Penultimate electrons = $8e^-$

D) $Ca^{2+} \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6$

Ultimate electrons = 8, Penultimate electrons = $8e^-$.

(Q9) Ans:- C

Solution:- According to paulis exclusion principle, no two identical fermions may occupy the same quantum state simultaneously. If this principle is not known, three electrons of lithium atom can occupy the same 1s orbital giving configuration $1s^3$.

(Q10) Ans:- C.

Solution:- Chromium has atomic number 24.

Actual Electronic Configuration:- $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$.

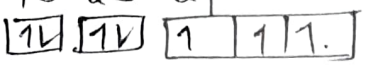
According to Afbau: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$.

Discripency is because of extra stability of half filled (d^5) orbitals.

JEE Advanced Level

Q11) Ans:- A.

Solution:- Nitrogen ($N=7$) $\rightarrow 1s^2\ 2s^2\ 2p^3$



Q12) Ans:- A, B, C, D.

Solution:-

A. $Cr[Z=24] \rightarrow [Ar]\ 3d^5\ 4s^1$.

B) Magnetic quantum number may be +ve, -ve & zero.

c) Silver ($Z=47$) $\rightarrow$ 24 e^- one spin

23 e^- opposite spin.

D) NH_3

Oxidation Number $\rightarrow$ $N + 3(1) = 0$

$N = -3$.

Q13) Ans:- A

Solution:- Electronic configuration $\rightarrow n\ell^x$ method.

n = principal quantum number.

ℓ = Subshell, x = no. of electrons.

Q14) Ans:- A

Solution:- $Cr[Z=24] \rightarrow [Ar]\ 4s^1\ 3d^5$

Half filled orbitals have enhanced stability due to

→ Symmetrical distribution of electrons

→ Exchange energy, which is maximized when spins are parallel.

Q15) Ans:- A.

Solution:- German word Afbau means buildingup.

Q16) Ans:- A.

Solution:- Next level after $3p^6$ is $4s^2$

Q17) Ans:- B.

Solution:- $Cr[Z=24] \rightarrow [Ar]4s^1 3d^5$

Integer Type

Q18) Ans:- 2.

Solution:- Any p-orbital can accommodate upto 2 electron with opposite spins.

Matrix Matching

Q19) Ans:- a) 3 b) 1 c) 2 d) 4.

Solution:-

a) d-Subleval Contain 3) 10 electrons.

b) No two electrons in 1) Paulis.
atom can have all
4 four quantum numbers are same.

c) f-Sub shell contain 2) 14 electrons

D) P-Sub shell Contain 4) 6 electrons.

Learner's Task

Q1) Ans:- D.

Solution:- Chromium ($Z=24$) → $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^1\,3d^5$

$1s^2$	$2s^2$	$2p^6$	$3s^2$	$3p^6$	$4s^1$	$3d^5$
↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑↓	↑	↑ ↑ ↑ ↑ ↑

15 orbitals are used for filling electrons.

Q2) Ans:- A

Solution:- Among the given set of orbitals 4p orbital is the nearest to the nucleus. Since 'p' orbital is more penetrating than 'd' orbital, it is more tightly bound by the nucleus.

Q3) Ans:- D.

Solution:- $Cr(Z=24) = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^1\,3d^5$

$4s^1$	$3d^5$
↑	↑ ↑ ↑ ↑ ↑

Unpaired electrons = 6.

Q4) Ans:- D.

Solution:- $Sc(Z=21) = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^1$.

Electron enters in to d-subshell.

Q5) Ans:- B.

Solution:- $4s < 3d$.

For 4s, $n+l = 4+0 = 4$.

For 3d, $n+l = 3+2 = 5$ $\quad 4s < 3d$

Q6) Ans:- c.

Solution:- Fe [Z=26] → $[Ar]3d^6 4s^2$

Fe^{2+} → $[Ar]\ 3d^6$.

Fe^{3+} → $[Ar]\ 3d^5$

Fe^{3+} is stable because of half filled configuration, its symmetry and exchange energy.

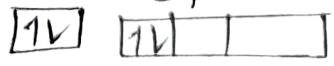
Q7) Ans:- c.

Solution:- The electronic configuration of nitrogen $1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$, is in accordance with Hund's rule.

→ Hund's rule state that electron pair up in subshells only after each orbital in the subshell has one electron.

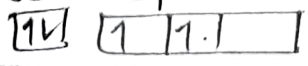
Q8) Ans:- c

Solution:- Silicon (Z=14) → [Ne] $3s^2$ $3p^2$



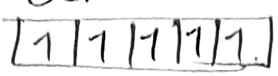
It is violating Hund's rule.

Correct → $[Ne]3s^2\ 3p^2$



Q9) Ans:- A

Solution:- Fe^{3+} → $[Ar]\ 3d^5$



Total unpaired electron = 5.

Q10) Ans:- B.

Solution:- Sodium(Na)[Z=11] = $1s^2 2s^2 2p^6 3s^1$

= $[Ne]3s^1$.

JEE Main Level Questions

Q1) Ans:- A, B.

Solution:- Cr (Z=24) → $[Ar]3d^5 4s^1$.

Cu (Z=29) → $[Ar]3d^{10} 4s^1$

Pd (Z=46) → $[Kr]4d^{10}, 5s^0$.

Pt (Z=78) → $[Xe]4f^{14} 5d^9 6s^1$.

Q2) Ans:- B, C.

Solution:- Given $[Ar]3d^{10} 4s^2 4p^4$ → ns^2np^4 Configuration.

VI A group element.

A) Boron (Z=5) → $1s^2 2s^2 2p^1$ → III A group.

B). Oxygen (Z=8) → $1s^2 2s^2 2p^4$ → VI A group.

C) Sulphur (Z=16) → $1s^2 2s^2 2p^6 3s^2 3p^4$ → VI A group.

D) Aluminium (Z=13) → $1s^2 2s^2 2p^6 3s^2 3p^1$ → III A group.

Q3) Ans:- A

Solution:- After np-orbitals are filled, the next orbital filled will be (n+1)s.

Q4) Ans:- A

Solution:- $Cr(Z=24) \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$

$n + l = 3.$

$n = 3 - 1 \rightarrow 2.$

2nd shell have 8 electrons

Q5) Ans:- B, C, D.

Solution:- A hydrogen atom has only one electron, that experiences no sheilding from other electron, and therefore its energy level only depends on its distance away from the nucleus, which is dependent on its value of (n)

Therefore, the orbitals of a hydrogen atom increase energy as follows:-

$1s < 2s = 2p < 3s = 3p = 3d < 4s = 4p = 4d = 4f < ---$

Q6) Ans:- A

Solution:- The number of sub energy levels in 'n' = n

For $n = 1$, Sub levels = 1

$n = 2$, Sub levels = 2.

Q7) Ans:- C

Solution:- $Th[Z=90] \rightarrow [Rn] 5f^0 6d^2 7s^2$

$\rightarrow [Rn] 7s^2 5f^1 6d^1$

Q8) Ans:- B.

Solution:- $[Z=112] \rightarrow [Rn]\ 5f^{14}\ 6d^{10}\ 7s^2$

Q9) Ans:- C

Solution:- Both the behaviour and arrangement of electrons are critical in determining the chemical properties of an element

Q10) Ans:- A.

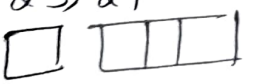
Solution:- The subshell comes after $5p^2$ is $6s^2$

Advanced Level Questions

Q11) Ans:- B, D, A

Solution:-

B) For, $n=2 \rightarrow 2S, 2P.$ $\rightarrow$ 4 orbitals. with 8 electrons.



D). $4S < 3d.$

For $4S \rightarrow n+l = 4+0 = 4.$

$3d \rightarrow 3+2 = 5$

Q12) Ans:- A, B, C.

Solution:- The electronic configuration of an atom depends on Pauli's Exclusion, Hund's Rule, Aufbau's principle.

Q13) Ans:- A.

Solution:- $N[Z=7] \rightarrow 1s^2\ 2s^2\ 2p^3$

According to Hund's rule, each of the three 2p orbitals will be singly occupied with electron having parallel spins.

Q14) Ans:- B.

Solution:-

→ 1s < 2s, is related to the energy levels of orbitals.

→ Paulis exclusion principle state than an orbital can have maximum of $2e^-$ and these must have opposite spins, it does not explain why the 1s < 2s.

Q15) Ans:- A

Solution:- Lanthanum (La) $[Z=57] \rightarrow [Xe]\ 5d^1\ 6s^2$

Q16) Ans:- C

Solution:- The behavior and arrangement of the electron are crucial in determining the chemical properties of an element.

Integer Type

Q17) Ans:- B.

Solution:- $Cr[Z=24] \rightarrow [Ar]\,4s^1 3d^5$

Q18) Ans:- 14.

Solution:- Maximum no. of electrons in 'f' sub energy = 14.

Matrix Matching

Q19) Ans:- A) c B) b c) a D) d

Solution:-

A) Hund's Rule → c) Maximum no. of unpaired with parallel.

B) Lowest value of n is filled up first → B) Minimum energy is filled up first

c) Aufbau principle → a) (n+l) Rule

D) Paulis Exclusion principle → d) 2 e^- with opposite spins.

7. RULES AND PRINCIPLES

KEY

TEACHING TASK

JEE MAINS LEVEL QUESTIONS

1	2	3	4	5	6	7	8	9	10
B	C	B	B	D	A,B	B	A	C	C

JEE ADVANCED LEVEL QUESTIONS

11	12	13	14	15	16	17	18	19
A	A,B,C,D	A	A	A	A	B	2	a-3,b-1,c-2,d-4

LEARNERS TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)

1	2	3	4	5	6	7	8	9	10
D	A	D	D	B	C	C	C	A	B

JEE MAINS LEVEL QUESTIONS

1	2	3	4	5	6	7	8	9	10
A,B	B,C	A	A	B,C,D	A	C	B	C	A

JEE ADVANCED LEVEL QUESTIONS

11	12	13	14	15	16	17	18	19
B,D,A	A,B,C	A	B	A	C	B	14	A-c,B-b,C-a,D-d