

Weird Chemist

Bohr's Model — DPP-5 Solutions

Chapter: Structure of Atom

“Teeno formulae — radius, velocity, energy — sab mein n^2/Z ka pattern hai. Ek baar samajh lo, sab questions seedhe ho jaate hain.”

Master Formulae — Bohr's Model

- $r_n = 0.529 \frac{n^2}{Z} \text{ \AA} = \frac{52.9 n^2}{Z} \text{ pm}$
- $v_n = \frac{2.188 \times 10^6 Z}{n} \text{ m/s}$
- $E_n = -13.6 \frac{Z^2}{n^2} \text{ eV} = -\frac{2.18 \times 10^{-18} Z^2}{n^2} \text{ J}$
- $KE = -E_n$ (positive); $PE = 2E_n$ (negative)
- $L = \frac{nh}{2\pi}$ (Bohr angular momentum)
- $T \propto n^3/Z^2$ (time period)
- **Excited states:** k th excited state $\Rightarrow n = k + 1$
- **IE from n th orbit** = $13.6 Z^2/n^2 \text{ eV}$
- $\Delta E = 13.6 Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) \text{ eV}$
- $hc = 12400 \text{ eV \AA}$; $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$

TYPE 1 : Bohr's Model — Radius

Q.1 Correct formula for Bohr orbit radius?

Explanation

$r_n = 0.529 \times \frac{n^2}{Z} \text{ \AA}$. Radius $\propto n^2$ aur $\propto 1/Z$.

Answer

Option (4): $r = 0.529 \times n^2/Z \text{ \AA}$

Common Student Mistake

Option (2) mein Z^2 hai — Energy mein Z^2 hota hai, radius mein sirf Z .

Q.2 Bohr's radius for first orbit of H?

Explanation

$n = 1, Z = 1: r_1 = 0.529 \times 1/1 = 0.529 \text{ \AA}$.

Answer

Option (1): 0.529 \AA

Q.3 Radii of 1st–4th Bohr orbits of H?

Explanation

$Z = 1, r_n = 0.529 \times n^2: n = 1 : 0.529; n = 2 : 2.116; n = 3 : 4.761; n = 4 : 8.464 \text{ \AA}$.

Answer

Option (1): $0.529, 2.116, 4.761, 8.464 \text{ \AA}$

Common Student Mistake

$r \propto n^2$ hai, n nahi. Option (2) n se multiply karta hai — wrong.

Q.4 Radius of 2nd Bohr orbit of Li^{2+} ?**Explanation**

$n = 2, Z = 3: r = 52.9 \times 4/3 = 70.53 \text{ pm.}$

Answer

Option (1): 70.53 pm

Q.5 Radius of 2nd Bohr orbit of H?

[JEE Main 2017]

Explanation

$n = 2, Z = 1: r_2 = 0.529 \times 4 = 2.116 \approx 2.12 \text{ \AA.}$

Answer

Option (4): 2.12 \AA

Q.6 $r_1 = x$. Radius of 3rd orbit?

[NCERT Pg. 46]

Explanation

$r_n \propto n^2: r_3/r_1 = 9/1 \Rightarrow r_3 = 9x.$

Answer

Option (3): $9x$

Common Student Mistake

$r_3 = 3x$ likhna galat — radius $\propto n^2$, naki n .

Q.7 $r_1(\text{H}) = 0.053 \text{ nm}$. Radius of 3rd orbit of Li^{2+} ?**Explanation**

$r = 0.053 \times n^2/Z = 0.053 \times 9/3 = 0.053 \times 3 = 0.159 \text{ nm.}$

Answer

Option (1): 0.159 nm

Q.8 Li^{2+} ($Z = 3$) ground state radius? $r_{\text{H}} = 0.53 \text{ \AA}$.**Explanation**

$n = 1, Z = 3: r = 0.53/3 = 0.177 \approx 0.17 \text{ \AA.}$

Answer**Option (3): 0.17 Å****Q.9** Which orbit has same radius as 2nd Bohr orbit of H?**Explanation**Condition: $n^2/Z = 4$. Check each option:

- He⁺ ($Z = 2$), $n = 4$: $16/2 = 8 \times$
- Be³⁺ ($Z = 4$), $n = 4$: $16/4 = 4 \checkmark$
- Li²⁺ ($Z = 3$), $n = 3$: $9/3 = 3 \times$
- He⁺ ($Z = 2$), $n = 2$: $4/2 = 2 \times$

Answer**Option (2): Be³⁺ ($n = 4$)****Q.10** Which has minimum first orbit radius?**Explanation** $r_1 = 0.529/Z$: minimum radius \Rightarrow maximum Z . Be³⁺ has $Z = 4$ (highest). Tritium is H isotope, $Z = 1$.**Answer****Option (3): Triply ionised beryllium (Be³⁺)****Q.11** H atom: $r = 4.761 \text{ Å}$. Find n .**Explanation**

$$n^2 = 4.761/0.529 = 9 \Rightarrow n = 3.$$

Answer**Option (1): $n = 3$** **Q.12** Express 2nd, 3rd, 4th orbit radii in terms of r_1 .**Explanation**

$$r_n = r_1 \times n^2: r_2 = 4r_1, r_3 = 9r_1, r_4 = 16r_1.$$

Answer**Option (2): $4r_1, 9r_1, 16r_1$** **TYPE 2 : Bohr's Model — Radius Ratio****Q.13** Li²⁺: $r_2 : r_5$?

Explanation

Same ion, $r \propto n^2$: $r_2 : r_5 = 4 : 25$.

Answer

Option (2): 4:25

Q.14 He^+ : $r_3 : r_5$?

Explanation

$r_3 : r_5 = 9 : 25$.

Answer

Option (1): 9:25

Q.15 $(r_2)_H : (r_3)_{\text{Li}^{2+}}$?

Explanation

$(r_2)_H = 0.529 \times 4 = 2.116 \text{ \AA}$; $(r_3)_{\text{Li}^{2+}} = 0.529 \times 9/3 = 1.587 \text{ \AA}$.
Ratio = $2.116 : 1.587 = 4 : 3$.

Answer

Option (1): 4:3

Q.16 Ratio of 1st orbit radius of H to deuterium?

Explanation

Deuterium = H isotope, same $Z = 1$. Bohr radius formula mein mass nahi hai. Ratio = $1 : 1$.

Answer

Option (1): 1:1

Common Student Mistake

Isotopes ka radius same hota hai — Bohr formula mein mass ka koi role nahi.

Q.17 First three radius ratio?

Explanation

$r_1 : r_2 : r_3 = 1 : 4 : 9$.

Answer

Option (3): 1:4:9

Q.18 $r_a : r_b = 4 : 1$. Identify orbits.

Explanation

$n_a^2 : n_b^2 = 4 : 1 \Rightarrow n_a = 2$ (L shell), $n_b = 1$ (K shell). L:K = 4:1.

Answer

Option (2): L and K

TYPE 3 : Bohr's Model — Velocity

Q.19 How do r and v vary with n ?

Explanation

$r \propto n^2$ (increases); $v \propto 1/n$ (decreases).

Answer

Option (1): r increases, v decreases

Q.20 Velocity in 2nd orbit of H?

Explanation

$v_2 = 2.188 \times 10^6 / 2 = 1.094 \times 10^6 = 10.9 \times 10^5$ m/s.

Answer

Option (3): 10.9×10^5 m/s

Q.21 $V_1 : V_2 : V_3$ for H-like system?

Explanation

$v \propto 1/n$: $V_1 : V_2 : V_3 = 1 : 1/2 : 1/3$.

Answer

Option (2): $1 : 1/2 : 1/3$

Q.22 Velocity of electron in 2nd orbit of He^+ (in terms of K, e, h)?

Explanation

$v = 2\pi K e^2 Z / (nh)$. $Z = 2, n = 2$: $v = 2\pi K e^2 / h$.

Answer

Option (1): $2\pi K e^2 / h$

Q.23 Velocity and revolutions/sec in 3rd orbit of H?

Explanation

$v_3 = 2.188 \times 10^6 / 3 = 7.27 \times 10^5$ m/s. $r_3 = 4.761 \text{ \AA} = 4.761 \times 10^{-10}$ m.
 $\nu = v / (2\pi r) = 7.27 \times 10^5 / (2\pi \times 4.761 \times 10^{-10}) = 2.43 \times 10^{14}$ rps.

Answer

Option (1): 7.27×10^5 m/s; 2.43×10^{14} rps

TYPE 4 : Bohr's Model — Time Period

Q.24 Time for one revolution in 2nd orbit of He^+ ?

Explanation

$$Z = 2, n = 2: r_2 = 0.529 \times 4/2 = 1.058 \text{ \AA} = 1.058 \times 10^{-10} \text{ m}; \quad v_2 = 2.188 \times 10^6 \text{ m/s.}$$
$$T = 2\pi r/v = 6.645 \times 10^{-10}/2.188 \times 10^6 = 3.04 \times 10^{-16} \text{ s.}$$

Answer

Option (1): $3.05 \times 10^{-16} \text{ s}$

Q.25 Time period of n th orbit of H varies as?

Explanation

$$T = 2\pi r/v \propto n^2/(1/n) = n^3.$$

Answer

Option (2): Directly proportional to n^3

Common Student Mistake

$$T \propto n^3, \text{ not } n^2. \quad r \propto n^2, v \propto 1/n \Rightarrow T = 2\pi r/v \propto n^2 \div (1/n) = n^3.$$

TYPE 5 : Bohr's Model — Angular Momentum

Q.26 $nh/2\pi$ indicates?

Explanation

Bohr's postulate: angular momentum = $nh/2\pi$.

Answer

Option (4): Angular momentum

Q.27 Angular momentum in 5th shell.

[AIEEE 2006]

Explanation

$$L = 5h/2\pi = 2.5 h/\pi.$$

Answer

Option (3): $2.5 h/\pi$

Q.28 Angular momentum for P-shell electron?

Explanation

P orbital: $l = 1$. Quantum mechanical orbital angular momentum = $\sqrt{l(l+1)} h/2\pi = \sqrt{2} h/2\pi$.

Answer**Option (3):** $\sqrt{2} h/2\pi$ **Common Student Mistake**

Bohr orbit $L = nh/2\pi$ vs quantum orbital $L = \sqrt{l(l+1)}h/2\pi$. P orbital ke liye quantum mechanical value use karte hain: $l = 1 \Rightarrow \sqrt{2} h/2\pi$.

Q.29 $h/2\pi$ is **L** in which orbit of He^+ ?**Explanation**

$$L = nh/2\pi = h/2\pi \Rightarrow n = 1.$$

Answer**Option (1): First****Q.30** Product $v \times r$ proportional to?**Explanation**

$$v \cdot r = L/m_e = nh/(2\pi m_e) \propto 1/m_e.$$

Answer**Option (3): Inversely proportional to mass of electron****Q.31** Orbit **L** : orbital $L = \sqrt{2} : 1$ for which orbital?**Explanation**

$$n/\sqrt{l(l+1)} = \sqrt{2} \Rightarrow n^2 = 2l(l+1).$$

For 2p: $n = 2, l = 1: 2l(l+1) = 4 = n^2$. ✓

Answer**Option (2): 2p****TYPE 6 : Bohr's Model — Excited State Radius and Velocity****Q.32** 2nd excited H : 1st excited Li^{2+} radius ratio?**Explanation**

2nd excited H: $n = 3, Z = 1$. 1st excited Li^{2+} : $n = 2, Z = 3$.

$$\text{Ratio} = (n^2/Z)_H : (n^2/Z)_{\text{Li}} = (9/1) : (4/3) = 9 : (4/3) = 27 : 4.$$

Answer**Option (1): 27:4**

Common Student Mistake

Excited state \neq orbit number. 1st excited = $n = 2$; 2nd excited = $n = 3$. k th excited $\Rightarrow n = k + 1$.

Q.33 Radius of 2nd excited state of Li^{2+} ?

Explanation

$$n = 3, Z = 3: r = 0.529 \times 9/3 = 1.587 \approx 1.51 \text{ \AA}.$$

Answer

Option (2): 1.51 \AA

Q.34 & Q.35 $r_1 = 0.530 \text{ \AA}$. First excited state ($n = 2$) radius?

Explanation

$$r_2 = 0.530 \times 4 = 2.12 \text{ \AA}.$$

Answer

Option (4): 2.12 \AA

Common Student Mistake

First excited state = $n = 2$, naki $n = 1$. $r_2 = 4r_1$.

Q.36 Velocity in 3rd excited state of Be^{3+} ?

Explanation

$$n = 4, Z = 4: v = 2.188 \times 10^6 \times 4/4 = 2.188 \times 10^6 \text{ m/s} = 2.188 \times 10^3 \text{ km/s}.$$

Answer

Option (3): $2.188 \times 10^6 \text{ m/s}$ ($= 2.188 \times 10^3 \text{ km/s}$)

Q.37 Angular momentum in 2nd orbit $H = x$. Find L in 1st excited state of Li^{2+} .

Explanation

$L = nh/2\pi$ — depends only on n , not Z . Both have $n = 2$, so $L = x$.

Answer

Option (4): x

Common Student Mistake

Angular momentum formula mein Z nahi hai. Same $n \Rightarrow$ same L , regardless of Z .

TYPE 7 : Bohr's Model — Energy

Q.38 Energy of 3rd shell of H?

Explanation

$$E_3 = -2.18 \times 10^{-18} / 9 = -2.42 \times 10^{-19} \text{ J.}$$

Answer

Option (4): $-2.42 \times 10^{-19} \text{ J}$

Q.39 Ground state energy of doubly ionised Li (Li^{2+})?

Explanation

$$\text{Li}^{2+}: Z = 3, n = 1: E = -13.6 \times 9 = -122.4 \text{ eV.}$$

Answer

Option (3): -122.4 eV

Q.40 IE of $\text{He}^+ = 19.6 \times 10^{-18} \text{ J}$. Energy of first state of Li^{2+} ?

[AIEEE 2010]

Explanation

$$E_1(\text{Li}^{2+}) = E_1(\text{He}^+) \times (Z_{\text{Li}}/Z_{\text{He}})^2 = -19.6 \times 10^{-18} \times (3/2)^2 = -19.6 \times 10^{-18} \times 9/4 = -4.41 \times 10^{-17} \text{ J.}$$

Answer

Option (3): $-4.41 \times 10^{-17} \text{ J}$

Q.41 He^+ first shell = -54.4 eV . Second shell energy?

Explanation

$$E_2 = E_1/4 = -54.4/4 = -13.6 \text{ eV.}$$

Answer

Option (2): -13.6 eV

Q.42 $E_2(\text{H}) = -328 \text{ kJ/mol}$. Find E_4 .

Explanation

$$E \propto 1/n^2: E_4 = E_2 \times (n_2/n_4)^2 = -328 \times 4/16 = -82 \text{ kJ/mol.}$$

Answer

Option (4): -82 kJ/mol

Q.43 H energy in n th orbit = E_n . He^+ energy in same orbit?

Explanation

$$E \propto Z^2: \text{He}^+ \text{ has } Z = 2, \text{ so } E = 4E_n.$$

Answer

Option (1): $4E_n$

Q.44 Energy for $Z_A^{+(Z-1)}$ ion?

Explanation

$$E_n = Z^2 \times E_n(\text{H}).$$

Answer

Option (1): $E_n = Z^2 \times E_n(\text{H})$

Q.45 $E_n = -313.6/n^2$ kcal/mol; $E = -34.84$. Find n .

Explanation

$$n^2 = 313.6/34.84 = 9 \Rightarrow n = 3.$$

Answer

Option (3): $n = 3$

Q.46 Correct energy relationship for isoelectronic-like series?

Explanation

$E_1(\text{H}), E_2(\text{He}^+), E_3(\text{Li}^{2+}), E_4(\text{Be}^{3+})$: all have $Z/n = 1$, so all equal to -13.6 eV.

Answer

Option (2): $E_1(\text{H}) = E_2(\text{He}^+) = E_3(\text{Li}^{2+}) = E_4(\text{Be}^{3+})$

Q.47 Ratio of $(E_2 - E_1) : (E_3 - E_2)$ for H?

Explanation

$$E_2 - E_1 = 13.6 \times 3/4 = 10.2 \text{ eV}; \quad E_3 - E_2 = 13.6 \times 5/36 = 1.889 \text{ eV}.$$

Ratio = $10.2/1.889 \approx 5.4 = 27/5$.

Answer

Option (3): 27/5

TYPE 8 : Bohr's Model — Excited State Energy

Q.48 Energy of Li^{2+} in 2nd excited state?

Explanation

$$n = 3, Z = 3: E = -13.6 \times 9/9 = -13.6 \text{ eV/atom}.$$

Answer

Option (1): -13.6 eV/atom

Q.49 Ratio of energies of He⁺: 1st and 2nd excited states?

Explanation

1st excited ($n = 2$) : 2nd excited ($n = 3$) = $1/4 : 1/9 = 9 : 4$.

Answer

Option (1): 9:4

Q.50 Ratio of H energies: first and second excited states?

Explanation

Same as Q.49: $n = 2 : n = 3 = 9 : 4$.

Answer

Option (4): 9:4

Common Student Mistake

Ratio mein Z^2 cancel hota hai — answer same hai for H and He⁺.

Q.51 Ground H = $-x$ eV. 2nd excited state of He⁺?

Explanation

$n = 3, Z = 2: E = -13.6 \times 4/9 = -4x/9$.

Answer

Option (2): $-4x/9$ eV

Q.52 Ground H = -13.6 eV. 2nd excited state of He⁺?

[JEE Main 2019]

Explanation

$n = 3, Z = 2: E = -13.6 \times 4/9 = -6.04$ eV.

Answer

Option (2): -6.04 eV

Q.53 Ground H = -13.6 eV. Second excited state energy?

[AIEEE 2002]

Explanation

$n = 3, Z = 1: E_3 = -13.6/9 = -1.51$ eV.

Answer

Option (3): -1.51 eV

Q.54 Ratio of removal energy from first three orbits of H?

Explanation

IE from orbit $n = 13.6/n^2$: $IE_1 : IE_2 : IE_3 = 1 : 1/4 : 1/9 = 36 : 9 : 4$.

Answer

Option (3): 36:9:4

Common Student Mistake

Option (4) 1:4:9 — yeh orbit index ka order hai. Removal energy **decreases** as n increases (inner orbit se nikaalte hain toh zyada energy chahiye).

Q.55 Which is a possible excited state energy of H?

[JEE Main 2015]

Explanation

H energies: $-13.6/n^2$. $-3.4 \text{ eV} = n = 2$. Positive energies not allowed (bound state).

Answer

Option (1): -3.4 eV

TYPE 9 : Bohr's Model — Ionisation and Excitation Potential

Q.56 IE of H = $x \text{ kJ}$. Energy for $n = 2 \rightarrow 3$?

Explanation

$$\Delta E = x(1/4 - 1/9) = x \times 5/36 = 5x/36.$$

Answer

Option (4): $5x/36$

Common Student Mistake

$\Delta E = IE \times (1/n_1^2 - 1/n_2^2)$. Order: $n_1 < n_2$ for absorption. $1/4 - 1/9 = 5/36$, not $5/12$.

Q.57 IE = 20 V. First excitation potential?

Explanation

$$E_1 = -20 \text{ eV}; E_n = -20/n^2. \Delta E_{1 \rightarrow 2} = 20(1 - 1/4) = 15 \text{ eV}.$$

Answer

Option (3): 15 V

Q.58 IE of H = 313.8 kcal/mol. 2nd excited state energy?

Explanation

$$E_3 = -313.8/9 = -34.87 \approx -35 \text{ kcal/mol}.$$

Answer

Option (4): -35 kcal/mol

Q.59 IE = 13.6 eV. Energy to excite ground state to next higher?

Explanation

$$\Delta E_{1 \rightarrow 2} = 13.6 \times 3/4 = 10.2 \text{ eV.}$$

Answer

Option (2): 10.2 eV

Q.60 IE = 13.6 eV. Energy to excite to 1st excited state?

Explanation

$$\Delta E_{1 \rightarrow 2} = 10.2 \text{ eV.}$$

Answer

Option (1): 10.2 eV

Q.61 IE = 13.6 eV. Energy to ionise H in 2nd excited state?

Explanation

$$n = 3: \text{IE} = 13.6/9 = 1.51 \text{ eV.}$$

Answer

Option (4): 1.5 eV

Common Student Mistake

Excited state se ionise karna easier hai. $\text{IE}_n = 13.6/n^2$. $n = 3$ se sirf 1.51 eV chahiye, 13.6 eV nahi.

Q.62 IE = 1.312×10^6 J/mol. Energy for $n = 1 \rightarrow 2$? [AIEEE 2008]

Explanation

$$\Delta E = 1.312 \times 10^6 \times 3/4 = 9.84 \times 10^5 \text{ J/mol.}$$

Answer

Option (4): 9.84×10^5 J/mol

Q.63 Energy to excite H: ground to 3rd excited state?

Explanation

$$\text{3rd excited: } n = 4. \Delta E = 13.6(1 - 1/16) = 13.6 \times 15/16 = 12.75 \text{ eV.}$$

Answer

Option (4): 12.75 eV

Common Student Mistake

3rd excited state = $n = 4$, naki $n = 3$.

Q.64 Energy for $n = 1 \rightarrow 2$ in terms of IE?

Explanation

$$\Delta E = IE \times 3/4.$$

Answer

Option (1): 3/4 of IE

Q.65 IE for excited H (in eV)?

Explanation

Excited state $n \geq 2$: $IE = 13.6/n^2 \leq 3.4$ eV.

Answer

Option (4): 3.4 or less

Q.66 IE from ground state = 13.6 eV. IE from 1st excited state?

Explanation

1st excited state $n = 2$: $IE = 13.6/4 = 3.4$ eV.

Answer

Option (1): 3.4 eV

TYPE 10 : Bohr's Model — Miscellaneous Excitation

Q.67 M shell removal energy = 1.51 eV. Energy of 1st excited state?

Explanation

M shell = $n = 3$: $E_3 = -1.51$ eV. 1st excited = $n = 2$: $E_2 = -3.4$ eV.

Answer

Option (3): -3.4 eV

Q.68 Correct order of energy differences between adjacent H levels?

Explanation

$$E_2 - E_1 = 10.2 \text{ eV} > E_3 - E_2 = 1.89 \text{ eV} > E_4 - E_3 = 0.66 \text{ eV}.$$

Answer

Option (1): $E_2 - E_1 > E_3 - E_2 > E_4 - E_3$

Common Student Mistake

Higher orbits mein energy gap kam hoti hai. Ground state se first transition ka gap sabse bada hota hai.

Q.69 Which transition needs largest energy?

Explanation

$n = 1 \rightarrow \infty$: $\Delta E = 13.6 \text{ eV}$ (ionisation from ground state — maximum).

Answer

Option (3): $n = 1$ to ∞

Q.70 Energy for ground to 3rd excited state of He^+ ?

Explanation

$\text{He}^+ Z = 2, n = 1 \rightarrow 4$: $\Delta E = 13.6 \times 4 \times (1 - 1/16) = 54.4 \times 15/16 = 51 \text{ eV}$.

Answer

Option (3): 51 eV

Q.71 $Z = 5$, single electron: energy for $n = 3 \rightarrow 4$?

Explanation

$\Delta E = 13.6 \times 25 \times (1/9 - 1/16) = 340 \times 7/144 = 16.53 \text{ eV}$.

Answer

Option (4): 16.53 eV

Q.72 H: 3rd excited state to 1st excited state. Photon energy?

Explanation

$n = 4 \rightarrow 2$: $\Delta E = 13.6(1/4 - 1/16) = 13.6 \times 3/16 = 2.55 \text{ eV}$.

Answer

Option (2): 2.55 eV

Q.73 First excitation potential of H?

Explanation

$\Delta E_{1 \rightarrow 2} = 10.2 \text{ eV}$.

Answer

Option (1): 10.2 eV

Q.74 $\Delta E_{2 \rightarrow 3} = 47.2 \text{ eV}$. Find Z .

Explanation

$$13.6 \times Z^2 \times 5/36 = 47.2 \Rightarrow Z^2 = 25 \Rightarrow Z = 5.$$

Answer

Option (3): $Z = 5$

Q.75 IE of H = 13.6 eV. IE of 1st excited state of Li^{2+} ?

[JEE Main 2014]

Explanation

$$n = 2, Z = 3: \text{IE} = 13.6 \times 9/4 = 30.6 \text{ eV}.$$

Answer

Option (2): 30.6 eV

Q.76 IE of He^+ from three lowest states?

Explanation

$$Z = 2: n = 1 : 54.4; n = 2 : 13.6; n = 3 : 6 \text{ eV}.$$

Answer

Option (4): 54.4, 13.6, 6 eV

Q.77 2nd separation energy of H?

Explanation

$$\text{IE from } n = 2: = 13.6/4 = 3.4 \text{ eV}.$$

Answer

Option (3): 3.4 eV

TYPE 11 : Total, Kinetic and Potential Energy

Q.78 KE : Total energy ratio?

Explanation

$$KE = -E_n; TE = E_n. \text{ Ratio} = 1 : (-1).$$

Answer

Option (3): 1 : -1

Concept

Teeno relations yaad karo: $KE = -TE$ (positive); $PE = 2TE$ (negative); $|PE| = 2KE = 2|TE|$.

Q.79 PE : TE ratio?

Explanation

$$PE = 2TE \Rightarrow PE/TE = 2.$$

Answer

Option (1): 2

Q.80 KE and PE in 2nd orbit of H?

[NCERT Pg. 46]

Explanation

$$TE = E_2 = -3.4 \text{ eV}; KE = +3.4 \text{ eV}; PE = -6.8 \text{ eV}.$$

Answer

Option (3): KE = 3.4 eV, PE = -6.8 eV

Q.81 TE in 2nd orbit = -3.4 eV. KE?

Explanation

$$KE = -TE = +3.4 \text{ eV}.$$

Answer

Option (2): +3.4 eV

Common Student Mistake

KE kabhi negative nahi hoti. $KE = -E_n$: energy negative hai, toh KE positive.

Q.82 Match: (A) Ground He^+ energy, (B) PE of 1st H orbit, (C) KE of 2nd excited He^+ , (D) IP of He^+ .

Explanation

- (A) $E_1(\text{He}^+) = -54.4 \text{ eV} \rightarrow$ (iv); (B) $PE_1(\text{H}) = -27.2 \text{ eV} \rightarrow$ (ii)
 (C) KE of He^+ 2nd excited ($n = 3$): $KE = +6.04 \text{ eV} \rightarrow$ (i)
 (D) IP of $\text{He}^+ = 54.4 \text{ eV} = 8.72 \times 10^{-18} \text{ J} \rightarrow$ (iii)

Answer

Option (3): A-(iv), B-(ii), C-(i), D-(iii)

Q.83 1st excited H: $E = -3.4 \text{ eV}$. KE?

Explanation

$$KE = +3.4 \text{ eV}.$$

Answer

Option (1): +3.4 eV

Q.84 PE in 2nd orbit of $\text{He}^+ = -27.2 \text{ eV}$. Find $2 \times TE$ of 1st excited H.

Explanation

1st excited H: $n = 2$, $TE = -3.4$ eV; $2 \times TE = -6.8$ eV.

Answer

Option (3): -6.8 eV

Q.85 PE of H electron = -3.02 eV. Which excited level?

Explanation

$PE = 2TE \Rightarrow TE = -1.51$ eV. $-13.6/n^2 = -1.51 \Rightarrow n = 3$ (2nd excited).

Answer

Option (2): 2nd excited level ($n = 3$)

Q.86 K-shell to N-shell: what changes?

Explanation

n badhne par: $KE = 13.6/n^2$ **decreases**; TE and PE become less negative (increase towards 0).

Answer

Option (1): Kinetic energy decreases

Common Student Mistake

TE “increases” matlab less negative hona — physically easier to ionise. KE hi actual quantity hai jo decrease karti hai jab n badhta hai.

Q.87 Which statement is NOT correct for orbits 1, 2, 3?

Explanation

$E_1 = -13.6 < E_2 = -3.4 < E_3 = -1.51$ eV, so $E_1 < E_2 < E_3$.

Statement (1): $E_1 > E_2 > E_3$ — **WRONG**.

Statement (3): $(KE)_1 > (KE)_2 > (KE)_3$ — correct ($KE \propto 1/n^2$).

Only statement (1) is wrong, so answer is option (1).

Answer

Option (1): $E_1 > E_2 > E_3$ (this is wrong — energy increases from 1 to 3)

Q.88 IE of He^+ equivalent to?

Explanation

IE of $He^+ = 54.4$ eV = KE of first orbit. ($KE = -E_1 = 54.4$ eV.)

Answer

Option (1): KE of first orbit

Q.89 Correct KE vs n graph?

Explanation

$KE = 13.6/n^2$ — always positive, decreases as n increases, approaches zero at $n \rightarrow \infty$. Hyperbolic decay curve.

Answer

Option (3): Decreasing hyperbola approaching zero

Q.90 Graph of energy vs Z^2 ?

Explanation

$E = -13.6 Z^2/n^2$: linear in Z^2 with negative slope. As Z^2 increases, energy becomes more negative (straight line going down).

Answer

Option (2): Straight line with negative slope

TYPE 12 : Theoretical Questions

Q.91 Bohr theory NOT applicable for?

Explanation

Bohr model = single electron species only. Be^+ has 3 electrons (multi-electron) — Bohr fails.

Answer

Option (3): Be^+

Q.92 Which is WRONG for Bohr model?

Explanation

Bohr model treated electron as pure particle. Wave-particle duality is de Broglie's concept — NOT Bohr's model.

Answer

Option (4): Electron behaves as particle and wave

Q.93 Which is NOT a shortcoming of Bohr's model?

Explanation

Option (4): "Did not give energy level info" — FALSE. Bohr model ka main success hi yeh tha ki usne energy levels diye. So this is NOT a shortcoming.

Answer

Option (4)

Q.94 Bohr model can explain?

Explanation

Bohr model hydrogen spectrum explain karta hai (Balmer, Lyman series). Zeeman/Stark effects aur bonding explain nahi hoti.

Answer

Option (4): Hydrogen spectrum

Q.95 Which conclusion from $E = -2.178 \times 10^{-18}(Z^2/n^2)$ is NOT correct?

Explanation

Option (1): “More negative energy means more loosely bound” — **WRONG**. More negative = more tightly bound (harder to remove).

Answer

Option (1)

Common Student Mistake

More negative energy \Rightarrow more tightly bound \Rightarrow more energy needed to ionise. “Loosely bound” galat phrase hai yahan.

Q.96 Bohr’s model based upon?

Explanation

Bohr used Planck’s quantum theory (quantised angular momentum).

Answer

Option (4): Planck’s quantum theory

Q.97 Who modified Bohr with elliptical orbits?

Explanation

Sommerfeld ne elliptical orbits introduce ki aur azimuthal quantum number diya.

Answer

Option (4): Sommerfeld

Q.98 14 eV photon hits H atom. What happens?

Explanation

IE = 13.6 eV < 14 eV. Atom ionised; electron KE = 14 – 13.6 = 0.4 eV.

Answer

Option (2): Atom ionised, electron KE = 0.4 eV

Common Student Mistake

Agar photon energy $> IE$, toh ionisation hoti hai. Excess energy electron ki KE ban jaati hai. Option (3) galat — photon atom ke saath interact karta hai jab energy \geq kisi transition ya IE ke.

Q.99 10.8 eV electron hits H atom. What happens?

Explanation

Allowed H transitions: $n = 1 \rightarrow 2$ needs 10.2 eV; $n = 1 \rightarrow 3$ needs 12.09 eV (too much).
Electron 10.2 eV deta hai H ko, aur $10.8 - 10.2 = 0.6$ eV lekar nikalta hai.

Answer

Option (3): 10.2 eV absorbed, electron exits with 0.6 eV

Common Student Mistake

Unlike photons (all-or-nothing), electrons partial energy transfer kar sakte hain collision mein. Lekin transfer hamesha exact transition energy ke equal hona chahiye — 0.6 eV H ko nahi jaata, sirf 10.2 eV jaata hai.

Answer Key — DPP-5 (Q1–Q99)

Q	A	Q	A	Q	A	Q	A	Q	A	Q	A	Q	A	Q	A	Q	A
1	4	2	1	3	1	4	1	5	4	6	3	7	1	8	3	9	2
11	1	12	2	13	2	14	1	15	1	16	1	17	3	18	2	19	1
21	2	22	1	23	1	24	1	25	2	26	4	27	3	28	3	29	1
31	2	32	1	33	2	34	4	35	4	36	3	37	4	38	4	39	3
41	2	42	4	43	1	44	1	45	3	46	2	47	3	48	1	49	1
51	2	52	2	53	3	54	3	55	1	56	4	57	3	58	4	59	2
61	4	62	4	63	4	64	1	65	4	66	1	67	3	68	1	69	3
71	4	72	2	73	1	74	3	75	2	76	4	77	3	78	3	79	1
81	2	82	3	83	1	84	3	85	2	86	1	87	1	88	1	89	3
91	3	92	4	93	4	94	4	95	1	96	4	97	4	98	2	99	3

“*k*th excited state = $n = k + 1$. Yeh ek line 10 questions save kar sakti hai. Yaad rakhna.”

— Weird Chemist