Quantum Numbers – 1 (Solutions)

Atomio structure-14

Not your marks, not your past—you decide your future with your effort and vision. *Use solutions only after attempting yourself!*

Explanation:

— Principal $n = 1, 2, 3, \ldots$ (shell, size, energy) #orbitals in shell $= n^2$, max $e^- = 2n^2$.

— Azimuthal $l = 0, 1, \ldots, n-1$ (subshell/shape): $s(0), p(1), d(2), f(3), g(4), h(5) \ldots$; orbitals in subshell $= 2l + 1$; max $e^- = 4l + 2$.

— Magnetic $m = -l, \ldots, 0, \ldots, +l$ (orientation). Each m is one orbital (max 2 e^-).

— Spin $s = \pm\frac{1}{2}$ (spin up/down). Pauli: no two e^- have all 4 QNs same.

Q1. For $n = 3$, $l = 2$, $m = +2$ how many orbitals are possible? (A)1 (B)2 (C)3 (D)4
Approach: Fixing n, l, m picks a single orbital.
Steps: Only s (spin) can still vary, but that does not create a new orbital.
Answer: (A) 1.
Similar Practice (NEET/JEE-style): How many orbitals for $n = 4, l = 3, m = -1$? **Answer:** 1.

Q2. Number of orbitals when $n = 3$? (A)1 (B)3 (C)4 (D)9
Approach: Shell-n has n^2 orbitals.
Steps: $3^2 = 9$.
Answer: (D) 9.
Similar Practice (NEET/JEE-style): For $n = 5$, orbitals =? **Answer:** 25.

Q3. Non-permissible subshell: (A)2d (B)4f (C)6p (D)3s
Approach: $l \leq n - 1$. For $n = 2$, allowed $l = 0, 1$ only.
Answer: (A) 2d (since $l = 2$ not allowed for $n = 2$).
Similar Practice (NEET/JEE-style): Which is not allowed: 3f or 7g? **Answer:** 3f (since $l = 3$ needs $n \geq 4$); 7g allowed ($l = 4 \leq 6$).

Q4. Number of orbitals in h subshell? (A)11 (B)15 (C)17 (D)19
Approach: h means $l = 5$; orbitals $= 2l + 1$.
Steps: $2(5) + 1 = 11$.
Answer: (A) 11.
Similar Practice (NEET/JEE-style): For g ($l = 4$), orbitals =? **Answer:** 9.

Q5. Correct for a 4d electron:
(A) $n = 4, l = 2, s = +\frac{1}{2}$ (B) $n = 4, l = 2, s = 0$ (C)$n = 4, l = 3, s = 0$ (D)$n = 4, l = 3, s = +\frac{1}{2}$
Approach: 4d $\Rightarrow n = 4, l = 2$; spin must be $\pm\frac{1}{2}$.
Answer: (A).
Similar Practice (NEET/JEE-style): A 5f electron has $(n, l) = (?, ?)$ **Answer:** $(5, 3)$.

Q6. For $n = 3$, allowed l values? (A)0 (B)1 (C)2 (D)All
Approach: $l = 0, 1, 2$ for $n = 3$.

Answer: (D) All of them.
Similar Practice (NEET/JEE-style): For $n = 1$, $l =$? **Answer:** 0 only.

Q7. For $n = 5, m = 2$, which statement is NOT correct?
(A)$l = 4$ (B)$l = 0, 1, 2, 3$; $s = +\frac{1}{2}$ (C)$l = 3$ (D)$l = 4, 3, 2$
Approach: For a given m, $|m| \leq l$ so $l \geq 2$.
Steps: (B) includes $l = 0, 1$ which can't have $m = 2$.
Answer: (B).
Similar Practice (NEET/JEE-style): With $m = 0$, which l are allowed? **Answer:** Any $l \geq 0$.

Q8. Max electrons in a p orbital with $n = 6, m = 0$? (A)14 (B)6 (C)2 (D)10
Approach: One orbital $\Rightarrow$ max 2 electrons (opposite spins).
Answer: (C) 2.
Similar Practice (NEET/JEE-style): Max electrons in the p subshell? **Answer:** 6.

Q9. Total m values available in $n = 4$ shell? (A)4 (B)8 (C)16 (D)32
Approach: Sum over subshells: $l = 0, 1, 2, 3$; orbitals $= 1 + 3 + 5 + 7 = 16$.
Answer: (C) 16.
Similar Practice (NEET/JEE-style): For $n = 2$, total m values? **Answer:** $1 + 3 = 4$.

Q10. How many electrons can have $n = 3, l = 2, m = +2, s = +\frac{1}{2}$?
Approach: That's a fully specified state $\rightarrow$ at most 1 electron.
Answer: (D) 1.
Similar Practice (NEET/JEE-style): How many with $n = 3, l = 2, m = +2$ (any spin)?
Answer: 2.

Q11. ψ_{420} corresponds to: (A)4d (B)3d (C)4p (D)4s
Approach: ψ_{nlm}: $n = 4, l = 2, m = 0 \Rightarrow$ 4d.
Answer: (A).
Similar Practice (NEET/JEE-style): ψ_{310} is? **Answer:** $3p$ ($l = 1, m = 0$).

Q12. Electron in 4d: which value is NOT possible? (A)$n = 4$ (B)$l = 1$ (C)$m = 1$ (D)$m = 2$
Approach: For d, $l = 2$; so $l = 1$ impossible.
Answer: (B).
Similar Practice (NEET/JEE-style): Possible m for $l = 2$? **Answer:** $-2, -1, 0, +1, +2$.

Q13. Atom with K2, L8, M11, N2: number of s electrons?
Approach: Each shell has an s subshell (max 2). Given all four shells have s^2.
Steps: $1s^2, 2s^2, 3s^2, 4s^2 \Rightarrow 8$ electrons.
Answer: (B) 8.
Similar Practice (NEET/JEE-style): In Ne ($1s^2 2s^2 2p^6$), s electrons =? **Answer:** 4.

Q14. If $l = 3$, type & number of orbitals?
Approach: $l = 3 \Rightarrow f$; orbitals $= 2l + 1 = 7$.
Answer: (C) $5f, 7$ (any nf has 7 orbitals).
Similar Practice (NEET/JEE-style): For $l = 2$? **Answer:** d, 5 orbitals.

Q15. $3p_y$ orbital: (n, l, m)?
Approach: $n = 3, l = 1$; p_y is a combo of $m = \pm 1$ (conventionally p_z is $m = 0$).
Answer: (C) Both (A) and (B).
Similar Practice (NEET/JEE-style): $3p_z$ has $m =$? **Answer:** 0.

Q16. Electrons a shell can hold is ...
Approach: Sum over $l = 0..n-1$ of $2(2l+1) = 2n^2$.
Answer: (C)$\sum_{l=0}^{n-1} 2(2l+1)$.
Similar Practice (NEET/JEE-style): For $n = 4$, max e^-? **Answer:** 32.

Q17. Max electrons in a subshell?
Approach: $4l + 2$.
Answer: (B) $4l + 2$.
Similar Practice (NEET/JEE-style): For $l = 3$ (f), max e^-? **Answer:** 14.

Q18. Which arrangement is NOT permissible?
(A)$3, 2, -2, -\frac{1}{2}$ (B)$4, 0, 0, -\frac{1}{2}$ (C)$5, 3, 0, +\frac{1}{2}$ (D)$3, 2$
Approach: (D) lacks m, s — not a full set. Others are valid.
Answer: (D).
Similar Practice (NEET/JEE-style): Is $(n = 2, l = 2, ...)$ ever valid? **Answer:** No ($l \leq n - 1$).

Q19. Number of atomic orbitals in $n = 4$?
Approach: $n^2 = 16$.
Answer: (B) 16.
Similar Practice (NEET/JEE-style): In $n = 1$? **Answer:** 1.

Q20. Max e^- in subshell with $n = 4, l = 3$?
Approach: $l = 3 \Rightarrow f$, max = 14.
Answer: (C) 14.
Similar Practice (NEET/JEE-style): Max e^- in d? **Answer:** 10.

Q21. Max e^- for $n = 3, l = 1, m = -1$?
Approach: One orbital $\Rightarrow$ 2 electrons.
Answer: (A) 2.
Similar Practice (NEET/JEE-style): For fixed (n, l, m) how many e^-? **Answer:** 2.

Q22. Number of orbitals with $n = 3, l = 1, m = 0$?
Answer: (A) 1.
Similar Practice (NEET/JEE-style): With $n = 3, l = 1$ (any m), how many orbitals? **Answer:** 3.

Q23. If $n = 3, l = 2$, max e^-?
Approach: 3d subshell: 10.
Answer: (D) 10.
Similar Practice (NEET/JEE-style): If $n = 3, l = 0$? **Answer:** 2.

Q24. For given l, total m values is ...
Answer: (C) $2l + 1$.
Similar Practice (NEET/JEE-style): For $l = 4$? **Answer:** 9.

Q25. Possible m for a p orbital?
Answer: (B) $-1, 0, +1$.
Similar Practice (NEET/JEE-style): For d? **Answer:** $-2, -1, 0, +1, +2$.

Q26. Notation for $n = 5, l = 3$?
Answer: (C) $5f$.
Similar Practice (NEET/JEE-style): $n = 6, l = 2$? **Answer:** $6d$.

Q27. Shape decided by ...
Answer: (C) Azimuthal l.
Similar Practice (NEET/JEE-style): Size/energy mainly by? **Answer:** n.

Q28. Orientation decided by ...
Answer: (A) Magnetic m.
Similar Practice (NEET/JEE-style): Spin is given by? **Answer:** $s = \pm\frac{1}{2}$.

Q29. QNs for $4s^1$ electron
Answer: (C) $4, 0, 0, +\frac{1}{2}$.
Similar Practice (NEET/JEE-style): For $3p^1$ (first p electron), one valid set? **Answer:** $(3, 1, 0, +\frac{1}{2})$.

Q30. Subshell with $l = 1$ is ...
Answer: (B) p.
Similar Practice (NEET/JEE-style): $l = 0$ is? **Answer:** s.

Q31. For $n = 3$, permitted (l, m)?
Answer: (A) Correct set.
Why this works: $l = 0, 1, 2$; $m = -l \ldots + l$.
Similar Practice (NEET/JEE-style): For $n = 2$? **Answer:** $l = 0$ ($m = 0$) and $l = 1$ ($m = -1, 0, +1$).

Q32. A *d orbital* can accommodate up to ...
Answer: (C) 2 electrons (one orbital).
Why this works: A *d subshell* holds 10, but a single orbital holds 2.
Similar Practice (NEET/JEE-style): An f orbital holds? **Answer:** 2.

Q33. Total electrons in any shell (n): expression?
Answer: (C) $\sum_{l=0}^{n-1} 2(2l + 1) = 2n^2$.
Similar Practice (NEET/JEE-style): For $n = 3$, value? **Answer:** 18.

Q34. Magnetic m relates to ...
Answer: (B) Orientation.
Similar Practice (NEET/JEE-style): Azimuthal l relates to? **Answer:** Shape.

Q35. Max e^- in a subshell is ...
Answer: (B) $4l + 2$.
Similar Practice (NEET/JEE-style): For p ($l = 1$), max? **Answer:** 6.

Q36. In 3rd shell, total orbitals = ...
Answer: (B) $n^2 = 9$.
Similar Practice (NEET/JEE-style): In 2nd shell? **Answer:** 4.

Q37. Possible orientations of a subshell = ...
Answer: (C) $2l + 1$.
Similar Practice (NEET/JEE-style): For f? **Answer:** 7.

Q38. Correct set for last electron of Fe ($Z = 26$)
Approach: Fe: [Ar] $3d^6 4s^2$; last e^- in $3d$.
Answer: (B) $n = 3, l = 2, m = \pm 2, s = +\frac{1}{2}$ (one valid option).
Similar Practice (NEET/JEE-style): Last e^- of Ca ($Z = 20$)? **Answer:** $4s$.

Q39. Max e^- for $n = 4, l = 3$
Answer: (C) 14.
Similar Practice (NEET/JEE-style): Max e^- for $l = 2$? **Answer:** 10.

Q40. Total subshells in 4th shell
Answer: (A) 4 (s, p, d, f).
Similar Practice (NEET/JEE-style): In 6th shell? **Answer:** 6.

Q41. Highest energy (n+l rule):
(A)3, 2 (5) (B)4, 2 (6) (C)4, 1 (5) (D)5, 0 (5)
Approach: Larger $(n + l)$ higher; tie-breaker: larger n higher.
Answer: (B) has $(n + l) = 6$ (highest).
Similar Practice (NEET/JEE-style): Which is lower: $4p$ or $3d$? **Answer:** $3d$ (tie 5, lower n).

Q42. For $n = 5$, number of orbitals with $l = 3$
Answer: (A) $2l + 1 = 7$.
Similar Practice (NEET/JEE-style): With $l = 2$? **Answer:** 5.

Q43. Which set is NOT permissible?
Answer: (B) $(3, 3, 1, -\frac{1}{2})$ since $l \leq n - 1$ so $l = 3$ not allowed for $n = 3$.
Similar Practice (NEET/JEE-style): Is $(2, 2, 0, +\frac{1}{2})$ valid? **Answer:** No.

Q44. Which set(s) are not possible?
Approach: Check basics: $l \leq n - 1$; $|m| \leq l$; $s = \pm\frac{1}{2}$.
Steps: (ii)$2, 2, 1, +\frac{1}{2}$; (iv)$1, 0, -1, -\frac{1}{2}$; (v)$3, 2, 3, +\frac{1}{2}$.
Answer: (B) (ii), (iv) and (v).
Similar Practice (NEET/JEE-style): Is $(4, 3, -2, +\frac{1}{2})$ valid? **Answer:** Yes.

Q45. Any f orbital can hold up to ...
Answer: (C) 2 electrons with opposite spins.
Similar Practice (NEET/JEE-style): An f *subshell* holds? **Answer:** 14.

Q46. Order by increasing energy: (A)$4,1$ (B)$4,0$ (C)$3,2$ (D)$3,1$
Approach: Use $(n+l)$ then n.
Steps: $D(4) < B(4) < C(5) < A(5)$ but tie broken by n: $D < B < C < A$.
Answer: (C) $D < B < C < A$.
Similar Practice (NEET/JEE-style): Which is higher: $5s$ or $4d$? **Answer:** $4d$ (both 4; tie by n).

Q47. Total atomic orbitals in 4th level
Answer: (C) 16.
Similar Practice (NEET/JEE-style): In 5th level? **Answer:** 25.

Q48. For $n = 3, l = 2, m = +2$ how many orbitals?
Answer: (A) 1.
Similar Practice (NEET/JEE-style): For $n = 3, l = 2$ (any m)? **Answer:** 5.

Q49. Which set has $m = 0$ for all orbitals listed?
Answer: (B) $3s, 2p_z, 3d_{z^2}$ each has $m = 0$.
Similar Practice (NEET/JEE-style): Does p_x have $m = 0$? **Answer:** No (it's a combo of $m = \pm 1$).

Q50. In any subshell, max electrons with same spin = ...
Approach: One per orbital with that spin; #orbitals $= 2l + 1$.
Answer: (C) $2l + 1$.
Similar Practice (NEET/JEE-style): For d ($l = 2$)? **Answer:** 5 with spin $+\frac{1}{2}$.

Q51. In N shell: electrons, orbitals, types (in order)
Answer: (C) $32, 16, 4$.
Similar Practice (NEET/JEE-style): In M shell? **Answer:** $18, 9, 3$.

Q52. Correct set for an electron in 4f
Answer: (C) $n = 4, l = 3, m = 1, s = +\frac{1}{2}$.
Similar Practice (NEET/JEE-style): Give another valid set. **Answer:** $(4, 3, -3, -\frac{1}{2})$.
