

Rules and Principles.

TEACHING TASK.

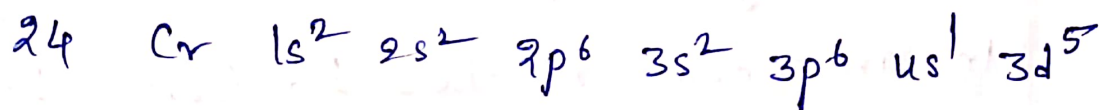
JEE MAIN LEVEL QUESTIONS

1. A.

According to Aufbau principle electrons fill starting from the lowest energy level to the highest.

2. b.

Chromium deviates from the expected Aufbau principle due to half filled and fully filled subshells.



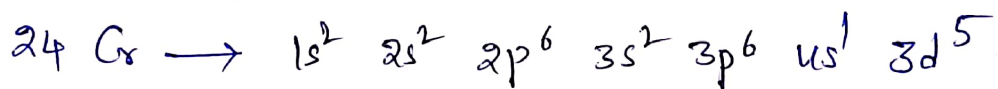
3. c.

Chromium electronic configuration is different from actual observed electronic configuration.



4. C.

Aufbau principle fails to explain the configuration of element with atomic number 24. i.e. Chromium.



5. a.

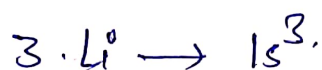
According to Pauli's Exclusion principle in an atom no two electrons having all four quantum numbers are same. They differ at least in their spin.

6. b.

Pauli's Exclusion principle limits number of electrons in a orbital. i.e maximum two electrons in a orbital with opposite spin.

7. C.

If Pauli's Exclusion principle not known the electronic configuration of lithium is



Pauli's Exclusion principle limits no. of electrons in a orbital.

8. C.

Hund's rule Explains the stability of atom with half filled or full filled orbitals.

9. C.

According to Hund's rule, when filling degenerate orbitals electrons will occupy ^{first} orbitals singly with the same spin.

10. B.

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$ is the ground state electronic configuration of Chromium.

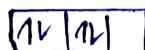
11. C.

The ground state electronic configuration

3s



3p

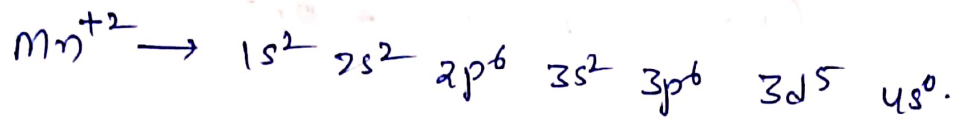
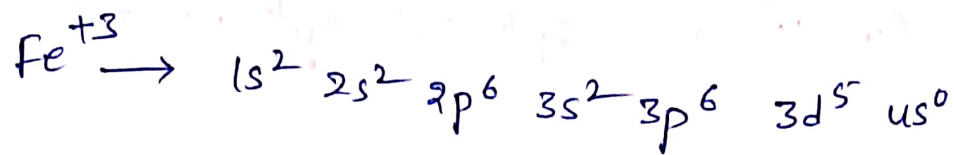


3d



is not correct because according to Hund's rule pairing of electrons will take place in all available degenerate orbitals after filling one ⁽⁴⁾ electron each.

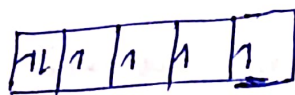
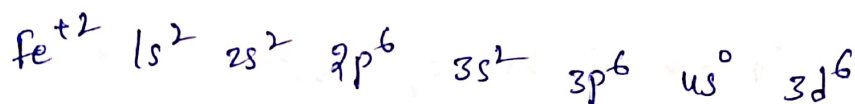
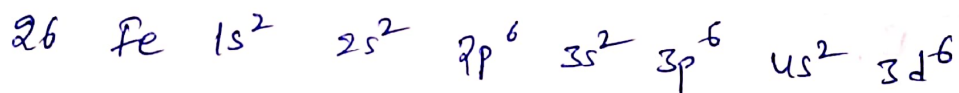
12. B.



So Fe^{+3} and Mn^{+2} have same electronic configuration.

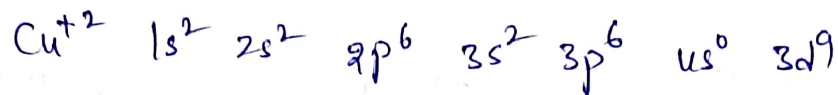
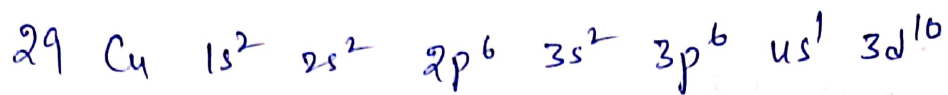
13. B.

Fe^{+2} has maximum number of unpaired electrons



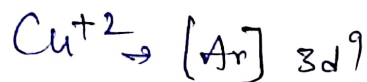
4 unpaired electrons.

14. D.



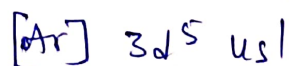
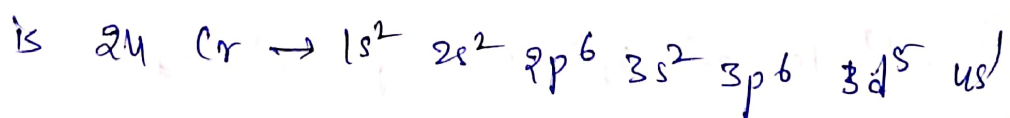
So

Electronic configuration of.



15. A, B.

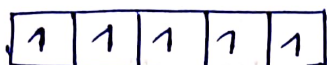
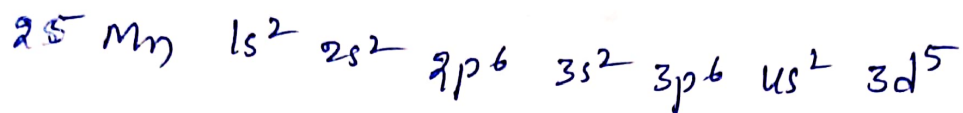
The electronic configuration of Chromium



- magnetic quantum number may have positive, negative and zero values.

16. B.

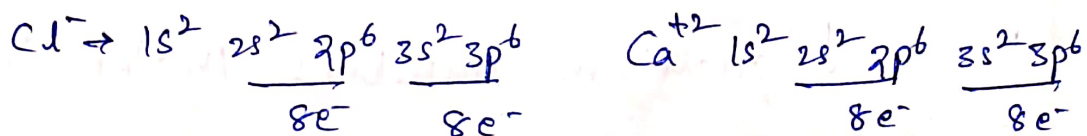
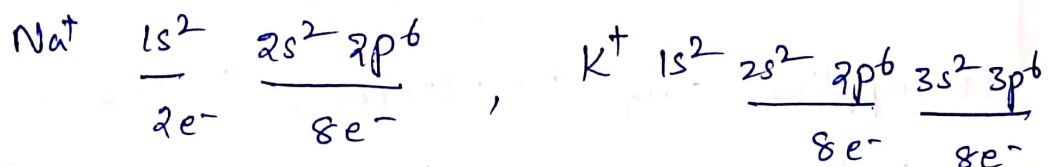
Electronic configuration of manganese.



manganese have 5 unpaired electrons according to ~~the~~ Hund's rule pairing of electrons in all available degenerate orbitals will be takes place after filling one electron each.

17. A.

Na^+ has 8 electrons in Ultimate shell and 2 electrons in penultimate shell.



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JEE ADVANCED LEVEL QUESTIONS.MULTI CORRECT ANSWERS

1. A, C.

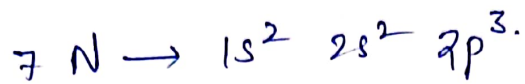
Aufbau principle states that electrons fill atomic orbitals from lowest to highest energy levels. And it provides a framework for understanding the arrangement of electron in an atom.

2. A, B, D.

Pauli's exclusion principle states that no two electrons in an atom can have the same set of four quantum numbers and it applies only to the electron in the same orbital and it prohibits electrons having identical quantum numbers in the same orbital.

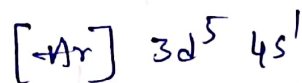
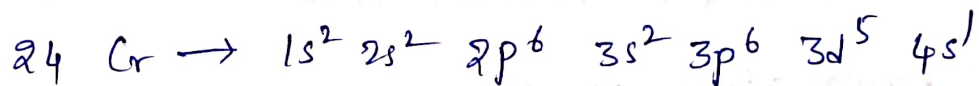
3. A.

The ground state electronic configuration of nitrogen is



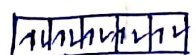
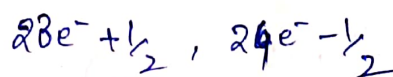
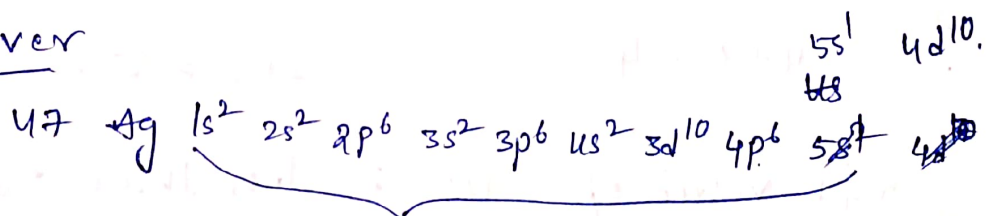
4. A, B, C.

• The electronic configuration of Chromium is



- Magnetic quantum number may be negative or positive or zero.

silver



REASON AND ASSERTION.

5. A.

Both A and R correct and R is correct explanation of A.

The Aufbau principle states that electrons occupy the lowest energy orbital available

This principle based on the idea that electrons are attracted to the positively charged nucleus and therefore the lowest energy orbital.

6. A.

Both A & R correct and R is correct explanation of A.

4s orbital filled before 3d orbital

their $n+l$ values are.

4s.

$$n=4, l=0$$

$$4+0=4$$

3d

$$n=3, l=2$$

$$3+2=5$$

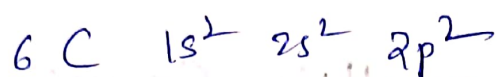
$n+l$ value of 4s is less than 3d so

4s fills first.

7. A.

Both Assertion and Reason correct and R is correct explanation of A.

Electroni Configuration of Carbon is



the energy order of $1s$, $2s$, $2p$ is

$$1s < 2s < 2p.$$

8. A.

Both correct and correct Explanation

according to hunds rule pairing of

electrons in all available degenerate

orbitals will be takesplace after filling

one electron each.

9. A.

Both Assertion and Reason correct and Reason is correct explanation of Assertion.

According to the Pauli's Exclusion principle no two electrons in an atom have all four quantum numbers are same. otherwise the electrons repels to each other and atom becomes unstable.

10. A.

Pauli's exclusion principle allows for the existence of multiple electrons in same orbital and explains why electrons in an atom have different spin

As the electrons in same spin in an orbital repels to each other.

11. A.

Assertion and reason both correct and reason is correct explanation of assertion.

It explains existance of multiple electrons in same orbital. Pauli's exclusion principle also prevent two electrons in an atom having same set of quantum numbers.

12. A.

Both A and R correct and R is correct explanation of A.

Hunds rule states that electrons occupy degenerate orbitals singly before pairing.

electrons repel each other due to their negative charge.

13. Both Assertion and reason are false.

Hunds rule is not consequence of the

Pauli's Exclusion principle.

Hunds rule follows from this principle. The number of unpaired electrons with different spins is wrong.

14. Assertion false

Reason true.

Aufbau principle explains why the electron configuration of nitrogen is $1s^2 2s^2 2p^3$.

Hunds rule explain $1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$ electronic configuration of nitrogen.

15. Assertion false

Reason is true.

according to Aufbau principle 3d orbital fill after 4s orbital.

according to Hund's rule 2p sublevel of nitrogen occupy separate orbitals with parallel spins before pairing up.

2p-orbitals are degenerate orbitals.

STATEMENT TYPE

16. A.

Statement I and II correct.

Electronic Configuration of any orbital can be simply represented by notation $n l^x$

n is number of main shell

l is symbol is Subshell

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17. A.

Ground state electronic configuration of

Cr is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

$[Ar] 3d^5 4s^1$

→ A set of half filled orbitals containing 1 electron each with their spin parallel provides extra stability.

COMPREHENSION TYPE

Comprehension - I

18. A.

Aufbau is a German word and its meaning building up.

19. A.

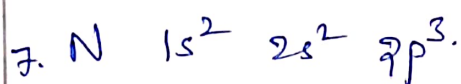
Energy order $1s < 2s < 2p < 3s < 3p < 4s < 3d$

comprehension - II

20. C.

According to Aufbau principle orbitals with lowest energy fills first.

As per this principle the electronic configuration of Nitrogen is



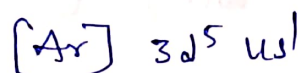
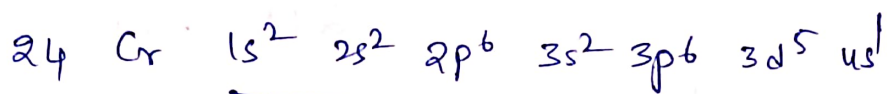
21. D.

Hund's rule maximizes the total spin of unpaired electrons.

INTEGER TYPE

22. B.

The electronic configuration of Chromium is



23. 6 e^- electrons.

Any p-orbitals can accommodate up to 6 electrons.

MATRIX MATCHING TYPE

19. $a \rightarrow C$, $b \rightarrow A$, $c \rightarrow B$, $d \rightarrow D$.

d-Sublevel contains 10 electrons.

No. of electron in a sub level = $2(2l+1)$

for d-subshell $l = 2$

$$2(2(2)+1) = 2(4+1) = 2(5) = \underline{10.e^-}$$

Pauli's exclusion principle :- No two electrons can have all four quantum numbers are same.

f-Subshell No. of $e^- = 2(2(3)+1)$

$$= 2(8+1)$$

$$2(7) = 14$$

p-Subshell No. of $e^- = 2(2(1)+1)$

$$2(2+1)$$

$$2(3)$$

$$= 6$$

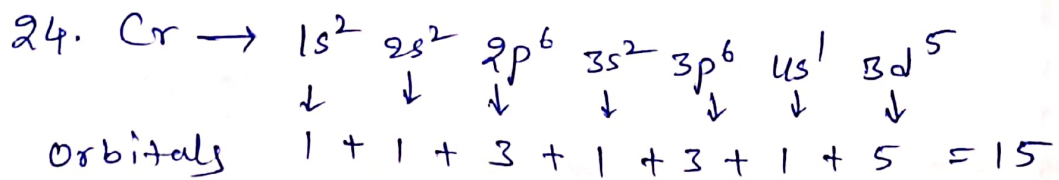
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LEARNERS TASK.

CONCEPTUAL UNDERSTANDING QUESTIONS.

1. D.

In the electronic configuration of Chromium total 15 orbitals are used.



2. A.

Among $4p$, $5s$, $4d$ $5d$ electrons most tightly bounded by nucleus is $4p$.

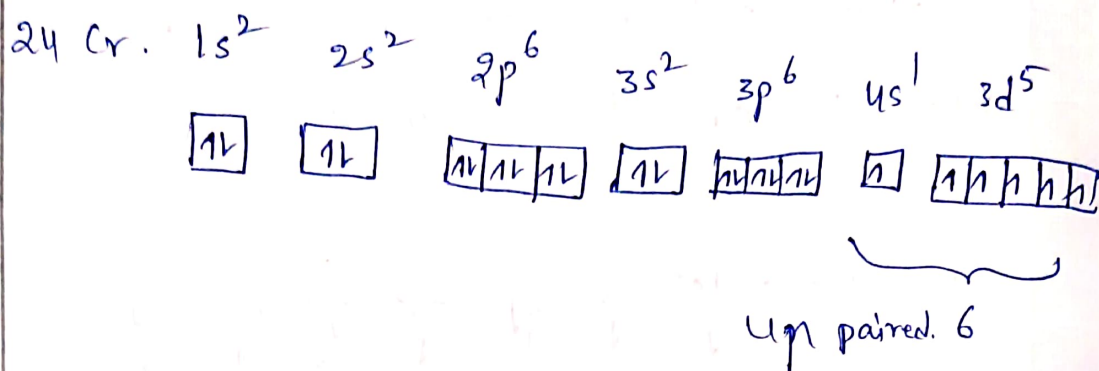
the energy order is

$$4p < 5s < 4d < 5d.$$

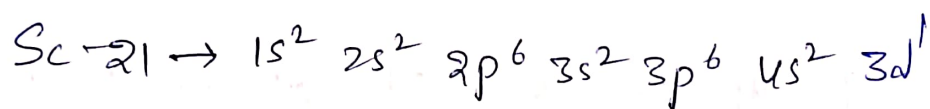
$4p$ is near to the nucleus bounded more tightly.

3. D.

The number of unpaired electrons in Chromium atom are 6.



4. D.



In Scandium the differentiating electron enters into d-orbitals.

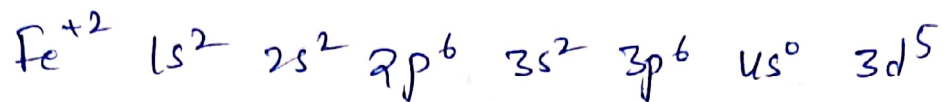
5. B.



Order $4s \rightarrow 3d$ $4s < 3d$.

6. B.C

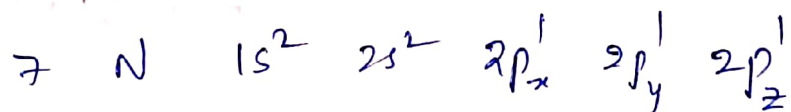
Fe^{+3} ion is most stable among the given ions because half filled 3d orbitals.



1	1	1	1	1
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7. C.

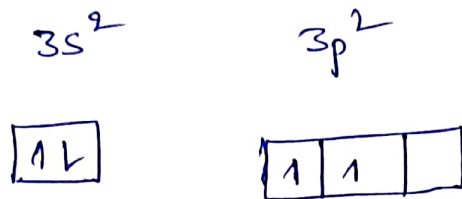
According to Hund's rule the electronic configuration of Nitrogen is



P-orbitals are degenerate so filled one electron each.

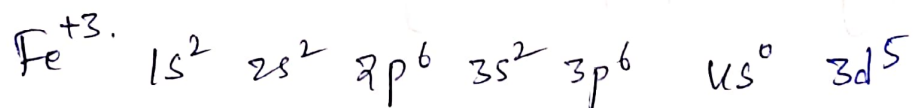
8. c.

The actual electronic configuration of
of Silicon (Valence shell)



It follows Hund's rule.

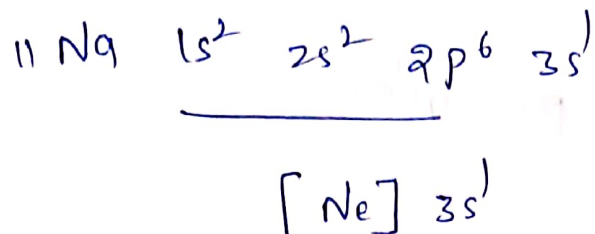
9. A.



There are 5-unpaired electrons in Fe^{+3}

10. B.

The electronic configuration of Sodium is



JEE MAINS LEVEL QUESTIONS

1. a.

Hunds rule governs the filling of degenerate orbitals.

2. b.

3d is higher energy level than 4s.
from $n+l$ values.

$$\begin{array}{l} 3d. \\ 3+2=5 \end{array}$$

$$\begin{array}{l} 4s \\ 4+0=4 \end{array}$$

3. A.

If two electrons have opposite spins
they must be in the same orbital according
to Pauli's Exclusion principle.

4. C.

Two electrons in the same orbital must
have different spins. as per Pauli's Exclusion
principle.

5. C.

It explains [Hund's rule] stability of
half filled and full filled orbitals.

6. D.

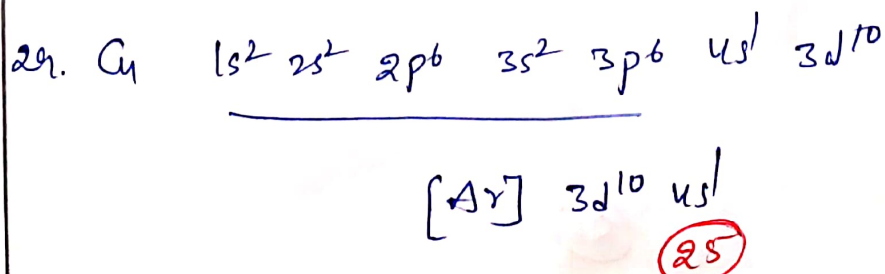
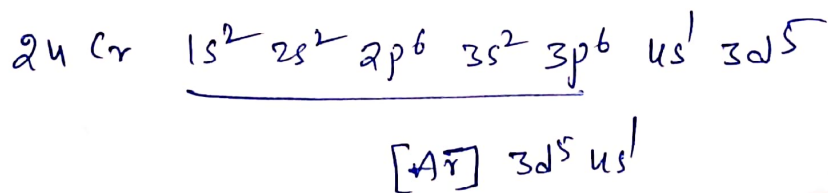
Hund's rule states that electrons must first occupy orbitals with opposite spins.

7. C.

According to Hund's rule when filling degenerate orbitals electrons will occupy separate orbitals with parallel spins to minimize electron-electron repulsion.

8. A, C.

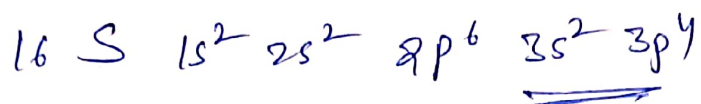
Electronic configurations of Cr and Cu are.



9. c.

The configuration $[\text{Ar}] 3d^{10} 4s^2 4p^4$

is similar to that of Sulphur



Both having 6 valence electrons.

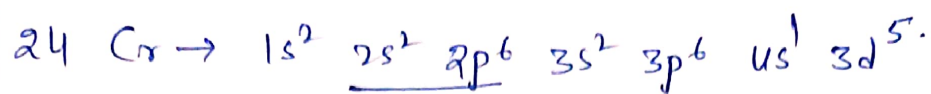
10. a.

After filling np next $(n+1)s$ will
filled.

11. ~~a~~.

11. A.

The electronic configuration of Cr is



$$n+1 = 3$$

$$n = 3 - 1 = 2$$

$$\boxed{n = 2}$$

$n+1 = 3$ means 2nd shell of Chromium.

2nd shell of Chromium contains 8 electrons.

12. A.

For Hydrogen and hydrogen like

Species the orbitals belongs to same

principal energy level having same

energy so,

$$\text{energy of } 3s = 3p = 3d$$

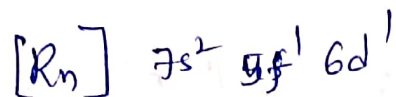
13. A.

Number of Sub energy levels = shell number.

$$\text{i.e. } = n$$

14. C.

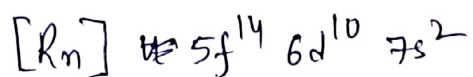
The electronic configuration of Thorium 90.



15. B.

$$Z = 112$$

The electronic configuration is



16. B.

The chemical properties of an element depends on arrangement of electrons.

17. A.

The Subshell comes after $5p^6$ is $6s^2$

JEE ADVANCE LEVEL QUESTIONS

MULTI CORRECT ANSWERS

1. a, b, d.

- Pauli's Exclusion principle applies all to all fermions.
- It prohibits two particles from occupying the same quantum state. It is consequence of wave nature of particles.

2. b, d.

The second principal energy level have 4 orbitals.

$$\text{No. of orbitals} = n^2$$

n = principal energy level.

$$\text{Second energy level } n=2, \quad 2^2 = 4 \text{ orbitals,}$$

$$\text{No. of electrons in a shell} = 2 \times n^2 = 2 \times 2^2 =$$

$$\text{us, } 3d \text{ (} n+1 \text{) value, } = 2 \times 4 = 8 \text{ electrons,}$$

$$4+0=4 \quad 3+2=5.$$

3. A, B, C.

Based on Pauli's Exclusion, Hund's rule
Aufbau's principle of electronic configuration
atoms depends.

REASON - ASSERTION TYPE.

4. B.

Both Assertion and reason correct ~~and~~ but
Reason is not correct Explanation of Assertion

- As per Aufbau principle electrons first fill the orbital which having lowest energy first.
 - This principle helps to predict electronic configuration of elements.
-

5. A.

Electrons occupies the lowest energy levels first because they are attracted to the positively charged nucleus, resulting a stable electronic configurations.

6. B.

The Aufbau principle allows us to predict the electron configuration of an atom.

By following the Aufbau principle, we can determine the order in which atomic orbitals are filled with electrons leading to the electronic configuration of an atom.

7. A.

Both Assertion and reason correct and Reason is correct explanation of Assertion.

Pauli's Exclusion principle applies to all particles with half-integer spin.

- This principle can apply to particles known as fermions.

8. A.

Pauli's Exclusion principle dictates the filling of electrons orbital in atoms.

This principle prevents more than two electrons from occupying the same orbital.

9. A.

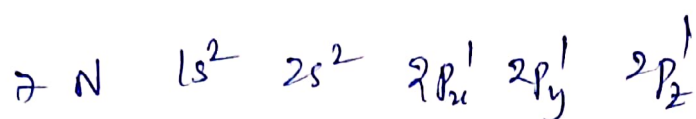
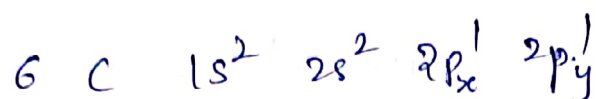
The Pauli's Exclusion principle explains the stability of matter and prevents the collapse of atom. without pauli's Exclusion principle electrons would occupy the lowest energy levels, leading to collapse of atoms, but this principle ensure that electrons occupy different quantum states.

11.

D.

Assertion false and Reason true.

According to Hund's rule the electronic configuration of carbon and nitrogen



Hund's rule states that electrons occupy degenerate orbitals singly before pairing up.

12. D.

Pauli's Exclusion principle applicable for all the fermions. like electron, proton, ~~neutrino~~ neutron regardless of whether they are in atom or not.

12. A.

Hund's rule helps determine the electron configuration of atoms with multiple electron orbitals. because it guides the filling of orbitals by electrons with parallel spins before pairing up, providing systematic approach to determining electron configurations.

13. Both Assertion and Reason are false.

According to Aufbau principle

4s fills before 3d because based on their $n+l$ values.

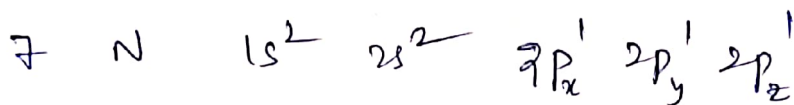
Hund's rule governs only degenerate orbitals.

STATEMENT TYPE

14. A.

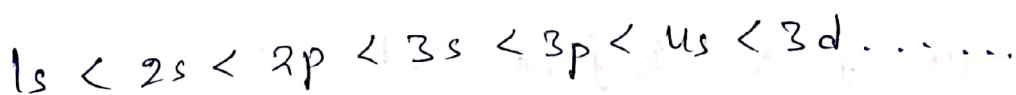
Atomic number of nitrogen is 7.

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



1	1	1
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15. A.



Energy increasing order

Pauli's Exclusion principle states that an orbital can have maximum of two electrons and these must have opposite spins.

COMPREHENSION TYPE

Comprehension - I

16. A.

According to Aufbau principle electron occupy orbitals based on their energy levels with lower energy level fills first.

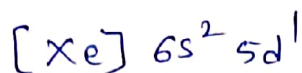
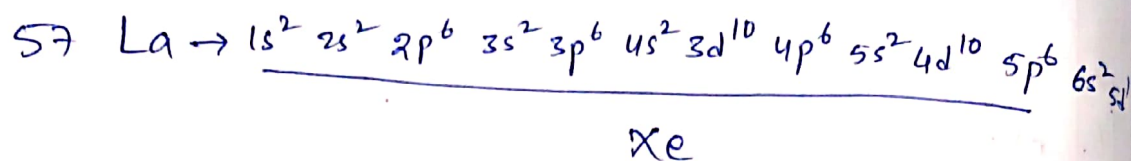
17. B.

Aufbau principle indicates the order in which electrons fill orbitals based on their energy levels.

Comprehension - II

18. A.

The electronic configuration of Lanthanum.



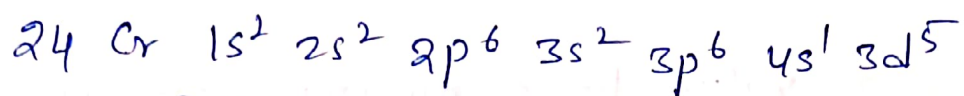
19. B.

The chemical properties of an element depends on relative arrangement of electrons in an atom.

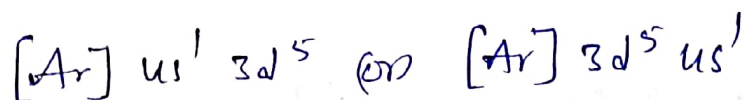
Integer Type

20. B.

The electronic configuration of Chromium is



Ar



21. 14.

The number of electron in any sub energy

$$\text{level} = 2(2l+1)$$

for f-subshell $l = 3$.

$$2(2(3)+1)$$

$$2(6+1)$$

$$2(7) = 14 \text{ electrons,}$$

(39)

MATRIX MATCHING TYPE

22. $A \rightarrow c$, $B \rightarrow a$, $C \rightarrow b$, $D \rightarrow d$.

Hund's rule:- maximum number of unpaired electrons with parallel spin.

- Low n value have minimum energy.

i.e. $n+l$ value.

- Aufbau principle - the orbital having minimum energy fill first.

- Pauli's Exclusion principle $2e^-$ with opposite spin.