# ATOMIC STRUCTURE

## (MAIN)

## FOUNDATION BUILDER (OBJECTIVE)

1. **(A)**

$_3Li^6 + ? \longrightarrow {}_2He^4 + {}_1H^3$

By law of conservation of mass and change the missing particle in neutron $\left({}_0^0n^1\right)$

2. **(D)**

$\frac{e}{M}$ ratio lies in the sequence $n < \alpha < p < l$

| Particle | Change | Mass |
|---|---|---|
| $\propto$ | + 2 | + 4 |
| n | 0 | + 1 |
| p | + 1 | + 1 |
| e | – 1 | $= 1/1837$ |

$\left(e/m\right)$ order $\longrightarrow$ $n < \propto < P < e$

3. **(D)**

Atomic Number = No. of protons in atom

By equation of change

$-1\times 56 + 1\times x = -2$

$\Rightarrow$ $x = 54$

4. **(D)**

Same number of neutrons hence, Isotones.

5. **(B)**

Cathode Ray are made of electrons hence, same change/mass ratio as of $\beta$ particle.

6. **(B)**

From Muliken's oil drop experiment, it was found that change on oil droplets is qualified.

Hence,

q = ne . where $e = -1.6\times 10^{-19}$, n = 1, 2, 3…

$\therefore$ (B)

7. **(B)**

$f = \frac{1}{T} \Rightarrow f = 1/2$ Hz

8. **(D)**

$\text{VIBGYOR}^{\text{highest wavelength}}_{\text{lowest frequency}}$

Energy $\propto$ freq.

$\therefore$ (D) red

9. **(C)**

10. **(C)**

Wave number $\Rightarrow \bar{\upsilon} = \frac{1}{\lambda}$

$$\Rightarrow \quad \frac{1}{500\times10^{-9}} \quad \Rightarrow \quad \frac{\overset{2}{\cancel{1000}}\times10^{5}}{\cancel{500}}$$

11. **(C)**

$$E = \frac{hc}{\lambda}, \ \frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1} = 2$$

12. **(B)**

$$\text{Frequency} = \frac{\text{velocity}}{\text{wavelength}} = \frac{3\times10^{8}}{5090\times10^{3}}$$

13. **(B)**

$$E = nh\nu$$

$$n = \frac{E}{h\nu}$$

$$= \frac{10^{3}}{6.626\times10^{-34}\times880\times10^{3}} = 1.72\times10^{30}$$

14. **(C)**

$$E_{\text{photon}} = \frac{12400}{\lambda\left(\text{in}A^{0}\right)} = \frac{12400}{8900} = 1.393\,\text{eV}$$

$$1.393\times1.6\times10^{-19}\times x = 3.15\times10^{-14}$$

$$x = \frac{3.15}{1.393\times1.6}\times10^{5} \qquad x = 1.41\times10^{5}$$

$\therefore$ (c)

15. **(A)**

$$E_{\text{absorbed}}\times\frac{50}{100} = E_{\text{emitted out}}$$

$$\frac{hc}{\lambda_{\text{absorbed}}}\times n_1\times\frac{50}{100} = n_2\times\frac{hc}{\lambda_{\text{emitted}}}$$

$$\frac{n_2}{n_1} = \frac{50}{100}\times\frac{\lambda_{\text{emitted}}}{\lambda_{\text{absorbed}}} = \frac{50}{100}\times\frac{5000}{4500} = \frac{5}{9} = 0.55$$

16. **(A)**

As PE = - 2 KE

PE will change from - 2x to $-\frac{2x}{4}$

= $-\frac{x}{2} + 2x = +\frac{3}{2}x$

17. **(A)**

$T_E = \frac{PE}{2}$, so first excited state

18. **(D)**

$TE = \frac{-13.6\ Z^2}{n^2} = \frac{-13.6 \times 16}{16} = -13.6$ and $TE = \frac{PE}{2}$

$\Rightarrow$ PE = - 27.2 eV

19. **(B)**

$TE = \frac{-13.6\ Z^2}{n^2} = \frac{-13.6 \times 1}{9} = -1.511$

$TE = \frac{PE}{2} \Rightarrow PE = -3.02eV$ $TE = -KE \Rightarrow KE = 1.51eV$

20. **(C)**

$r = \frac{0.529n^2}{Z}\ A^0$

$r_{3rd} = \frac{0.529 \times 9}{2} = 2.3805\,A^0$ $r_{4th} = \frac{0.529 \times 16}{2} = 4.232$

21. **(D)**

$r_x = \frac{0.529\ n^2}{Z}$, n = 4

$r_H = \frac{0.529n^2}{Z}$, n = 1, z = 1

$r_x < r_H$

$\Rightarrow$ $\frac{0.529 \times 16}{Z} < 0.529 \Rightarrow Z > 16$

22. **(B)**

$v = 2.18 \times 10^6 \frac{Z}{n}$

$v \propto \frac{Z}{n}$ $\frac{v_1}{v_2} = \frac{n_2}{n_1} = \frac{5}{3}$

$\therefore$ (B)

23. **(D)**

$r_2 = \frac{a_0 \times 4}{Z} = R \qquad r_3 = \frac{a_0 \times 9}{Z}$

$\Rightarrow \quad r_3 = \frac{9R}{4}$

24. **(B)**

Ground state of hydrogen atom = 0.529 Å

$r = \frac{0.529 \times n^2}{z} = \frac{0.529 \times (n)^2}{4} = 0.529 \qquad \Rightarrow \; n = 2$

25. **(D)**

$V = \frac{2.18 \times 10^6 Z}{n}, \; v \; \alpha \; z, \; v \; \alpha \; \frac{1}{n}$

26. **(D)**

$\nu = \frac{V}{2\pi r} = \frac{2.18 \times 10^6 \times \frac{1}{2}}{2\pi \times 4 \times 0.529 \times 10^{-10}} = 8.13 \times 10^{14} \; s^{-1}$

27. **(C)**

$E = \frac{nhC}{\lambda} = nhc\bar{\upsilon}$

$10 = nhcx \qquad n = \frac{10}{hcx}$

28. **(C)**

$E = \frac{13.6Z^2}{n^2} = \frac{13.6 \times 1}{4} = 3.4$

29. **(D)**

$mvr = \frac{nh}{2\pi}$

$r = \frac{0.529n^2}{Z} \qquad mvr \; \alpha \; \sqrt{r}$

Angular momentum $\alpha \sqrt{r}$

30. **(B)**

$\nu = \frac{V}{2\pi r} \propto \frac{Z^2}{n^3}$

$\nu_H = \frac{1}{27} = T \qquad \nu_{He^+} = \frac{4}{8} = x$

$\frac{2}{27} = \frac{T}{x} \qquad x = \frac{27}{2} T$

= B

31. **(A)**

$$TE = \frac{-13.6Z^2}{n^2}eV$$

$$TE_{4,H} = \frac{-13.6}{16}eV = -KE = -E \qquad TE_{Li^{2+}} = \frac{-13.6 \times 9}{1} = x$$

$$\frac{1}{144} = \frac{-E}{x}$$

X = –144 E

32. **(B)**

$$R_{H} \times 1^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = R_{H} \times 2^2\left(\frac{1}{n_1'^2} - \frac{1}{n_2'^2}\right)$$

$$\Rightarrow \quad 1\times\left(\frac{1}{1} - \frac{1}{25}\right) = 4\times\left(\frac{1}{1} - \frac{1}{n_2^2}\right)$$

$$\Rightarrow \quad \frac{\cancel{24}^{6}}{25} = \cancel{4} \times \frac{n_2^2 - 1}{n_2^2} \qquad \Rightarrow \quad 6n_2^2 = 25n_2^2 - 25$$

$$\Rightarrow \quad 19n_2^2 = 25 \qquad \Rightarrow \quad n_2^2 = \frac{25}{15} = 1$$

$\therefore$ (b)

33. **(D)**

$$f = \frac{KZe^2}{r^2}$$

$$= \frac{KZe^2}{\left(\frac{0.529n^2}{Z}\right)^2} \propto \frac{Z^3}{n^4} \qquad f_{Li^{2+}} = \frac{27}{16} = f$$

$$f_H = \frac{1}{1} = x \qquad \frac{27}{16} = \frac{f}{x}$$

X = 16f/27

34. **(C)**

$$a = \frac{V^2}{r}$$

$$= \frac{\frac{(2.18 \times 10^6)^2 Z^2}{n^2}}{\frac{0.529n^2}{Z}} \qquad \propto \frac{z^3}{n^4}$$

$$a_{1,He^+} \propto \frac{8}{1} \qquad a_{2,Be^{3+}} \propto \frac{64}{16}$$

$$\Rightarrow \quad a_{2,Be^{3+}} = \frac{1}{2}\zeta$$

35. **(D)**

Follow the expression

$$r = \frac{n^2 \times 0.529}{Z}$$

$\Rightarrow$ (D)

36. **(A)**

Follow the expression

$$E = \frac{-13.6Z^2}{n^2}$$

$\Rightarrow$ (A)

37. **(B)**

See theory

38. **(A)**

$2n_2 + 3n_1 = 18$

$2n_2 - 3n_1 = 6$

Solve this and we get

$n_1 = 2,\ n_2 = 6$

So, $\frac{(6-2)(6-2+1)}{2} = 10$

39. **(B)**

$n_1 + n_2 = 4$

$n_2 - n_1 = 2$

$\Rightarrow \quad n_2 = 3,\ n_1 = 1$

$$\bar{\upsilon} = \frac{1}{\lambda} = R_H \times 2^2\left(\frac{1}{1^2} - \frac{1}{3^2}\right)$$

$$= R_H \times 4\left(\frac{8}{9}\right)$$

40. **(A)**

$$\frac{1}{\lambda} = R_H Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\nu = \frac{c}{\lambda} = cR_H Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\nu = \frac{c}{\lambda} = cR_H Z^2\left(\frac{1}{n^2} - \frac{1}{(n+1)^2}\right) = cR_H Z^2\left(\frac{2n+1}{n^2(n+1)^2}\right)$$

When n >>> 1 then $(n+1) \approx n$ and $(2n+1) \approx 2n$

$$\nu = 2cR_H Z^2 \frac{n}{n^4} = \frac{2cR_H Z^2}{n^3}$$

41. **(C)**

$$\frac{1}{\lambda_{min}} = 3^2 \times R\left(\frac{1}{3^2} - 0\right) = R$$

$$\Rightarrow \lambda_{min} = \frac{1}{R}$$

42. **(B)**

$$\frac{1}{\lambda_{max}} = R_H \times (2)^2\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

$$\frac{1}{\lambda_{max}} = R_H \times 4\left(\frac{1}{1} - \frac{1}{4}\right) \qquad \Rightarrow \lambda_{max} = \frac{1}{3R_H}$$

43. **(B)**

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = R\left(\frac{1}{1^2} - \frac{1}{n^2}\right)$$

$$n = \left[\frac{\lambda R}{\lambda R - 1}\right]^{\frac{1}{2}}$$

44. **(B)**

$E = E_1 + E_2$

$$\frac{hc}{\lambda} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$$

$$\lambda = \frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$$

45. **(C)**

$$\frac{1}{\lambda} = R_H Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\frac{1}{2170 \times 10^{-9}} = R_H\left(\frac{1}{n^2} - \frac{1}{7^2}\right) \qquad \Rightarrow n = 4$$

46. **(A)**

$$\frac{n(n-1)}{2} = 15$$

$n = 6$

$$\frac{1}{\lambda} = R_H Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\frac{1}{\lambda} = 109677\left(\frac{1}{1^2} - \frac{1}{6^2}\right)$$

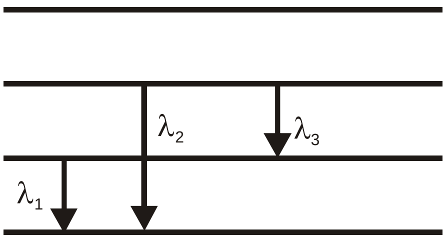
$= 937.3$ Å

47. **(A)**

$$\frac{n(n-1)}{2} = 6$$

n = 4, so excited state is $3^{rd}$

48. **(B)**




$1/\lambda_2 = 1/\lambda_1 + 1/\lambda_3$

$\lambda_2 = \lambda_1\lambda_3/(\lambda_1 + \lambda_3)$

49. **(A)**

$$\frac{1}{\lambda_L} = R_H\left(\frac{1}{1^2} - \frac{1}{\infty^2}\right) \Rightarrow \frac{1}{x} = R_H$$

$$\frac{1}{\lambda_B} = R_H \times 4\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

$$\frac{1}{\lambda_B} = \frac{1}{x} \times \frac{5}{9}$$

50. **(C)**

$$\Delta x \times m\Delta v = \frac{h}{4\pi}$$

$$\Delta x \times \Delta p = \frac{h}{4\pi}$$

$$\Delta x = \Delta p$$

$$(\Delta p)^2 = \frac{h}{4\pi}, \ \Delta p = \sqrt{\frac{h}{4\pi}}$$

$$m\Delta v = \sqrt{\frac{h}{4\pi}}$$

$$\Delta V = \frac{1}{2m}\sqrt{\frac{h}{\pi}}$$

51. **(C)**

Mass = $100 \times 10^3$ kg

V = 23.76 km s/hr = $23.76 \times \frac{5}{18}$ m / s

h = $6.6 \times 10^{-34}$

$$\lambda = \frac{h}{mV} = \frac{6.626 \times 10^{-34}}{100 \times 10^3 \times 23.76 \times \frac{5}{18}} \simeq 10^{-39} \text{m}$$

52. **(C)**

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}m\left(\frac{h}{m\lambda}\right)^2 \left(\begin{matrix}\lambda = \frac{h}{mv} \\ v = \frac{h}{m\lambda}\end{matrix}\right)$$

$$= \frac{1}{2}\frac{mh^2}{m^2\lambda^2} = \frac{1}{2}\frac{h^2}{m\lambda^2}$$

$$KE \ \alpha \ \frac{1}{m}$$

53. **(B)**

$$2\pi r = n\lambda$$

$$\lambda = \frac{2\pi r}{n} \qquad \Rightarrow \lambda = \frac{2\pi \times 3^2 x}{3} = 6\pi x$$

54. **(D)**

$$\left.\begin{matrix} m = 200g \\ v = 10 \ ms^{-1} \end{matrix}\right\} \Delta V = \frac{0.1}{100} \times 10$$

$$\Delta x \times m\Delta V = \frac{h}{4\pi}$$

$$\Delta x = \frac{h}{4\pi m\Delta v} = \frac{6.626 \times 10^{-34}}{4\pi \times \frac{200}{1000} \times \frac{0.1}{100} \times 10}$$

55. **(D)**
Follow theory

56. **(C)**
Follow theory

57. **(A)**

$\nu = 3.5 \times 10Hz$

$\nu_0 = 1.5 \times 10^{15}Hz$

$h = 6.6 \times 10^{-34}$

$KE = h\nu - h\nu_0$

$KE = 6.6 \times 10^{-34}(3.5 \times 10^{15} - 1.5 \times 10^{15}) = 1.32 \times 10^{-18}$ J

58. **(C)**

$KE = h\nu - h\nu_0$

$$\frac{1}{2}mv^2 = hc\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$$

$$v^2 = \frac{2hc}{m}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$$

$$v = \sqrt{\frac{2hc}{m}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)}$$

$$v = \sqrt{\frac{2hc}{m}\left(\frac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)}$$

59. **(D)**

$\lambda = \frac{h}{mv}$

$\frac{\lambda_A}{\lambda_B} = \frac{v_B}{v_A}$

When $\lambda_B = 2\lambda_A$, then $V_A = 2V_B$

$KE = \frac{1}{2}mv^2$

$\frac{T_A}{T_B} = \frac{V_A^2}{V_B^2}$

$\frac{T_A}{T_B} = \frac{4}{1}$

Also $T_A - T_B = 1.50$

$\therefore \quad T_B = 0.50$

$T_A = T_B + 1.5$

$= 0.50 + 1.50$

$= 2$

Also, $4.25 = W_A + T_A$

$4.20 = W_B + T_B$

$W_A = 4.25 - 2 = 2.25$

$W_B = 4.20 - 0.50 = 3.70$

60. **(B)**

$K_A = E_A - 2 \quad K_B = E_B - 4$

$\lambda_A = \frac{h}{\sqrt{2mK_A}}, \ \lambda_B = \frac{h}{\sqrt{2mK_B}}$

$\frac{\cancel{h}}{\sqrt{\cancel{2m}\ K_B}} = 2\frac{\cancel{h}}{\sqrt{\cancel{2m}\ K_A}}$

$\frac{1}{K_B} = \frac{4}{K_A}$

$E_A - 2 = 4E_B - 16 \qquad E_A - 2 = 4E_A + 2 - 16$

$3E_A = 12 \Rightarrow E_A = 4$

$\Rightarrow \quad E_B = 4.5$

61. **(A)**

See theory

62. **(A)**

Orbital angular momentum = $\sqrt{l(l+1)}\,\dfrac{h}{2\pi} = \sqrt{6}\times\dfrac{h}{2\pi}$

63. **(A)**

$\lambda = \dfrac{h}{mV}$

64. **(C)**
See theory

65. **(D)**
See theory

66. **(B)**

$\sqrt{l(l+1)}\,\dfrac{h}{2\pi}$

67. **(B)**
See theory

68. **(A)**
See theory

69. **(D)**
See theory

70. **(D)**
See theory

71. **(C)**
See theory

72. **(D)**
See theory

73. **(B)**
See theory

74. **(C)**
See theory

75. **(A)**
See theory

76. **(A)**
See theory

77. **(D)**

$n = 3, l = 3, m = 0, s = -1/2$

Not possible

78. **(C)**

Follow n + l rule

79. **(D)**

Follow theory

80. **(A)**

Follow $n + l$ rule

81. **(D)**

A g subshell will have 9 orbitals so there will be 18 electrons

82. **(C)**

n = 5

83. **(C)**

26(Iron) follow electronic configuration

84. **(D)**

(D) is not possible because 'P' sub shell cannot have more than 7 electrons.

85. **(A)**

$Mn = 3d^5\ 4s^2$

$Ti = 3d^2\ 4s^2$

$V = 3d^3\ 4s^2$

$Al = 3s^2\ 3p^1$

86. **(A)**

$\sqrt{n(n+2)}$ $\quad Fe = 3d^6\ 4s^2$

n = 4

$\sqrt{4(4+2)}$

87. **(C)**

$s = \pm\frac{1}{2}\times 5 = \frac{5}{2}$

88. **(A)**

See configuration.

89. **(D)**
Same as 85

90. **(C)**
See Theory

91. **(B)**
$\mu = \sqrt{n(n+2)}$
$2.83 = \sqrt{n(n+2)}$
$n = 2$

92. **(C)**
Same as 91

93. **(D)**
$\mu = \sqrt{n(n+2)}$
$1.73 = \sqrt{n(n+2)}$
n = 1

94. **(B)**
$\mu = \sqrt{n(n+2)}$
Write the electric configuration for both Fe and Co and after removal of 3 electron from I & 2 electron from cobalt the unpaired in $Fe^{+3} = 5$ and $Co^{+2} = 3$

## GET EQUIPPED TO JEE - Main

**1.** **(C)**
$E_{1, Li^{2+}} = \frac{9}{4} E_{1, He^{+}} = \frac{9}{4} \times 19.6 \times 10^{-18}$
$= 4.41 \times 10^{-17}$ J

**2.** **(D)**
$Al: 1s^2 2s^2 2p^6 3s^2 3p^1$
$\Rightarrow$ outermost $e^- : n = 3, \ell = 1$

**3.** **(A)**
$E = \frac{hc}{\lambda} \Rightarrow \frac{E_1}{E_2} = 2$

**4.** **(B)**
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$
$\ell = 1 \Rightarrow$ p subshell $\Rightarrow 12 e^-$

$\ell = 2 \Rightarrow$ d subshell $\Rightarrow 10e^-$

**5.** **(D)**

Orbital angular momentum $\alpha\sqrt{\ell(\ell+1)}$

$\Rightarrow$ same $\ell$ value has same orbital angular momentum.

**6.** **(B)**

By $(n+\ell)$ rule

**7.** **(B)**

$$r_3He^+ = \frac{n^2}{Z}a_0 = \frac{3^2}{2}a_0 = 4.5a_0$$

**8.** **(C)**

$$\nu = \frac{C}{\lambda} = \frac{3\times10^8}{500\times10^{-9}} = 6\times10^{14}\text{ Hz}$$

**9.** **(D)**

$$\frac{1}{\lambda} = 9\times15200 = 136800$$

**10.** **(D)**

**11.** **(A)**

Atomic no. $= 25 \quad \Rightarrow$ Mn

**12.** **(C)**

$2^{nd}$ series $\Rightarrow$ Balmer

$4^{th}$ Line in Balmer $\Rightarrow 6 \to 2$

**13.** **(A)**

Paschal Lines : $5 \to 3$

$4 \to 3$

**14.** **(B)**

**15.** **(A)**

$$E = \frac{1240}{242}\times1.6\times10^{-19}\times6.022\times10^{23}\times\frac{1}{1000}$$

**16.** **(C)**

m cannot be greater then $\ell$

**17.** **(A)**

**18.** **(D)**

**19.** **(A)**

$$\frac{1}{\lambda} = R\left(\frac{1}{4} - \frac{1}{9}\right) = \frac{5R}{36}$$

**20.** **(D)**

$$r = \frac{n^2}{Z}a_0$$

**21.** **(A)**

$1s^2 2s^2 2p^4$

No. of unpaired electron $= 2$

$\Rightarrow$ total spin $= 1$

Magnetic moment $= \sqrt{2 \times 4} = \sqrt{8}$

**22.** **(B)**

No. of angular nodes $= 2$

**23.** **(A)**

$$E = x\left(\frac{1}{4} - \frac{1}{9}\right) = \frac{5x}{36}$$

**24.** **(B)**

**25.** **(C)**

$$\text{Orbital angular momentum } = \sqrt{2 \times 3}\,\frac{\pi}{2\pi}$$

$$= \sqrt{6}\,\frac{h}{2\pi}$$

**26.** **(B)**

No. of radical nodes $= n - \ell - 1$

$= 2 - 1 - 1 = 0$

**27.** **(B)**

$$p = \frac{6.6 \times 10^{-34}}{0.1 \times 10^{-9}} = 66 \times 10^{-25}$$

**28.** **(D)**

**29.** **(D)**

$$\frac{nh}{2\pi} = \frac{2h}{\pi} = n = 4$$

$$\frac{1}{\lambda} = R\left(\frac{1}{9} - \frac{1}{16}\right)$$

$\lambda = \frac{144}{7R}$

**30.** **(B)**

Min. $\lambda \Rightarrow$ Max. E

**31.** **(C)**

$\frac{1}{\lambda} = R\left(\frac{1}{4} - \frac{1}{n^2}\right)$

$\lambda = \frac{4n^2}{R\left(n^2 - 4\right)} \Rightarrow R = \frac{4}{R}$

**32.** **(A)**

$E_{C\to A} = E_{C\to B} + E_{B\to A}$

$= \frac{1240}{364.6} + \frac{1240}{121.5}$ eV

$= 3.4 + 10.2$ $\quad = 13.6\,eV$

$= 13.6 = \frac{1240}{\lambda}$ $\quad \Rightarrow \lambda = 91.17\,nm$

**33.** **(A)**

Minimum $= 1$ $\quad 4 \to 1$

Maximum $= 4$ $\quad 4 \to 3 \to 2 \to 1$ & $4 \to 1$

$\frac{\Delta n\left(\Delta n + 1\right)}{2} \to$ only if sufficiently large number of atoms are present

**34.** **(D)**

Shortest wavelength implies maximum energy

$\therefore \frac{n\left(n-1\right)}{2} = 15$

$\Rightarrow \frac{1}{\lambda_{6\to 1}} = R_H\left(1\right)^2\left(\frac{1}{1} - \frac{1}{36}\right)$

$\frac{1}{\lambda} = \frac{35R}{36}$ $\quad \therefore \lambda = \frac{36}{35R}$

**35.** **(C)**

Total orbitals $= 3\ell + 1$

$= 3 \times 2 + 1$

$= 7$

$e^-$ in 1 orbital still $= 2$

Since it has only 2 types of spin

**36.** **(B)**

$L=\frac{nh}{2\lambda}$

**37.** **(B)**

$235+1=146+x+3$

$\Rightarrow x=90-3=87$

**38.** **(C)**

Radial $=1\rightarrow$ spherical

Angular $=3-1-1=1$

**39.** **(A)**

$S\rightarrow$ spherical (non-directional)

**40.** **(D)**

$E_{III\rightarrow I}=2E-E=\frac{hc}{\lambda}$

$E_{II\rightarrow I}=\frac{4E}{3}-E=\frac{hc}{\lambda'}$

$\Rightarrow\frac{E}{3}=\frac{hc}{\lambda'}$

$\Rightarrow\lambda'=3\lambda$

## WINDOW TO JEE MAIN

1. **(A)**

$Mn^{2+}=[Ar]3d^5$

$n=5\Rightarrow\mu=\sqrt{5(5+2)}=\sqrt{35}$ B.M.

$Fe^{2+}=[Ar]3d^6$, $n=4$

$Ti^{2+}=[Ar]3d^2$, $n=2$

$Cr^{2+}=[Ar]3d^4$, $n=4$

2. **(C)**

Refer theory

3. **(B)**

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

$n=4,\ \ell=0,\ m=0,\ s=\pm\frac{1}{2}$

4. **(C)**

$E_2-E_1=-3.4-(-13.6)=10.2\text{ eV}$

5. **(C)**
K.E. = 1000 eV = 1 KeV

6. **(A)**
Refer theory

7. **(A)**
$$\lambda = \frac{6.62\times10^{-34}}{0.5\times100} = 1.32\times10^{-35}\ \text{m}$$

8. **(B)**
No. of redial nodes = 5 – 2 – 1 = 2

9. **(D)**
Refer theory

10. **(D)**
Refer theory

11. **(C)**
Electrons enter into n = 3, $\ell = 2$ first because for same $(n+\ell)$ value, n value is lower for it.

12. **(C)**
If n = 4, $\ell < 4$ $(\ell = 0 \text{ to } 3)$

13. **(C)**
n = 3, $\ell = 2$, n = + 2 represents single orbital of 3d, which can accommodate max. 2 electron.

14. **(A)**
No. of nodal plane $= \ell = 1$

15. **(C)**
Refer theory

16. **(B)**
$$\lambda = \frac{6.62\times10^{-34}}{10\times10^{-3}\times100} = 6.62\times10^{-34}\,\text{m}$$

17. **(D)**
Angular momentum in an orbit $= \frac{nh}{2\pi}$
$$= \frac{5h}{2\pi}$$

18. **(C)**

$$\Delta V = \frac{0.001}{100} \times 300 = 3 \times 10^{-3} \text{ m/s}$$

$$\Delta X \geq \frac{h}{4\pi m \Delta V} = \frac{6.62 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 3 \times 10^{-3}}$$

$$= 19.3 \times 10^{-3} \text{ m}$$

19. **(C)**

For 4f, n = 4, $\ell = 3, m = -3$ to +3 & $\ell = \pm\frac{1}{2}$

20. **(D)**

Refer theory

21. **(C)**

For this system

$$\frac{1}{\lambda} = 2R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{1}{\lambda} = 2R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = 2R \times \frac{5}{36}$$

$$\lambda = \frac{18}{5R}$$

22. **(C)**

$(n+\ell)\uparrow$, higher energy

For $(n+\ell)$ having same value, n should be higher.

23. **(A)**

Ionisation enthalpy $= 1.312 \times 10^{16}$ J/mol

$$= \frac{1.312 \times 10^{6}}{60.2 \times 10^{23}} \text{ J/atom}$$

Energy required $= \frac{1.312 \times 10^{6}}{6.02 \times 10^{23}}\left[\frac{1}{1^2} - \frac{1}{2^2}\right]$

$$= \frac{1.312 \times 10^{6}}{6.02 \times 10^{23}} \times \frac{3}{4} = 0.16 \times 10^{-17} \text{ J/atom}$$

$$= 9.84 \times 10^{5} \text{ J/mol}$$

24. **(C)**

$$\Delta V = \frac{0.005}{100} \times 600 = 3 \times 10^{-2} \text{ m/s}$$

$$\Delta X = \frac{6.62 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 3 \times 10^{-2}} = 1.92 \times 10^{-3} \text{ m}$$

25. **(B)**

$$\lambda = \frac{6.63\times10^{-34}}{1.67\times10^{-27}\times10^{3}} = 3.97\times10^{-10}\ \text{m}$$

$$= 0.397\ \text{nm}$$

26. **(D)**

$$\text{Energy} = \frac{242\times10^{3}}{6.02\times10^{23}}\ \text{J/atom}$$

$$E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E} = \frac{2\times10^{-25}\times6.02\times10^{23}}{242\times10^{3}}$$

$$\lambda = 4.9\times10^{7}\,\text{m} = 490\ \text{nm}$$

27. **(B)**

$$\text{I.E.} \propto \frac{z^2}{n^2}$$

$$\frac{\text{I.E. of } Li^{2+}}{\text{I.E. of } He^{+}} = \frac{9}{4} \Rightarrow \text{I.E. of } Li^{2+} = 4.41\,\text{J/mol}$$

28. **(C)**

Refer theory

29. **(B)**

$$\frac{1}{\lambda} + \frac{1}{680} = \frac{1}{355} \Rightarrow \frac{1}{\lambda} = \frac{1}{355} - \frac{1}{680}$$

$$\lambda = \frac{355\times680}{(680-355)} = 742.76\ \text{nm}$$

30. **(B)**

$(n+\ell)\uparrow$ energy$\uparrow$

For same $(n+\ell)$, $n\uparrow$ energy$\uparrow$

31. **(B)**

$$\lambda = \frac{6.63\times10^{-34}}{1000\times36\times\frac{5}{18}}$$

$$\lambda = 6.63\times10^{-38}\,\text{m}$$

32. **(B)**

$n = 5,\ m = +1$ $\quad (4 \text{ orbitals} = 8 \text{ electrons})$

$n = 2,\ \ell = 1,\ m = -1,\ s = -\frac{1}{2}$ $\quad$ (1 electron of 2p)

33. **(A)**

$$\bar{\upsilon} = \frac{1}{\lambda} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5}{36}R$$

34. **(C)**

$n = 3,\ \ell = 2, m = +2$ (1 orbitals of 3d)

35. **(D)**

$$E = -2.178 \times 10^{-18} \times \frac{z^2}{n^2} J$$

$$\Delta E = \frac{2 \times 10^{-25}}{\lambda} = 2.178 \times 10^{-18} \times \left[\frac{1}{1} - \frac{1}{4}\right]$$

$$\lambda = \frac{2 \times 10^{-25} \times 4}{3 \times 2.178 \times 10^{-18}} = 1.22 \times 10^{-7} \text{ m}$$

36. **(C)**

Energy of $Li^{2+} = -13.6 \times \frac{9}{n^2} eV$

If $n = 2$ then

$$\text{Energy} = -13.6 \times \frac{9}{4} eV$$

$$= -30.6 \text{ eV}$$

37. **(C)**

$$\frac{1}{2}mv^2 = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$$

$$v^2 = \frac{2hc}{m}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$$

$$v = \sqrt{\frac{2hc}{m}\left(\frac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)}$$

38. **(D)**

$$\text{T.E.} = -\text{ K.E.} = \frac{\text{P.E.}}{2} = -\frac{1}{2}\frac{e^2}{r}$$

39. **(A)**

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{6.63 \times 10^{-34}}{6.63 \times 10^{-3} \times 100}$$

$$\lambda = 10^{-33} \text{ m}$$

40. **(D)**

$\text{Energy} = 495.5 \text{ KJ/mol}$

$$= \frac{495.5 \times 10^3}{6.022 \times 10^{23}} \text{ J/atom}$$

$$\upsilon = \frac{E}{h} = \frac{495.5 \times 10^3}{6.022 \times 10^{23} \times 6.626 \times 10^{-34}}$$

$$\upsilon = 1.24 \times 10^{25}\ s^{-1}$$

41. **(D)**

$Rb = [Kr]5s^1$

$n = 5, \ell = 0, m = 0, s = \pm\frac{1}{2}$

42. **(C)**

$E = -13.6 \times \frac{1}{n^2} eV$

If n = 2 then

$E = -3.4\ eV$

43. **(B)**

Refer theory

44. **(C)**

$\lambda = \frac{h}{\sqrt{2mqV}}$

$\frac{h}{\lambda} = \sqrt{2mqV} = \sqrt{2meV}$

45. **(D)**

No. of orbital $= n^2 = 25$