

Class:- 8

Rules and Principles

Teaching Task

JEE Main level

Q1) Ans:- B.

Solution:- $\text{Cr} = 24 = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$
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.



Q3) Ans:- B.

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

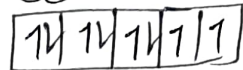
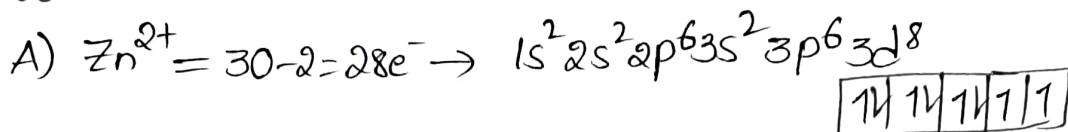
B) $\text{Fe}^{3+} = 26 - 3 = 23e^-$, $\text{Mn}^{2+} = 25 - 2 = 23e^-$

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

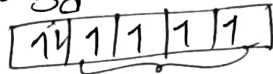
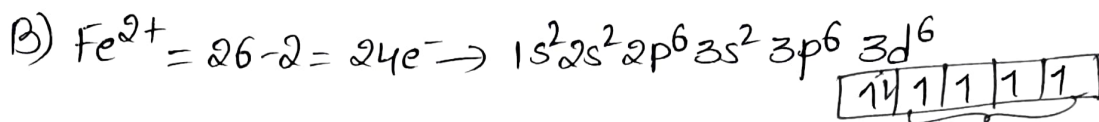
D) $\text{Se}^{3+} = 34 - 3 = 31e^-$, $\text{Cr}^{3+} = 24 - 3 = 21e^-$

Q4) Ans:- B

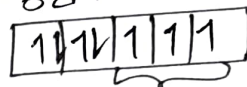
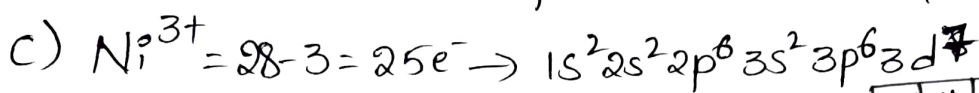
Solution:-



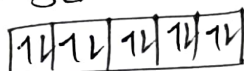
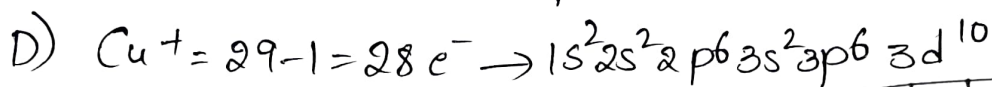
Unpaired electrons = 2.



Unpaired electrons = 4.

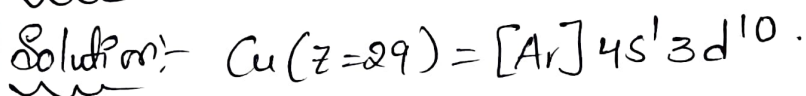


Unpaired electrons = 3

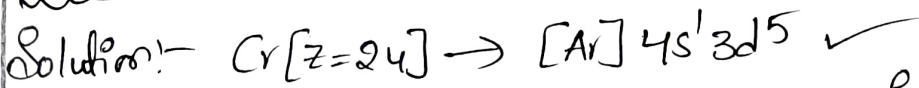


unpaired electrons = 0.

Q5) Ans:- D



Q6) Ans:- A, B.



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

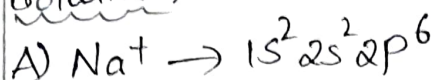
→ Silver $[Z=47] \rightarrow 24$ electrons have one spin &
23 electrons have opposite spins

Q7) Ans:- B

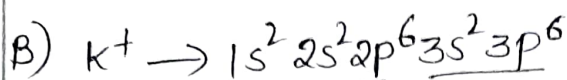
Solution:- In Mn, 5 electrons are arranged in 3d according to Hund's rule.

Q8) Ans:- A

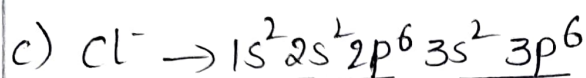
Solution:-



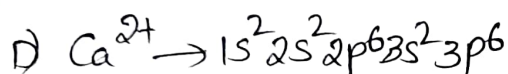
Ultimate electron = $8e^-$, Penultimate electron = $8e^-$



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



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



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

Q9) Ans:- C

Solution:- According to Pauli's 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 Aufbau: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$

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

JEE Advanced Level

Q11) Ans: A.

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

$\uparrow\downarrow$	$\uparrow\downarrow$	$\uparrow$	$\uparrow$	$\uparrow$
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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 or zero.

C) Silver ($Z=47$) $\rightarrow 24e^-$ one spin
 $23e^-$ opposite spin.

D) NH_3

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

Q13) Ans: A

Solution: Electronic configuration $\rightarrow nd^x$ method.

n = principal quantum number

d = 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

$\rightarrow$ Symmetrical distribution of electrons

$\rightarrow$ Exchange energy, which is maximized when spins are parallel.

Q15) Ans:- A

Solution:- German word Aufbau means building up.

Q16) Ans:- A

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

Integer Type

Q17) Ans:- B

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

Q18) Ans:- 2

Solution:- Any p-orbital can accommodate up to 2 electrons with opposite spins.

Matrix Matching

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

Solution:-

a) d-sublevel contains 5 10 electrons.

b) No two electrons in A) Pauli's.

atom can have all

4 four quantum numbers are same.

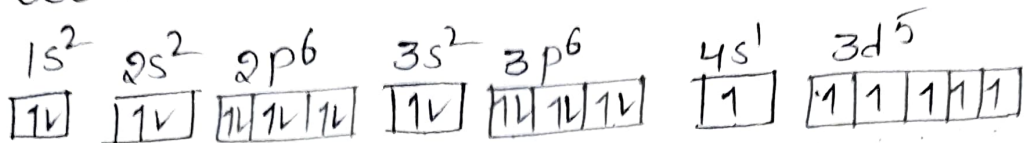
c) f-sub shell contains B) 14 electrons

D) p-sub shell contains D) 6 electrons.

learner's Task

Q1) Ans:- D.

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

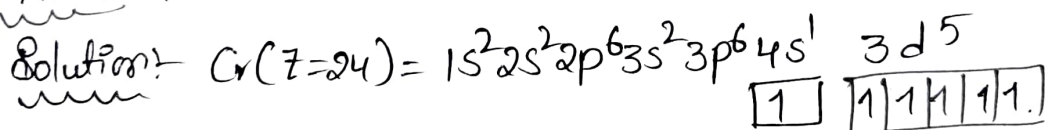


15 orbitals are used for filling electrons.

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.



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 into d-subshell.

Q5) Ans:- B.

Solution:- $4s < 3d$.

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

For 3d, $n+l = 3+2 = 5$

$4s < 3d$

Q6) Ans:- c.

Solution:- $\text{Fe} (Z=26) \rightarrow [\text{Ar}] 3d^6 4s^2$

$\text{Fe}^{2+} \rightarrow [\text{Ar}] 3d^6$

$\text{Fe}^{3+} \rightarrow [\text{Ar}] 3d^5$

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.

$\rightarrow$ Hund's rule states that electron pair up in subshells only after each orbital in the subshell has one electron.

Q8) Ans:- c.

Solution:- Silicon ($Z=14$) $\rightarrow [\text{Ne}] 3s^2 3p^2$

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It is violating Hund's rule.

Correct $\rightarrow [\text{Ne}] 3s^2 3p^2$

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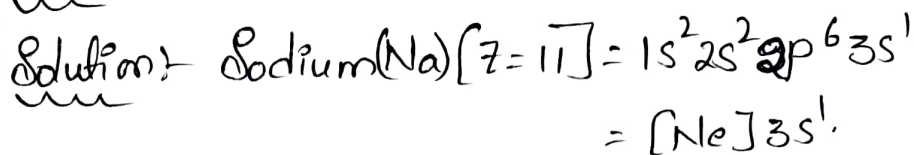
Q9) Ans:- A.

Solution:- $\text{Fe}^{3+} \rightarrow [\text{Ar}] 3d^5$

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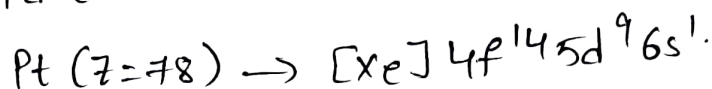
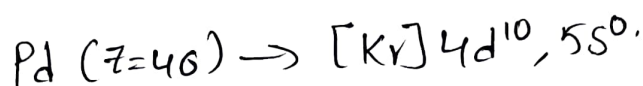
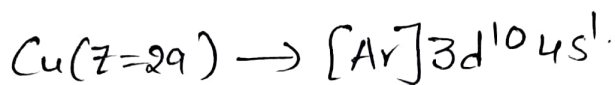
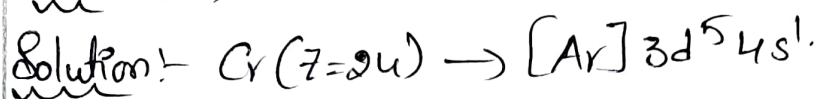
Total unpaired electrons = 5

Q10) Ans:- B.

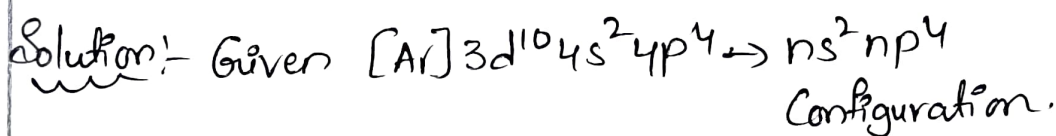


JEE Main level Questions

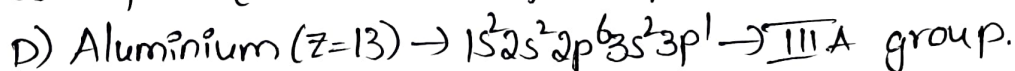
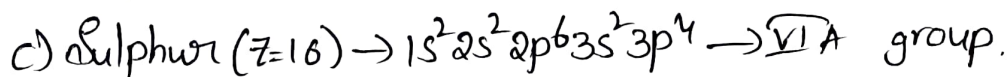
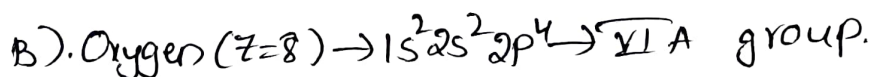
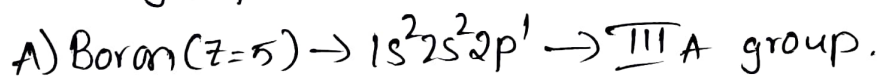
Q1) Ans:- A, B,



Q2) Ans:- B, C.



VIA group element.



Q3) Ans:- A

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

Q4) Ans:- A

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

$$n + l = 3.$$

$$n = 3 - 1 \rightarrow 2.$$

2nd shell have 8 electrons

Q5) Ans:- B, C, D.

Solution:- A hydrogen atom has only one electron, that experiences no shielding 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:-

$$1s < 2s = 2p < 3s = 3p = 3d < 4s = 4p = 4d = 4f < \dots$$

Q6) Ans:- A

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

$$\text{For } n=1, \text{ Sub levels} = 1$$

$$n=2, \text{ Sub levels} = 2.$$

Q7) Ans:- A.

Solution:- $\text{Th}(Z=90) \rightarrow [\text{Rn}] 5f^0 6d^2 7s^2$
 $\rightarrow [\text{Rn}] 7s^2 5f^1 6d^1$

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.

Solution:

B) For $n=2 \rightarrow 2s, 2p. \rightarrow 4$ orbitals with electrons.


D). $4s < 3d$.

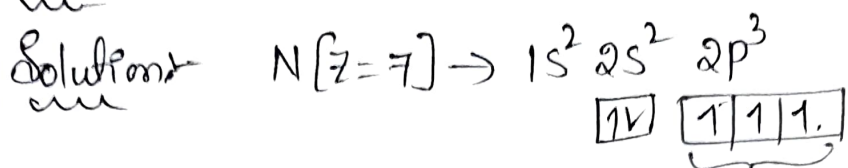
For $4s \rightarrow n+l = 4+0 = 4$.

$3d \rightarrow 3+2 = 5$.

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.



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

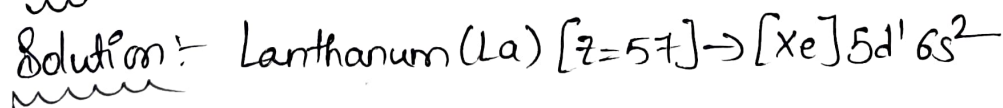
Q14) Ans:- B.

Solution:-

$\rightarrow 1s \times 2s$, is related to the energy levels of orbitals.

$\rightarrow$ Pauli's exclusion principle states that an orbital can have maximum of $2e^-$ and these must have opposite spins, it does not explain why the $1s \times 2s$.

Q15) Ans:- A.



Q16) Ans:- C.

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

Integer Type:

Q17) Ans:- B.

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

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 $\rightarrow$ C) Maximum no. of unpaired with parallel.

B) Lowest value of n is filled up first $\rightarrow$ B) Minimum energy is filled up first

C) Aufbau principle $\rightarrow$ a) $(n+l)$ Rule.

D) Pauli's Exclusion $\rightarrow$ d) $2e^-$ with opposite spins. principle.