ATOMIC STRUCTURE

(ADVANCED)

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 $\left({}_0^0 n^1\right)$

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 β 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)**

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

Energy $\propto$ freq.

$\therefore$ (D) red

9. **(C)**

10. **(C)**

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

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

11. **(B)**

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

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)**

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

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

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

$\therefore \quad (c)$

15. **(A)**

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

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

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

16. **(A)**

As PE = - 2 KE

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

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

17. **(A)**

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

18. **(D)**

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

$\Rightarrow$ PE = - 27.2 eV

19. **(B)**

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

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

20. **(C)**

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

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

21. **(D)**

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

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

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

$R_x < r_H$

22. **(B)**

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

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

$\therefore$ (B)

23. **(D)**

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

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

24. **(B)**

Ground state of hydrogen atom = 0.529 Å

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

25. **(D)**

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

26. **(D)**

$$\nu = \frac{V}{2\pi r} = \frac{2.18\times10^{6}\times\frac{1}{2}}{2\pi\times4\times0.529\times10^{-10}} = 8.13\times10^{14}\ s^{-1}$$

27. **(C)**

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

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

28. **(C)**

$$E = \frac{13.6Z^2}{n^2} = \frac{13.6\times1}{4} = 3.4$$

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)**

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

$$TE_{4,H} = \frac{-13.6}{16}eV = -KE = -E \qquad TE_{Li^{2+}} = \frac{-13.6\times9}{1} = x$$

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

X = –144 E

32. **(B)**

$$R_H\times1^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right) = R_H\times2^2\left(\frac{1}{n_1^{12}}-\frac{1}{n_2^{12}}\right)$$

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

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

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

$\therefore$ (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. Follow the expression

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

$\Rightarrow$ (d)

36. Follow the expression

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

$\Rightarrow$ (a)

37. See theory

38. $2n_2 + 3n_1 = 18$

$2n_2 - 3n_1 = 6$

Solve this and we get

$n_1 = 2,\ n_2 = 6$

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

39. $n_1 + n_2 = 4$

$n_2 - n_1 = 2$

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

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

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

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

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

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

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

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

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

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

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

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

44. $E = E_1 + E_2$

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

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

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

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

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

n = 6

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

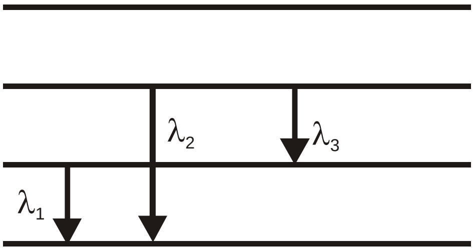
$$\frac{1}{\lambda} = 109677\left(\frac{1}{1^2} - \frac{1}{6^2}\right)$$

$= 937.3$ Å

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

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

48.



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

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

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

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

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

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

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

$\Delta x = \Delta p$

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

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

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

51. mass = 100×10^3 kg

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

h = 6.6×10^{-34}

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

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

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

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

53. $2\pi r = n\lambda$

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

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

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

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

55. Follow theory

56. (Follow theory)

57. $\nu = 3.5 \times 10 Hz$

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

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

$KE = h\nu - h\nu_0$

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

58. $KE = h\nu - h\nu_0$

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

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

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

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

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

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

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

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

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

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

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

$3E_A = 12 \Rightarrow E_A = 4$

$\Rightarrow \quad E_B = 4.5$

61. See theory

62. Orbital angular momentum = $\sqrt{l(l+1)}\ \frac{h}{2\pi} = \sqrt{6} \times \frac{h}{2\pi}$

63. $\lambda = \frac{h}{mV}$

64. See theory

65. See theory

66. $\sqrt{l(l+1)}\ \frac{h}{2\pi}$

67 to 76. See theory

77. n = 3, l = 3, m = 0, s = –1/2
Not possible

78. Follow n + l rule

79. Follow theory

80. Follow n + l rule

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

82. angular part cannot be 0 so no angular node , Hence s orbital. Two radial node means 3s

83. see theory

84. n = 5

85. See the graphs

86. Follow n – l – l

87. increasing Z will decrease radius

88. $\Psi_{3s} = \frac{1}{9\sqrt{3}}\left(\frac{1}{a_0}\right)^{3/2} (6 - 6\sigma + \sigma^2)e^{-\frac{\sigma}{2}}$; where $r = \frac{2r.Z}{3a_0}$

The maximum red all distance of node from nucleus will be $r = \frac{3}{2}\frac{(\sqrt{3}+3)}{Z}a_0$

radial node occurs where probability of finding e^- = 0

$\therefore \quad \Psi^2 = 0 \text{ or } \Psi = 0$

$\therefore \quad 6 - 6\sigma + \sigma^2 = 0 \text{ or } \sigma = 3 \pm \sqrt{3} = \frac{2rZ}{3a_0} \Rightarrow r = \frac{3}{2}\frac{3+\sqrt{3}}{z}a_0$

89. Probability of finding e^- is zero implies mat $\Psi^2 = 0$ or $\Psi = 0$

$(\sigma - 1) = 0,\ \sigma = 1 \Rightarrow r = \frac{a_0}{2z}$

$(\sigma^2 - 8\sigma + 12) = 0$

$(\sigma - 6)(\sigma - 2) = 0$

$\sigma = 6, \Rightarrow r = \frac{6a_0}{2Z} = \frac{3a_0}{Z}$

$R = 2, \Rightarrow r = \frac{a_0}{Z}$

90. 26(Iron) follow electronic configuration

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

92. $Mn = 3d^5\,4s^2$

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

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

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

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

n = 5

$\sqrt{5(5+2)}$

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

95. See configuration.

96. Same as 92

97. See Theory

98. $\mu = \sqrt{n(n+2)}$

$2.83 = \sqrt{n(n+2)}$

99. Same as 98

100. $\mu = \sqrt{n(n+2)}$

$1.73 = \sqrt{n(n+2)}$

N = 1

101. $\mu = \sqrt{n(n+2)}$

Write the electric configuration for both fe and Co and after removal of 3 electron from cobalt the unpaired in $Fe^{+3} = 5$ and $Co^{+3} = 4$

FOUNDATION BUILDER (SUBJECTIVE)

1. $E = \frac{nhc}{\lambda}$

$$600 = \frac{6.626\times10^{-34}\times3\times10^{8}\times2\times10^{22}}{\lambda}$$

$$600 = \frac{39.759\times10^{4}}{\lambda}$$

$$\lambda = 6630\,\text{nm}$$

2. $$E = \frac{hc}{\lambda} = \frac{19.878\times10^{-26}}{4.995\times10^{-7}}$$

$$= 3.979\times10^{-19}\ \text{J}$$

$$3.979\times10^{-19}\,\text{J} = 1\,\text{photon}$$

$$10^{3}\,\text{J} = 0.251\times10^{22}\ \text{photons}$$

$$\frac{0.25\times10^{22}}{6.022\times10^{23}}$$

$$0.0416\times10^{-1}$$

$$4.16\times10^{-3}$$

3. $$QE = \frac{\text{moles dissociated}}{\text{moles of photons abscrbed}}$$

$$2 = \frac{0.01}{\text{moles of photons absorbed}}$$

$$0.005\times6.022\times10^{23}$$

$$5\times10^{-3}\times6.022\times10^{23}$$

$$30.11\times10^{20}$$

4. Energy given to I_2 molecule $= \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{450\times10^{-10}}$

$$= 4.417\times10^{-19}\ \text{J}$$

Also energy used for breaking up of I_2 molecules

$$= \frac{240\times10^{3}}{6.022\times10^{23}} = 3.948\times10^{-19}\ \text{J}$$

$\therefore$ Energy used in importing KE to two I atoms = [4.417 – 3.984]

$$\text{KE}/\text{Iodine atom} = \left[4.417 - \frac{3.984}{2}\right]\times10^{-19}$$

$$= 0.216\times10^{-19}\ \text{J}$$

5.

(a) $$\frac{1}{\lambda} = R_H\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = 109677\left(\frac{1}{4} - \frac{1}{9}\right)$$

$$= \frac{109677\times5}{36} = 6564\,\overset{0}{\text{A}}$$

(b) $$\frac{1}{\lambda} = R_H\left(\frac{1}{4^2} - \frac{1}{5^2}\right) = 109677\left(\frac{1}{16} - \frac{1}{25}\right)$$

$$= \frac{109677 \times 9}{400} = 40523 \overset{0}{A}$$

9. (c) $\frac{1}{\lambda} = R_H \left(\frac{1}{9^2} - \frac{1}{10^2} \right) = 109677 \left(\frac{1}{81} - \frac{1}{100} \right)$

6.

Lyman Series

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

$$\frac{1}{\lambda} = \frac{109678 \times 3}{4}$$

$$\lambda = 1015 \overset{0}{A}$$

Balmer Series

$$\frac{1}{\lambda} = 109678 \left(\frac{1}{2^2} - \frac{1}{3^2} \right)$$

$$= 109678 \left(\frac{1}{4} - \frac{1}{9} \right)$$

$$= \frac{109678 \times 5}{36}$$

$$\lambda = 6564 \overset{0}{A}$$

Paschen Series

$$\frac{1}{\lambda} = 109078 \left(\frac{1}{3^2} - \frac{1}{4^2} \right)$$

$$= \frac{109678 \times 7}{144} = 18756 \overset{0}{A}$$

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

$$\frac{1}{\lambda} = 109678 \times 3^2 \left(\frac{1}{1^2} - \frac{1}{3^2} \right)$$

$$= 109678 \times 9 \left(\frac{1}{1} - \frac{1}{9} \right)$$

$$= \frac{109678 \times 9 \times 8}{9} = 113.9 \overset{0}{A} \text{ or } 11.39 \text{ nm}$$

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

$$\frac{1}{2170} = 1.09677 \times 10^7 \left(\frac{1}{n_1^2} - \frac{1}{7^2} \right)$$

Solve $n_1 = 4$

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

$$\frac{1}{\lambda} = 109678\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

$$= \frac{109678 \times 3}{4}$$

$$\lambda = 1215\,\overset{0}{A}$$

10. Energy given to H atom = $\frac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{1028 \times 10^{-10}}$

$$= 1.933 \times 10^{-18}\,J = 12.07\,eV$$

$\therefore$ Energy of the H atom offer excitation = – 13.6 + 12.07

$\therefore$ $E_n = \frac{E_1}{n^2}$

$n^2 = \frac{-13.6}{-1.53} \approx 9$ n = 3

Thus electron in H atom is excited to 3rd orbit

I induced $\lambda_1 = \frac{hc}{E_3 - E_1}$

$E_1 = -13.6\,eV$, $E_3 = -1.53\,eV$

$$\lambda_1 = \frac{6.026 \times 10^{-34} \times 3 \times 10^{8}}{(-1.53 + 13.6) \times 1.602 \times 10^{-19}} = 1028 \times 10^{-10}\,m = 1028\,\overset{0}{A}$$

$\therefore$ II Induced $\lambda_2 = \frac{hc}{E_2 - E_1}$

$E_1 = -13.6\,eV$ $E_2 = \frac{-13.6}{4}\,eV$

$$\lambda_2 = \frac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{\left(\frac{-13.6}{4} + 13.6\right) \times 1.602 \times 10^{-19}} = 1216 \times 10^{-10}\,m = 1216\,\overset{0}{A}$$

$\therefore$ III Induced $\lambda_3 = \frac{hc}{E_3 - E_2}$

$E_1 = -13.6\,eV$, $E_2 = \frac{-13.6}{4}\,eV$, $E_3 = \frac{-13.6}{9}\,eV$

$$\lambda_3 = \frac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{\left(\frac{-13.6}{9} + \frac{13.6}{4}\right) \times 1.662 \times 10^{-19}}$$

$$= 6568 \times 10^{10}\,m = 6568\,\overset{0}{A}$$

11. For visible line spectrum, i.e Balmer series $n_1 = 2$

Also for minimum energy transition. $n_2 = 3$

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

$$= 1.1 \times 10^{7}\left[\frac{1}{4} - \frac{1}{9}\right] = \frac{1.1 \times 10^{7} \times 5}{36}$$

$\lambda = 6.55 \times 10^{-7}$ meter

$$E = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{6.55\times10^{-7}} = 3.03\times10^{-19}\text{ Joules}$$

Energy released = $E\times N_A$

$$= 3.03\times10^{-19}\times6.022\times10^{23}$$
$$= 18.25\times10^{4}\text{ J}$$
= 182.5 kJ

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

$$= \frac{109677\times35}{36}$$

$$= 937.8\overset{0}{A}$$

13. Threshold wavelength $\left(\lambda^0 = 230\text{nm} = 230\times10^{-9}\text{m}\right)$

$$E_\rho = 13.6\left(1-\frac{1}{9}\right) = 12.09\,\text{eV}$$

$$KE_{max} = 12.09\times1.6\times10^{-19} - \frac{6.626\times10^{-34}\times3}{230\times10^{-9}}$$

$$= 1.07\times10^{-18}\text{ J}$$

14. $\overline{U} = 1.096\times10^{7}\left[1-n^2\right]$ where n = 2

Maximum wavelength means. Minimum Energy (minimum tranish)

$\overline{U} = 1.096\times10^{7}\left(1-2^{-2}\right]$

Maximum wavelength = $1215\overset{0}{A}$ or 1.216×10^{-7} meters

Minimum wavelength means maximum energy (max to)

$\overline{U} = 1.096\times10^{7}\left(1-\infty^{-2}\right]$

0.912×10^{-7} meter

Series will be ultraviolet region

15. for He^+, $\frac{1}{\lambda} = R_H Z^2\left[\frac{1}{2^2}-\frac{1}{4^2}\right]$

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

Since λ is same

$$z^2\left[\frac{1}{2^2}-\frac{1}{4^2}\right] = \left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$$

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

$n_1 = 1$ and $n_2 = 2$

16. shortest wavelength [largest energy] max transition

$\frac{1}{\lambda} = \overline{U} = R_H\left[\frac{1}{2^2}-\frac{1}{\infty^2}\right]$

= 109677/4 $= 27419\,\text{cm}^{-1}$

17. $V = \frac{2.18\times10^{6} Z}{n}$

$V \propto \frac{1}{n}$ $\quad V = \frac{2.18\times10^{6}\times1}{2} = 1.09\times10^{6}$ m/sec

$T = \frac{2\pi r}{V}$

18. i) $E = \frac{-13.6 Z^{2}}{n^{2}} = -\frac{13.6\times1}{9} = -1.51 eV$

ii) $r = \frac{0.529\, n^{2}}{z} = 0.529\times9 = 4.761 \overset{0}{A}$

iii) $\frac{1}{\lambda} = R_H\left(\frac{1}{1^2} - \frac{1}{3^2}\right]$

$\frac{1}{\lambda} = 109677\times1\left(\frac{8}{9}\right)$

$= 1025 \overset{0}{A}$ or 1.032×10^{-7} m

iv) $v = \frac{C}{\lambda} = \frac{3\times10^{8}}{1.032\times10^{-7}}$ 2.90×15

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

$r_I = 0.529 \overset{0}{A}$

$r_{II} = 0.529\times4 = 2.116 \overset{0}{A}$

$r_{III} = 0.529\times9 = 4.761 \overset{0}{A}$

$r_I\ He^{+} = \frac{0.529\times1}{2} = 0.2645 \overset{0}{A}$

$r_{II}\ He^{+} = \frac{0.529\times4}{2} = 1.058 \overset{0}{A}$

$r_{III}\ He^{+} = 0.529\times9 = 2.38 \overset{0}{A}$

20. $E = \frac{313.6\times Z^{2}}{n^{2}} = \frac{313\times1}{16} = 19.6\,Kcal$

21. $\frac{-13.6}{16}$ ______________ 4

$\frac{-13.6}{9}$ ______________ 3

$\frac{-13.6}{4}$ ______________ 2

– 13. 6 ______________ 1

$E_3 - E_1 = -1.51 - (-13.6)$ $\quad = 12.09$ eV

22. $E_n = \frac{-2.17\times10^{-12}}{n^{2}}\,erg$

$E_2 = -\frac{21.7\times10^{-12}}{4} = -5.425\times10^{-12}\,erg$

For removal of electron $E_2 = \frac{hc}{\lambda}$ E_2 should be given to remove electron i.e. + ve

$$\lambda = \frac{6.626\times10^{-27}\times3\times10^{10}}{5.425\times10^{-12}} = 3663.6\times10^{-8}\ \text{cm} = 3663.6\ \overset{0}{A}$$

So the longest wavelength = $3663-6\ \overset{0}{A}$

23. E_1 for $Li^{2+} = \frac{E_1 \text{ for } H\times Z^2}{n^2} = \frac{13.6\times9}{4} = 30.6\,eV$

E_1 for $Be^{3+} = \frac{E_1 \text{ for } H\times Z^2}{n^2} = \frac{13.6\times16}{4} = 54.4\,eV$

24. Energy of one photon = $\frac{hc}{\lambda}$

$$= \frac{6.626\times10^{-34}\times3\times10^{8}}{4500\times10^{-10}}\,J$$

$$= 4.42\times10^{-19}\ J$$

Energy emitted by bulb $=150\times\frac{8}{100}\ J/sec \left(\text{watt} = \frac{J}{sec}\right)$

$\therefore \quad n\times4.42\times10^{-19} = 150\times\frac{8}{100}$

$n = 27.2\times10^{18}$

25. E_3 for H = -2.41×10^{-12} erg

E_2 for H = -5.42×10^{-12} erg

$\therefore$ for a jump from III to II shell

$$\Delta E = E_3 - E_2 = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{E_3-E_2} = \frac{6.626\times10^{-27}\times3\times10^{10}}{-2.41\times10^{-12}+5.42\times10^{-12}}$$

$$= 6602.9\times10^{-8}\ \text{cm} = 6603\ \overset{0}{A}$$

26. $V = \frac{2.18\times10^{6}\times Z}{n} = \frac{2.18\times10^{6}}{3}$

$= 0.726\times10^{6}$

27. $v = \frac{V}{2\pi r} = \frac{2.18\times10^{6}}{2\times2\times3.14\times0.529\times4\times10^{-10}}$

$= 0.0819\times10^{16}\times10^{-8} \quad = 0.0819\times10^{8}$

28. E_1 for H = – 13 .6 eV

E_2 for H = $-\frac{13.6}{22} = -\frac{13.6}{4} = -3.4\,eV$

$E_1 - E_2 = -3.4-(-13.6) = +10.2\,eV$

Difference in two level = 10.2 eV

Also for transition of H like atom

$\lambda = 3\times10^{-8}$ m

$\frac{1}{\lambda} = R_H \times Z^2$ ________

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

$R_H = 109677\,cm^{-1} = 109677\times10^2\,m^{-1}$

$\therefore \quad \frac{1}{3\times10^{-8}} = 109677\times10^2\times2^2\left(\frac{3}{4}\right)$

$Z^2 = 4 \qquad Z = 2\ He^+$

29. The no of waves made by a bohr is equal to orbit no.

30. $E = hv$

$3.97\times10^{-19} = hv$

$v = \frac{3.97\times10^{-19}}{6.626\times10^{-34}} \qquad v = 0.599\times10^{15}$

31. copper surface $= \left(w = 4.5\,eV = \frac{hc}{\lambda^0}\right) 4.5\times1.6\times10^{-19} = \frac{6.626\times10^{-34}\times3\times10^8}{\lambda^0}$

$7.2\times10^{-19} = \frac{19.878\times10^{-26}}{\lambda^0} \quad = 2.76\times10^{-7}$ m

Similarly for sodium and cerium surface.

32. Energy of photon = work function + KE

Energy of photon = work function + eV_0

e = electronic charge $\qquad V_0$ = slopping potential

eV_0 = energy required to stop the ejection to electron

$E_{photon} = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^8}{253.7\times10^{-9}} = 7.834\times10$

$= \frac{7.834\times10^{-19}}{1.602\times10^{-19}} \qquad eV = 4.89\,eV$

Work function = 4.65 eV

33. Binding energy of electron = $180.69\,kJ\,mol^{-1}$

Binding energy of one electron = $\frac{180.69\times10^3}{6.022\times10^{23}}$ J

$= 30.00\ 49\times10^{-20}$

Binding energy $= hv^0$

$V^0 = \frac{30.0049\times10^{-20}}{6.626\times10^{-34}} = 4.52\times10^{14}\,sec^{-1}$

34.

35. Energy of photon liberated from He^+ during emission of first line of lymon sense.

$E = 13.6\,2^2\left(\frac{1}{h_1^2}-\frac{1}{h_2^2}\right) = 13.6\times4\left(\frac{1}{1^2}-\frac{1}{2^2}\right)$

$= \frac{13.6 \times 4 \times 3}{4} = 40.8\,\text{eV}$

This energy is used in liberating electron from H atom from ground state.

Therefore,

$40.8\,\text{eV} = E_1 \text{ of H} + KE^{-}\left(\frac{1}{2}mv^2\right)$

$40.8\,\text{eV} = 13.6 + KE$

KE = 40.8 – 13.6 = 27. eV

$= 27.2 \times 1.602 \times 10^{-12}$

$= 43.57 \times 10^{-12}$

36. $\rho = \frac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{360 \times 10^{-10}}$

$= 5.52 \times 10^{-18}$ Joules

kE = hv – hvo

$= 5.52 \times 10^{-18} - 7.52 \times 10^{-19}$

$= 47.68 \times 10^{-19}$ Joules

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

$= \frac{6.626 \times 10^{-34}}{\frac{100}{1000} \times 100} = 0.6626 \times 10^{-34}, 6.626 \times 10^{-35}$

38. $kE = \frac{1}{2}mv^2 = 4.55 \times 10^{-25}\,\text{J}$

$4^2 = \frac{4.55 \times 10^{-25} \times 2}{9.108 \times 10^{-31}}$

$4 = 10^3\,\text{m sec}^{-1}$

$\lambda = \frac{h}{mv} = \frac{6.629 \times 10^{-34}}{9.108 \times 10^{-31} \times 10^{3}}$

$= 7.27 \times 10^{-7}$ meter

39. $\underset{\left(\text{in } \overset{0}{\text{A}}\right)}{\lambda} = \left[\frac{150}{V}\right]^{1/2}$

$\lambda = \sqrt{\frac{150}{v}}$

$\lambda = \sqrt{\frac{150}{100}} \qquad = 1.227\,\overset{0}{\text{A}}$

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

$= \frac{6.626 \times 10^{-34}}{9.108 \times 10^{-31} \times \frac{3 \times 10^{8} \times 1}{20}}$

$= 4.899 \times 10^{-11}\,\text{m}$

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

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

$= \frac{6.626\times10^{-34}}{4\times3.14\times9.108\times10^{-31}\times10^{-10}}$

$= 5.8\times10^{5}\ \text{m}\sec^{-1}$

42. $\Delta v = 3\times10^{7}\times0.02 = 6\times10^{5}$

$\Delta x = \frac{6.6\times10^{-34}}{4\times3.14\times1.67\times10^{-27}\times6\times10^{5}}$

43. for an electron

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

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

Thus, $\frac{1}{2}m\frac{h^2}{m^2\lambda^2} = eV$

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

$= \frac{1\times6.626\times10^{-34}}{2\times9.108\times10^{-31}\times\left(1.54\times10^{-10}\right)^2\times1.602\times10^{-19}}$

= 63.3 volt

44. Due to Hund’s Rule

45. A d subshell can have maximum 10 electrons

46. $\left.\begin{array}{l} S^2 = \text{dimagnetic} \\ \quad = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6 \end{array}\right]$ magnetic moment = 0

$Co^{3+} = \text{Paramagnetic}$

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

$\mu = \sqrt{n(n+2)}$

$\sqrt{4(4+2)}$ = 4.8913 BM

47. $\Psi_{2s} = \frac{1}{2\sqrt{2\pi}}\left[\frac{1}{a_0}\right]^{1/2}\left[2-\frac{r}{a_0}\right]e^{-r/2a_0}$

AT $r = r_0$, radial node is formed

For radial node at $r = r_0$, $\psi_{2s}^2 = 0$ this is possible only when $\left[2-\frac{r}{a_0}\right] = 0$

$2 = \frac{r_0}{a_0}$ $\quad$ $r_0 = 2q_0$

GET EQUIPPED TO MAINS

1. **(C)**

$$E_{1,Li^{2+}} = \frac{9}{4}E_{1,He^{+}} = \frac{9}{4}\times19.6\times10^{-18}$$

$$= 4.41\times10^{-17}\text{ J}$$

2. **(D)**

$n\ell$: $1s^2 2s^2 2p^6 3s^2 3p^1$

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

6. **(B)**

By $(n+\ell)$ rule

7. **(B)**

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

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 : $5 \rightarrow 3$

$4 \rightarrow 3$

14. **(B)**

15. **(A)**

$$E = \frac{1240}{242} \times 1.6 \times 10^{-19} \times 6.022 \times 10^{23} \times \frac{1}{1000}$$

16. **(C)**

m cannot be greater then ℓ

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)**

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)**

$$p=\frac{6.6\times10^{-34}}{0.1\times10^{-9}}=66\times10^{-25}$$

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)

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

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

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

$=13.6=\dfrac{1240}{\lambda}$ $\qquad$ $\Rightarrow\lambda=91.17\,nm$

33. (a)

Minimum $=1$ $\qquad$ $4\to1$

Maximum $=4$ $\qquad$ $4\to3\to2\to1$ & $4\to1$

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

34. (d)

Shortest wavelength implies maximum energy

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

$$\Rightarrow\frac{1}{\lambda_{6\to1}}=R_H\left(1\right)^2\left(\frac{1}{1}-\frac{1}{36}\right)$$

$\dfrac{1}{\lambda}=\dfrac{35R}{36}$ $\qquad$ $\therefore\lambda=\dfrac{36}{35R}$

35. (c)

Total orbitals $=3\ell+1$

$=3\times2+1$

$=7$

e^- in 1 orbital still $= 2$
Since it has only 2 types of spin

36. **(b)**

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

37. **(b)**

$235 + 1 = 196 + x + 3$
$\Rightarrow x = 90 - 3 = 87$

38. **(c)**

Radial $= 1 \rightarrow$ spherical
Angular $3 - 1 - 1 = 1$

39. **(a)**

$S \rightarrow$ spherical (non-directional)

40. $E_{111\rightarrow 1} = 2E - E = \frac{hc}{\lambda}$

$$E_{11\rightarrow 1} = \frac{4E}{3} - E = \frac{hc}{\lambda'}$$

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

$$\Rightarrow \lambda' = 3\lambda$$

GET EQUIPPED TO ADVANCE

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

$$\frac{1}{\lambda} = 1069n \times 4\left(\frac{1}{3^2} - \frac{1}{\infty^2}\right)$$

$$\lambda = \boxed{2051Å}$$

2. $$T = \frac{3\pi r}{V} = 2\pi \times \frac{\frac{0.529n^2}{z}}{\frac{2.18 \times 10^6 z}{n}}$$

$$T \propto \frac{n^3}{z^2}$$

3. $\frac{-13.6}{16}$ ____________________ 4

$\frac{-13.6}{9}$ ____________________ 3

$\frac{-13.6}{4}$ ____________________ 2

13.6 ____________________ 4

$E_4 - E_2 = 2.55eV$

5. $$\lambda = \frac{h}{\sqrt{2\ KE.m}}$$

$$\lambda = \frac{6.626 \times 10^{34}}{\sqrt{2 \times 6.8 \times 1.6 \times 10^{-19} \times 9.106 \times 10^{31}}}$$

Total is 20.4 out of which 136 goes for ionization. So rest is 6.8 which goes for KE

$\boxed{= 4.7\ \text{Å}}$

6. $\Delta x + \Delta P = \dfrac{h}{4\pi}$

$\Delta P = \dfrac{h}{4\pi\Delta x} = \dfrac{6.626 \times 10^{-34}}{4 \times 3.14 \times 1 \times 10^{-9}}$

$= 0.527 \times 10^{-25}$

$= \boxed{5.2 \times 10^{-26}}$

7. $\dfrac{1}{\lambda} = R_H Z^2\left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right), \dfrac{1}{\lambda} = 109677 \times 4\left(\dfrac{1}{2^2} - \dfrac{1}{\infty}\right)$

$\lambda = 911\text{Å}$

$\lambda = \dfrac{h}{mc} = \dfrac{6.628 \times 10^{-34}}{3 \times 10^8 m}$

8. By looking at wavelength increasing for can say it belongs to visible range

$E_p = \dfrac{1242}{486.4} = 2.55$ eV $\Rightarrow$ 4th orbit to 2nd orbit

9. $r = \dfrac{0.529 \times 4}{Z}$

$= \dfrac{0.529 \times 4}{3} = 0.705\text{Å}$

10. $WF = E_p - K_{max}$

$= 4 \times 10^{-20} - \dfrac{(6.626 \times 10^{-34})^2}{2 \times 9.11 \times 10^{-31} \times (59 \times 10^{-10})}$

$= 3.313 \times 10^{-20}$J

11. $\dfrac{hc}{\lambda} = \dfrac{hc}{8208} - \dfrac{hc}{22800}$

$\lambda = 12825\text{Å}$

12. $\lambda_1 = \sqrt{\dfrac{150}{100}}\text{Å}$ …(1)

$\lambda_2 = \sqrt{\dfrac{150}{81}}\text{Å}$ …(2)

$\lambda_3 = \sqrt{\dfrac{150}{49}}\text{Å}$ …(3)

From (1), (2) and (3)

$\dfrac{\lambda_3 - \lambda_2}{\lambda_1} = \dfrac{20}{03}$

13. No. of node = 1

14. $9_0 = 0$ is electron is in nucleus $e^{-r/90} = 0$

15

16. **(a)**

P.E. = - 2 K.E.

$\Rightarrow$ $P.E. = -mv^2$

17. **(b)**

$\lambda = \dfrac{h}{mv}$, $K.E. = \dfrac{1}{2}mv^2$

$$\lambda = \frac{h}{\sqrt{2m\,K.E.}}$$

$$\lambda = \frac{6.6\times10^{-34}}{\sqrt{2\times9.1\times10^{-31}\times4.55\times10^{-25}}} = 7.27\times10^{-7}\,m$$

18

19. **(c)**

No. of orbitals $= 2l+1$

20. **(a)**

$$\frac{E_{1H}}{E_{2Be}} = \frac{1/1}{(4)^2/(2)^2} = \frac{4}{16} = 1:4$$

21. $\frac{1}{\lambda} = R_H\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = \frac{3R_H}{4}$

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

$$\frac{1}{\lambda} = R_H \times 16\left(\frac{1}{1^2} - \frac{1}{2^2}\right)\frac{R_H \times 16 \times 3}{4} = R_H \times 12$$

(D) (Be^{3+})

22. $\overline{U} = R_H\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = 152000$

$$\overline{U} = R_H \times 9\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = \frac{R_H \times 9 \times 5}{364}$$

= 137096.25

23. $KE_1 = h\nu_1 - h\nu^0$

$$KE_2 = h\nu_2 - h\nu^0$$

$$\frac{1}{k} = \frac{\nu_1 - \nu_0}{\nu_2 - \nu_0}$$

$$\nu_0 = \frac{k\nu_1 - \nu_2}{k - 1}$$

24. $-(n^{th}) + (n+1)^{th} = (n-1)^{th}$

$(n+1)^2 - (n)^2 = (n-1)^2$

$2n + 1 = n^2 - 2n + 1$

$N^2 - 4n = 0 \Rightarrow n = 4$

33. **(a)**

$U = +2\times \text{Total Energy}$