Q1. Who discovered the nucleus of the atom?

A) J.J. Thomson
B) John Dalton
C) Ernest Rutherford
D) Niels Bohr

Answer: C) Ernest Rutherford

Explanation:
Rutherford discovered the atomic nucleus through his famous gold foil experiment, showing that most of the atom is empty space with a dense central core.

Q2. The electron was discovered by:

A) Rutherford
B) Bohr
C) Thomson
D) Chadwick

Answer: C) Thomson

Explanation:
J.J. Thomson discovered the electron using the cathode ray tube experiment.

Q3. Which of the following has the same number of electrons, protons, and neutrons?

A) He^{+}
B) H
C) O
D) ^{42}He

Answer: D) ^{42}He

Explanation:
$^{4}_{2}He$ has:

Protons = 2

Neutrons = 2 (4 - 2)

Electrons = 2 (neutral atom)

Q4. Which subatomic particle has no charge?

A) Electron
B) Proton
C) Neutron
D) Positron

Answer: C) Neutron

Explanation:
Neutrons are neutral particles present in the nucleus, having no electric charge.

Q5. What was the major drawback of Rutherford’s atomic model?

A) It didn’t explain the presence of electrons
B) It violated the Heisenberg principle
C) It couldn't explain the stability of atoms
D) It didn’t discover the nucleus

Answer: C) It couldn't explain the stability of atoms

Explanation:
According to classical physics, electrons revolving around the nucleus should lose energy and spiral into the nucleus, making atoms unstable, which contradicts observed stability.

Q6. What is the maximum number of electrons that can be accommodated in the third shell (n = 3)?

A) 8
B) 18
C) 32
D) 2

Answer: B) 18

Explanation:
Maximum electrons = $2n^2 = 2 \times 3^2 = 18$

Q7. The energy of an electron in a hydrogen atom is quantized because:

A) It has zero mass
B) It exists only in specific energy levels
C) It is positively charged
D) Its orbit is elliptical

Answer: B) It exists only in specific energy levels

Explanation:
Bohr proposed that electrons exist in discrete energy levels (quantized orbits), not between them.

Q8. Which of the following quantum numbers defines the shape of an orbital?

A) Principal quantum number (n)
B) Azimuthal quantum number (l)
C) Magnetic quantum number (m)
D) Spin quantum number (s)

Answer: B) Azimuthal quantum number (l)

Explanation:
The azimuthal quantum number l defines the shape of the orbital:

l = 0 (s), 1 (p), 2 (d), 3 (f)

Q9. Which quantum number gives the orientation of orbital in space?

A) n
B) l
C) m
D) s

Answer: C) m

Explanation:
Magnetic quantum number (m) describes the orientation of the orbital in space with respect to magnetic fields.

Q10. What is the value of 'l' for a d-orbital?

A) 0
B) 1
C) 2
D) 3

Answer: C) 2

Explanation:
The value of azimuthal quantum number (l) for:

s = 0

p = 1

d = 2

f = 3

Q11. The maximum number of orbitals associated with the principal quantum number n = 3 is:

A) 3
B) 9
C) 6
D) 18

Answer: B) 9

Explanation:
Number of orbitals in a shell = n^2
For n = 3: $3^2 = 9$ orbitals

Q12. Which quantum number distinguishes the two electrons in the same orbital?

A) Principal quantum number (n)
B) Azimuthal quantum number (l)
C) Magnetic quantum number (m)
D) Spin quantum number (s)

Answer: D) Spin quantum number (s)

Explanation:
The spin quantum number (s) can be +½ or −½.
It differentiates between two electrons in the same orbital (Pauli Exclusion Principle).

Q13.
According to Bohr's theory, what will be the ratio of the velocities of an electron in the first and third orbit of the hydrogen atom?

A. 1 : 3
B. 3 : 1
C. 1 : 9
D. 9 : 1

Answer: B

Explanation:
In Bohr's model, the velocity of an electron in the nth orbit is inversely proportional to n:

$v \propto 1 / n$

So,
$v_1 / v_3 = 1 / 1 \div 1 / 3 = 3 : 1$

Q14. The number of unpaired electrons in the nitrogen atom (atomic number 7) is:

A) 1
B) 2
C) 3
D) 4

Answer: C) 3

Explanation:
Electronic configuration: $1s^2\ 2s^2\ 2p^3$ → 3 unpaired electrons in 2p orbitals (one in each p orbital due to Hund's rule).

Q15. Which of the following sets of quantum numbers is not allowed?

A) n = 2, l = 1, m = 0, s = +½
B) n = 3, l = 2, m = –2, s = –½
C) n = 3, l = 0, m = 1, s = +½
D) n = 4, l = 1, m = –1, s = –½

Answer: C) n = 3, l = 0, m = 1, s = +½

Explanation:
For l = 0, m must be 0.
So, m = 1 is not allowed.

Q16. Which rule states that no two electrons in an atom can have the same set of four quantum numbers?

A) Hund's Rule
B) Aufbau Principle
C) Pauli Exclusion Principle
D) Bohr's Rule

Answer: C) Pauli Exclusion Principle

Explanation:
This principle says each electron in an atom must have a unique set of quantum numbers.

Q17. Which of the following is the correct order of filling orbitals as per the Aufbau principle?

A) 1s → 2s → 2p → 3s → 3p → 3d
B) 1s → 2s → 2p → 3s → 3p → 4s
C) 1s → 2s → 3s → 3p → 3d
D) 1s → 3s → 2s → 2p → 3p

Answer: B) 1s → 2s → 2p → 3s → 3p → 4s

Explanation:
Aufbau principle uses the (n + l) rule for filling orbitals.
Lower (n + l) fills first. If same, lower n fills first.

Q18. How many radial nodes are present in a 3p orbital?

A) 1
B) 0
C) 2
D) 3

Answer: A) 1

Explanation:
Radial nodes = n – l – 1
For 3p: n = 3, l = 1 → 3 – 1 – 1 = 1 radial node

Q19. Which orbital will experience the highest effective nuclear charge in a multi-electron atom?

A) 2s
B) 2p
C) 3s
D) 3p

Answer: A) 2s

Explanation:
The 2s orbital penetrates closer to the nucleus than 2p, 3s, or 3p, so it experiences greater effective nuclear charge.

Q20. In the hydrogen atom, the total number of nodes for 3s orbital is:

A) 2
B) 3
C) 0
D) 1

Answer: A) 2

Explanation:
Total nodes = n – 1
For 3s: n = 3 → 3 – 1 = 2 nodes

Q21. What is the total number of orbitals associated with n = 4?

A) 4
B) 8
C) 16
D) 32

Answer: C) 16
Explanation: Total orbitals = $n^2 = 4^2 = 16$

Q22. What is the shape of the orbital for l = 2?

A) Spherical
B) Dumbbell
C) Double dumbbell
D) Diffused sphere

Answer: C) Double dumbbell
Explanation: l = 2 → d-orbital, which has a cloverleaf (double dumbbell) shape.

Q23. The number of planar nodes in a 4p orbital is:

A) 1
B) 2
C) 3
D) 4

Answer: A) 1
Explanation: Planar (angular) nodes = l = 1 for p-orbital.

Q24. Which orbital is filled after 3p according to the Aufbau principle?

A) 4s

B) 3d
C) 4p
D) 5s

Answer: A) 4s
Explanation: Order: 3p → 4s → 3d → 4p

Q25. Which of the following violates the Aufbau principle?

A) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
B) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$
C) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^2$
D) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3d^1$

Answer: D) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3d^1$
Explanation: 3d can't be filled before 4s.

Q26. Which electron configuration represents a violation of Hund's Rule?

A) $1s^2\ 2s^2\ 2p^4$
B) $1s^2\ 2s^2\ 2p^6$
C) $1s^2\ 2s^2\ 2p^3$
D) $1s^2\ 2s^2\ 2p^2$

Answer: A) $1s^2\ 2s^2\ 2p^4$
Explanation: $2p^4$ must be arranged with maximum unpaired electrons first.

Q27. The quantum numbers for the last electron in potassium (Z = 19) are:

A) n = 3, l = 1, m = 0, s = +½
B) n = 3, l = 2, m = 1, s = –½
C) n = 4, l = 0, m = 0, s = +½
D) n = 4, l = 1, m = 1, s = –½

Answer: C) n = 4, l = 0, m = 0, s = +½
Explanation: Last electron enters $4s^1$ orbital.

Q28. Which element has a half-filled d-subshell in its ground state?

A) Cu (Z = 29)
B) Zn (Z = 30)
C) Cr (Z = 24)
D) Fe (Z = 26)

Answer: C) Cr (Z = 24)
Explanation: Cr = [Ar] $3d^5$ $4s^1$ → half-filled 3d.

Q29. Which set of quantum numbers is possible for a 3d electron?

A) n = 3, l = 1, m = –1
B) n = 3, l = 2, m = 0
C) n = 2, l = 2, m = 1
D) n = 3, l = 3, m = 2

Answer: B) n = 3, l = 2, m = 0
Explanation: 3d → l = 2 → m can be –2 to +2.

Q30. The maximum number of electrons that can have n = 3 and l = 2 is:

A) 6
B) 10
C) 14
D) 2

Answer: B) 10
Explanation: d-subshell = 5 orbitals × 2 = 10 electrons

Q31. Which of the following orbitals has spherical shape?

A) s-orbital
B) p-orbital
C) d-orbital
D) f-orbital

Answer: A) s-orbital
Explanation: Only s-orbitals are spherical.

Q32. The total number of nodal planes in a p-orbital is:

A) 0
B) 1
C) 2
D) 3

Answer: B) 1
Explanation: All p-orbitals have 1 angular node (nodal plane).

Q33. Which of the following orbitals can never exist?

A) 1s
B) 2p
C) 3f
D) 4d

Answer: C) 3f
Explanation: f-orbital (l = 3) needs n ≥ 4.

Q34. Which element has the configuration [Ne] $3s^2$ $3p^3$?

A) Sulphur
B) Phosphorus
C) Chlorine
D) Argon

Answer: B) Phosphorus
Explanation: [Ne] = 10, + $3s^2$ + $3p^3$ = 15 → Z = 15

Q35. Which of the following orbitals will be filled first?

A) 3d
B) 4s
C) 4p
D) 4d

Answer: B) 4s
Explanation: According to (n + l) rule, 4s has lower energy than 3d.

Q36. Which of the following is NOT a postulate of Bohr's atomic model?

A. Electrons revolve around the nucleus in fixed circular orbits
B. Energy is continuously emitted by electrons in an orbit
C. Angular momentum of an electron is quantized
D. Only certain orbits are allowed for the electron

Answer: B

Explanation:
Bohr stated that an electron in a particular orbit does not emit energy continuously. Energy is only emitted or absorbed when the electron jumps between orbits.

Q37. What is the energy of an electron in the first Bohr orbit of a hydrogen atom?

A. -13.6 eV
B. -3.4 eV
C. -1.51 eV
D. 0 eV

Answer: A

Explanation:
Energy in the nth orbit = $-13.6 / n^2$ eV
For n = 1 → Energy = -13.6 eV

Q38. How many radial nodes are present in a 3p orbital?

A. 0
B. 1
C. 2
D. 3

Answer: B

Explanation:
Radial nodes = n - l - 1
For 3p: n = 3, l = 1
→ 3 - 1 - 1 = 1 radial node

Q39. Which quantum number specifies the orientation of an orbital?

A. Principal quantum number (n)
B. Azimuthal quantum number (l)
C. Magnetic quantum number (m)
D. Spin quantum number (s)

Answer: C

Explanation:
Magnetic quantum number (m) indicates the orientation of an orbital in space. For example, p orbitals have m values of -1, 0, and +1.

Q40. What is the maximum number of electrons that can be accommodated in the N shell?

A. 8
B. 18
C. 32
D. 50

Answer: C

Explanation:
Maximum electrons = $2 \times n^2$
For N shell (n = 4): $2 \times 4^2 = 32$ electrons

Q41. What is the de Broglie wavelength of a particle of mass m and velocity v?

A. lambda = mv
B. lambda = h / mv
C. lambda = mv / h
D. lambda = h / eV

Answer: B

Explanation:
According to de Broglie,
lambda = h / (mv),
where h = Planck's constant, m = mass, v = velocity

Q42. Which orbital has the lowest energy in a multi-electron atom?

A. 4s
B. 3d
C. 4p
D. 5s

Answer: A

Explanation:
Use the (n + l) rule:

4s: n + l = 4 + 0 = 4

3d: n + l = 3 + 2 = 5

4p: n + l = 4 + 1 = 5
→ Lower (n + l) = lower energy → 4s orbital

Q43. How many electrons can have n = 3 and l = 2 quantum numbers?

A. 10
B. 14
C. 6
D. 4

Answer: A

Explanation:
l = 2 means d orbital.
Possible m values = -2, -1, 0, +1, +2 → 5 orbitals
Each orbital can hold 2 electrons → 5 × 2 = 10 electrons

Q44. Which of the following quantum number sets is NOT allowed?

A. n = 2, l = 1, m = 0
B. n = 3, l = 0, m = 0
C. n = 3, l = 2, m = 3
D. n = 4, l = 3, m = -2

Answer: C

Explanation:
For l = 2 (d orbital), m can be -2, -1, 0, +1, +2
So m = 3 is not allowed. Hence option C is invalid.

Q45. What is the radius of the second Bohr orbit of the hydrogen atom?

A. 0.529 angstrom
B. 1.06 angstrom
C. 2.12 angstrom
D. 4.24 angstrom

Answer: C

Explanation:
Radius of nth orbit = $0.529 \times n^2$ angstrom
For n = 2: $r = 0.529 \times 4 = 2.116 \approx 2.12$ angstrom