Detailed Stepwise Solutions
Full-2 [JEE] • Atomic Structure — 19

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*Note: Har question se pehle ek chhota sa concept recap diya gaya hai, phir bilkul step-by-step solution. Jahan key mismatch mila, waha **(Ke y mismatch)** note kiya gaya hai.*

Q1. Two orbitals: A (n=3, ℓ=2, m=0) and B (n=3, ℓ=1, m= + 1). Correct statement?
Conceptual Approach (Hinglish): Hydrogen atom me energy sirf n par depend karti hai (*degeneracy in* l, m). Multi-electron atoms me screening/penetration ki wajah se same n me l badhne se energy badhti hai ($3d > 3p > 3s$).
Approach: H me: same n=3 ⇒ same energy. Multi-electron me: $3d$ (A) *higher* than $3p$ (B).
Final Answer: (A) Both have same energy in H. (Key had B — **mismatch corrected**)

Q2. For $n = 5,\ \ell = 3$: number of orbitals?
Conceptual Approach (Hinglish): Kisi ek subshell me orbitals = $2\ell + 1$. $\ell = 3$ (f-subshell) ke liye $2 \cdot 3 + 1 = 7$.
Final Answer: (B) 7. (Key had C — **mismatch corrected**)

Q3. For $n = 4$, all orbitals with $m = 0$ me max electrons?
Conceptual Approach (Hinglish): $n = 4$ me $\ell = 0, 1, 2, 3$; har ℓ me $m = 0$ ek orbital hota hai. Total 4 orbitals, max 2 e^- per orbital.
Steps: Total electrons = $4 \times 2 = 8$.
Final Answer: (D) 8.

Q4. Electron confined to radius 10^{-15} m: minimum Δp?
Conceptual Approach (Hinglish): Heisenberg: $\Delta x\, \Delta p \geq \dfrac{\hbar}{2}$.
Steps: $\Delta p \sim \dfrac{\hbar}{2\Delta x} = \dfrac{1.055 \times 10^{-34}}{2 \times 10^{-15}} \approx 5 \times 10^{-20}\ \text{kg} \cdot \text{m/s} \sim 10^{-19}$.
Final Answer: (A) 10^{-19} kg · m/s.

Q5. Δx half ho jaye to Δp?
Conceptual Approach (Hinglish): Product constant lower bound — position ke half hone par momentum ki uncertainty double.
Final Answer: (A) Doubled.

Q6. Same kinetic energy par kiski de Broglie wavelength max?
Conceptual Approach (Hinglish): $\lambda = \dfrac{h}{p}$; $p = \sqrt{2mK}$. Lighter particle ⇒ smaller p ⇒ larger λ.
Final Answer: (C) Electron.

Q7. $v \to 4v$ karne par λ?
Conceptual Approach (Hinglish): $\lambda = \dfrac{h}{mv}$; speed 4× hone par wavelength 1/4.
Final Answer: (D) $\lambda/4$.

Q8. Bohr radius of H $= a_0$. Third orbit radius of Li^{2+}?
Conceptual Approach (Hinglish): $r_n = \dfrac{n^2 a_0}{Z}$. Li^{2+}: $Z = 3,\ n = 3 \Rightarrow r = \dfrac{9a_0}{3} = 3a_0$.
Final Answer: (D) $9a_0/3 = 3a_0$. (Key had A — **mismatch corrected**)

Q9. H first orbit speed $= v$. He^+ second orbit speed?
Conceptual Approach (Hinglish): $v_n = \dfrac{Z\alpha c}{n}$. H(1): $v = \alpha c$. $He^+(Z = 2)$ at $n = 2$: $v = \dfrac{2\alpha c}{2} = \alpha c = v$.
Final Answer: (B) v. (Key had A — **mismatch corrected**)

Q10. Ratio PE:KE:TE (H atom)?
Conceptual Approach (Hinglish): Bohr/virial: $PE = -2\,KE$, $TE = KE + PE = -KE$.
Final Answer: (A) $-2 : 1 : -1$.

Q11. Ionisation energy of Li^{2+}?
Conceptual Approach (Hinglish): H-like: $E_{\text{ion}} = 13.6Z^2$ eV $= 13.6 \times 9 = 122.4$ eV.
Final Answer: (D) 122.4 eV.

Q12. $n = 3 \to n = 1$ emission: Rydberg form?
Conceptual Approach (Hinglish): $1/\lambda = R\left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right)$ with n_1=1, n_2=3.
Final Answer: (B) $1/\lambda = R(1/1^2 - 1/3^2)$.

Q13. UV region series?
Conceptual Approach (Hinglish): UV $\Rightarrow$ Lyman ($n_f = 1$).
Final Answer: (A) Lyman.

Q14. Ratio of wavelengths: first Balmer to first Lyman?
Conceptual Approach (Hinglish): First Balmer: $3 \to 2$, so $1/\lambda_B = R\left(\frac{1}{4} - \frac{1}{9}\right) = \frac{5R}{36}$.
Steps: First Lyman: $2 \to 1$, $1/\lambda_L = R\left(1 - \frac{1}{4}\right) = \frac{3R}{4}$.
Steps: $\dfrac{\lambda_B}{\lambda_L} = \dfrac{1/(5R/36)}{1/(3R/4)} = \dfrac{36}{5} \cdot \dfrac{3}{4} = \dfrac{108}{20} = \dfrac{27}{5}$.
Final Answer: (D) 27/5. (Key had A — **mismatch corrected**)

Q15. Work function $= 2.5$ eV, threshold wavelength?
Conceptual Approach (Hinglish): $\lambda_0 = \dfrac{hc}{\phi} \approx \dfrac{1240 \text{ eV} \cdot \text{nm}}{2.5 \text{ eV}} = 496$ nm.
Final Answer: (A) 496 nm. (Key had C — **mismatch corrected**)

Q16. Frequency $> \nu_0$ ke saath intensity badhane se kya badhta hai?
Conceptual Approach (Hinglish): Einstein eqn: $K_{\max} = h\nu - \phi$ (intensity se $K_{\max}$, V_s nahi badalta). Intensity $\Rightarrow$ photon count $\Rightarrow$ current.
Final Answer: (C) Number of photoelectrons.

Q17. Frequency doubled (above threshold) — $K_{\max}$?
Conceptual Approach (Hinglish): $K_{\max} = h\nu - \phi$; $\nu \to 2\nu \Rightarrow K_{\max} \to 2h\nu - \phi$. General case

me *increase hota hai* but exactly double nahin unless $\phi \ll h\nu$.
Final Answer: (D) Increases but not doubles.

Q18. Shortest wavelength?
Conceptual Approach (Hinglish): EM spectrum: λ: $\gamma <$ X $<$ UV $< \dots$.
Final Answer: $(C) Gammarays.$

Q19. True statement about EM waves?
Conceptual Approach (Hinglish): $\vec{E} \perp \vec{B} \perp$ direction of propagation; in phase in free space.
Final Answer: (B) E and B both perpendicular to each other and propagation.

Q20. Photon and electron have same de Broglie wavelength. Whose momentum greater?
Conceptual Approach (Hinglish): Dono ke liye $p = \frac{h}{\lambda}$. Same $\lambda \Rightarrow$ same p.
Final Answer: (C) Both same. (Key had B — **mismatch corrected**)

Corrected Answer Key (after full solutions):

Q1	A	Q2	B	Q3	D	Q4	A	Q5	A
Q6	C	Q7	D	Q8	D	Q9	B	Q10	A
Q11	D	Q12	B	Q13	A	Q14	D	Q15	A
Q16	C	Q17	D	Q18	C	Q19	B	Q20	C

Note: Original shared key mismatched on Q1, Q2, Q8, Q9, Q14, Q15, Q20. Above table reflects the corrected, fully-worked answers.