EXERCISE - 1 [A]

1. **(A)**

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

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

2. **(D)**

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

Particle	Charge	Mass
$\propto$	+ 2e	+ 4u
n	0	+ 1u
p	+ 1e	+ 1u
e	– 1e	$= \frac{1}{1837} u$

$\left(\frac{q}{m}\right)$ order $\longrightarrow$ $n < \alpha < p < e$

3. **(D)**

Atomic Number = No. of protons in atom

By equation of charge

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

$\Rightarrow$ x = 54

4. **(D)**

Same number of neutrons hence, Isotones.

5. **(B)**

Cathode Ray are made of electrons hence, same charge/mass ratio as of β particle.

6. **(B)**

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

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

$\therefore$ (B)

7. **(B)**

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

8. **(D)**

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

$$\text{Energy} \propto \text{freq.}$$

$\therefore$ (D) red

9. **(C)**

Rutherford's experiment showed first time that atom has nucleus.

10. **(C)**

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

$$\Rightarrow \quad \frac{1}{500 \times 10^{-9}} \quad \Rightarrow \quad \frac{\overset{2}{\cancel{1000}} \times 10^{6}}{\cancel{500}}$$

11. **(C)**

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

12. **(B)**

$$\text{Frequency} = \frac{\text{velocity}}{\text{wavelength}} = \frac{3 \times 10^{8}}{5090 \times 10^{3}}$$

13. **(B)**

$$E = nh\nu$$

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

$$= \frac{10^{3}}{6.626 \times 10^{-34} \times 880 \times 10^{3}} = 1.72 \times 10^{30}$$

14. **(C)**

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

$$1.393 \times 1.6 \times 10^{-19} \times x = 3.15 \times 10^{-14}$$

$$x = \frac{3.15}{1.393 \times 1.6} \times 10^{5} \qquad x = 1.41 \times 10^{5}$$

$\therefore \quad (c)$

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 $-\frac{2x}{4}$

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

17. **(A)**

$TE = \frac{PE}{2}$, 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)**

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

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

20. **(C)**

$$r = \frac{0.529n^2}{Z}\ Å$$

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

21. **(D)**

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

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

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

$R_x < r_H$

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)**

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

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

24. **(B)**

Ground state of hydrogen atom = 0.529 Å

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

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

28. **(C)**

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

29. **(D)**

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

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

Angular momentum $\alpha \sqrt{r}$

30. **(B)**

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

$$\frac{\nu_{He^+}}{\nu_H} = \frac{\frac{2^2}{2^3}}{\frac{1^2}{3^3}} \Rightarrow \frac{\nu_{He^+}}{\delta} = \frac{27}{2} \Rightarrow \nu_{He^+} = \frac{27}{2}\delta$$

31. **(A)**

$$E = -KE$$

$$E \propto \frac{Z^2}{n^2}$$

$$\frac{E_{1,\,Li^{2+}}}{E_{4,\,H}} = \frac{\frac{3^2}{1^2}}{\frac{1^2}{4^2}} \Rightarrow \frac{E_{1,\,Li^{2+}}}{-€} = \frac{144}{1} \Rightarrow E_{1,\,Li^{2+}} = -144\,€$$

32. **(B)**

$$R_{\not{H}} \times 1^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = R_{\not{H}} \times 2^2\left(\frac{1}{n_1^{12}} - \frac{1}{n_2^{12}}\right)$$

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

$$\Rightarrow \quad \frac{\not{24}^{\,6}}{25} = \not{4} \times \frac{n_2^2 - 1}{n_2^2} \qquad \Rightarrow \quad 6n_2^2 = 25n_2^2 - 25$$

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

$\therefore$ (b)

33. **(D)**

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

$$= \frac{KZe^2}{\left(\frac{0.529n^2}{Z}\right)^2} \propto \frac{Z^3}{n^4}$$

$$\frac{f_{1,\,H}}{f_{2,\,Li^{2+}}} = \frac{\frac{1^3}{1^4}}{\frac{3^3}{2^4}} \Rightarrow \frac{f_{1,\,H}}{f} = \frac{16}{27} \Rightarrow f_{1,\,H} = \frac{16}{27}f$$

34. **(C)**

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

$$= \frac{\dfrac{(2.18\times10^6)^2 Z^2}{n^2}}{\dfrac{0.529n^2}{Z}} \qquad \propto \frac{z^3}{n^4}$$

$$\frac{a_{2,\,Be^{3+}}}{a_{1,\,He^{+}}} = \frac{\dfrac{4^3}{2^4}}{\dfrac{2^3}{1^4}} \Rightarrow \frac{a_{2,\,Be^{3+}}}{\zeta} = \frac{64}{128} \Rightarrow a_{2,\,Be^{3+}} = \frac{1}{2}\zeta$$

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)**

Transition of an electron from n = 2 to n = 1 is in *UV* spectrum.

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)**

$n_1 + n_2 = 4$

$n_2 - n_1 = 2$

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

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

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

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

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

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

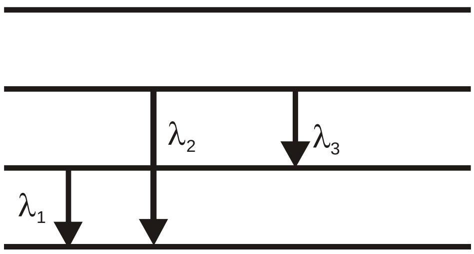
= 937.3 Å

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 × 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. **(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. **(C)**

Uncertainty principle has significance only on microscopic particles.

55. **(A)**

$\nu = 3.5 \times 10^{15}$ Hz

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

h = 6.6 × 10^{-34}

KE = $h\nu - h\nu_0$

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

56. **(C)**

KE = $h\nu - h\nu_0$

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

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

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

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

57. **(A)**

$WF = E_p - K_{max}$

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

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

58. **(B)**

$KE_1 = h\nu_1 - h\nu_0$

$KE_2 = h\nu_2 - h\nu_0$

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

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

59. **(A)**

Number of nodal planes = l

60. **(A)**

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

61. **(A)**

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

62. **(C)**

For 3f orbital n = 3, l = 3, which is not possible because l can lie between 0 to n – 1.

63. **(D)**

Schrodinger equation gives n, l, m_l

64. **(B)**

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

65. **(B)**

Shape is decided by Azimuthal quantum number l.

66. **(A)**

Number of radial nodes = n – l – 1

67. **(D)**

Number of electrons in any orbit $= \sum_{\ell=0}^{\ell=n-1} 2(2\ell+1)$

68. **(D)**

Plank theory explains dual nature of photon.

69. **(C)**

Orbital is a region where probability of finding electron is very high (90-95%).

70. **(D)**

de-Broglie concept, Heisenberg's principle and Schrodinger wave equation all are based on wave nature on electron.

71. **(B)**

p-orbital contain maximum 2 electrons.

72. **(C)**

Magnetic quantum number decide orientation of orbital in space.

73. **(A)**

Principal quantum number n decide location and energy of electron.

74. **(A)**

m_l can have values between $-l$ to $+l$.

75. **(D)**

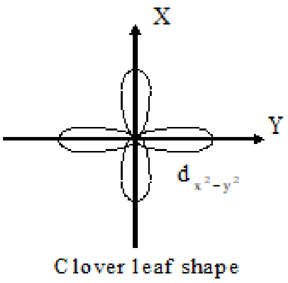
n = 3, l = 3, m = 0, s = –1/2

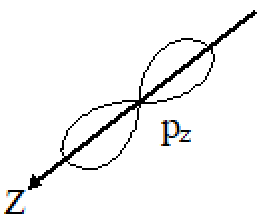
Which is not possible because l can lie between 0 to n – 1.

76. **(C)**

Follow n + l rule

77. **(D)**





78. **(A)**

Follow n + l rule

79. **(D)**

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

80. **(C)**
Angular part cannot be 0 so no angular node, Hence s orbital. Two radial node means 3s

81. **(D)**
4d atomic orbitals have one radical node, so graph will have two maxima.

82. **(C)**
n = 5

83. **(C)**
See the graph of 3s, 3p and 3d.

84. **(D)**
Number of local maxima = n – *l*

85. **(C)**
Increasing Z will decrease radius

86. **(C)**
Fe_{26} : [Ar] $4s^2$ $3d^6$

87. **(D)**
(D) is not possible because 'p' sub shell cannot have more than 6 electrons.

88. **(A)**
$Mn = 3d^5\,4s^2$

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

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

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

89. **(A)**
$Fe : 3d^6\,4s^2$

$Fe^{2+} : 3d^6\ 4s^0$

n = 4

$\mu = \sqrt{4(4+2)} = 2\sqrt{6}\,BM$

90. **(C)**
$s = \pm\frac{1}{2}\times 5 = \frac{5}{2}$

91. **(A)**
Next element is copper.
$Cu - [Ar]3d^{10}\,4s^1$ (Exception)

92. **(D)**

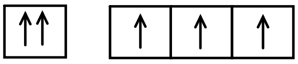
$Mg^{2+}:[Ne] \Rightarrow n=0$

$Ti^{3+}:[Ar]\,3d^{1}\,4s^{0} \Rightarrow n=1$

$V^{3+}:[Ar]\,3d^{2}\,4s^{0} \Rightarrow n=2$

$Fe^{2+}:[Ar]\,3d^{6}\,4s^{0} \Rightarrow n=4$

93. **(C)**



Both electrons in s-orbital have same spin in this configuration.
Hence, their all quantum numbers are same so Pauli principle is violated.

94. **(B)**

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

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

$Fe^{2+}:[Ar]\,3d^{6}\,4s^{0} \Rightarrow n=4$

$Ni^{2+}:[Ar]\,3d^{8}\,4s^{0} \Rightarrow n=2$

$Mn^{2+}:[Ar]\,3d^{5}\,4s^{0} \Rightarrow n=5$

$Co^{3+}:[Ar]\,3d^{6}\,4s^{0} \Rightarrow n=4$

95. **(C)**

$3.873=\sqrt{n(n+2)} \Rightarrow n=3$

$Mn^{2+}:[Ar]\,3d^{5}\,4s^{0} \Rightarrow n=5$

$Mn^{3+}:[Ar]\,3d^{4}\,4s^{0} \Rightarrow n=4$

$Mn^{4+}:[Ar]\,3d^{3}\,4s^{0} \Rightarrow n=3$

$Mn^{5+}:[Ar]\,3d^{2}\,4s^{0} \Rightarrow n=2$

96. **(D)**

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

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

N = 1

97. **(B)**

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

$Fe^{3+}:[Ar]\,3d^{5}\,4s^{0} \Rightarrow n=5$

$Co^{2+}:[Ar]\,3d^{7}\,4s^{0} \Rightarrow n=3$

$$\frac{\mu_{Fe^{3+}}}{\mu_{Co^{2+}}}=\frac{\sqrt{5(5+2)}}{\sqrt{3(3+2)}}=\frac{\sqrt{35}}{\sqrt{15}}$$

EXERCISE - 1 [B]

1. (A)
Hydrogen nucleus has only one proton & no neutron.

2. (A)
Cathode rays are electrons, hence mass of cathode rays same for all gases.

3. (D)
For electron
$$\frac{e}{m}=\frac{1.6\times10^{-19}}{9.1\times10^{-31}}\ C/kg$$
For α particle
$$\frac{e}{m}=\frac{2\times1.6\times10^{-19}}{4\times1.67\times10^{-27}}C/kg$$

4. (A)
Radius of nucleus is of order 10^{-15} m while radius of atom is of order 10^{-10} m.

5. (C)
$$\begin{aligned}\text{Radius of nucleus } &=1.3\times10^{-15}(M)^{1/3}\\ &=1.3\times10^{-15}(64)^{1/3}\\ &=5.2\times10^{-15}m\\ &=5.2\,fm\end{aligned}$$

6. (C)
Cathode rays are electron & hence their speed is less than light.

7. (B)
$$-6.4\times10^{-19}=n\times\left(-1.6\times10^{-19}\right)\Rightarrow n=4$$

8. (D)
Rutherford experiment proved that positive charge of atom is concentrated in central region called nucleus which is almost stationary.

9. (D)
$$\begin{aligned}\text{Energy } &=40\times20\\ &=800J\end{aligned}$$
$$800\times\frac{80}{100}=n\times\frac{6.626\times10^{-34}\times3\times10^{8}}{620\times10^{-9}}$$
$$n=2\times10^{21}$$

10. (B)

$$\frac{1}{500}=\frac{1}{800}+\frac{1}{\lambda}\Rightarrow\lambda=\frac{500\times800}{800-500}=\frac{4000}{3}=1333\,\text{nm}$$

11. (D)

$$r_{3,\,Li^{2+}}=\frac{3^2}{3}\times r_{1,\,H}=3\times r_{1,\,H}$$

12. (C)

$$E_{3,Li^{2+}}=-\left(\frac{9}{9}\right)\times\left(\frac{E_{1,He^+}}{4}\right)=\frac{1}{4}\times19.6\times10^{-18}=-4.9\times10^{-18}\text{ J / atom}$$

13. (D)

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

$\Rightarrow$ outermost $e^-: n=3,\ \ell=1$

14. (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 $\Rightarrow 10e^-$

15. (D)

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

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

16. (B)

By $(n+\ell)$ rule

17. (B)

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

18. (C)

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

19. (D)

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

20. (D)

In a given shell, *l* = 2, *m* = +2, denotes one particular orbital which can contain only one electron with spin value = $\frac{1}{2}$.

21. (A)

Atomic no. $= 25 \Rightarrow$ Mn

22. (C)

2^{nd} series $\Rightarrow$ Balmer

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

23. (A)

Paschan Lines : $5 \rightarrow 3$

$4 \rightarrow 3$

24. (B)

Splitting of spectral lines in electric field is called as stark effect.

25. (A)

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

26. (C)

m cannot be greater then ℓ

27. (A)

$Co : [Ar] 4s^2\ 3d^7$

$Co^{3+} : [Ar]\ 4s^0\ 3d^6$

28. (D)

$Cr : [Ar] 4s^1\ 3d^5$

29. (A)

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

30. (D)

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

31. (A)

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

No. of unpaired electron $= 2$

$\Rightarrow$ total spin $= 1$

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

32. (B)

No. of angular nodes $= 2$

33. **(A)**

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

34. **(B)**

XZ-plane is the nodal plane for p_y orbital.

35. **(C)**

Orbital angular momentum $=\sqrt{2\times 3}\,\frac{\pi}{2\pi}=\sqrt{6}\,\frac{h}{2\pi}$

36. **(B)**

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

$= 2-1-1=0$

37. **(B)**

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

38. **(D)**

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

39. **(D)**

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

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

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

40. **(B)**

Min. $\lambda \Rightarrow \text{Max. E}$

41. **(C)**

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

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

42. **(A)**

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

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

$= 3.4 + 10.2 = 13.6\,eV$

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

43. (A)

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

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

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

44. (D)

Shortest wavelength implies maximum energy

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

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

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

45. (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

46. (B)

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

47. (B)

4 $235 + 1 = 146 + x + 3$

$\Rightarrow x = 90 - 3 = 87$

48. (C)

Radial node (spherical) = 3 – 1 –1 = 1

Angular node (non-spherical) = 1

49. (A)

$S \to$ spherical (non-directional)

50. (D)

$E_{111\to1} = 2E - E = \frac{hc}{\lambda}$

$E_{11\to1} = \frac{4E}{3} - E = \frac{hc}{\lambda'}$

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

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. **(D)**

Angular momentum in an orbit $= \dfrac{nh}{2\pi}$

$= \dfrac{5h}{2\pi}$

3. **(C)**

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

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

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

4. **(C)**

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

5. **(C)**

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

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

6. **(A)**

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

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

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

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

$= 9.84 \times 10^5$ J/mol

7. **(C)**

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

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

8. **(B)**

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

$$= 0.397 \text{ nm}$$

9. **(D)**

$$\text{Energy} = \frac{242 \times 10^{3}}{6.02 \times 10^{23}} \text{ J/atom}$$

$$E = \frac{hC}{\lambda} \Rightarrow \lambda = \frac{hC}{E} = \frac{2 \times 10^{-25} \times 6.02 \times 10^{23}}{242 \times 10^{3}}$$

$$\lambda = 4.9 \times 10^{-7} \text{m} = 490 \text{ nm}$$

10. **(B)**

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

$$\frac{\text{I.E. of Li}^{2+}}{\text{I.E. of He}^{+}} = \frac{9}{4} \Rightarrow \text{I.E. of Li}^{2+} = 4.41 \times 10^{-17} \text{ J/atom}$$

Energy of first orbit of $Li^{2+} = -\text{I.E. of } Li^{2+}$

11. **(C)**

$${}_{64}Gd \rightarrow [Xe]4f^{7}\,5d^{1}\,6s^{2}$$

12. **(B)**

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

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

13. **(B)**

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

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

14. **(B)**

$$\lambda = \frac{6.63 \times 10^{-34}}{1000 \times 36 \times \frac{5}{18}}$$

$$\lambda = 6.63 \times 10^{-38} \text{m}$$

15. **(B)**

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

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

16. **(A)**

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

17. **(C)**

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

18. **(D)**

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

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

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

19. **(C)**

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

If $n = 2$ then

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

$= -30.6 \ eV$

20. **(C)**

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

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

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

21. **(A)**

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

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

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

22. **(D)**

Energy $= 495.5$ KJ/mol

$$= \frac{495.5\times10^{3}}{6.022\times10^{23}}\text{ J/atom}$$

$$\upsilon = \frac{E}{h} = \frac{495.5\times10^{3}}{6.022\times10^{23}\times6.626\times10^{-34}}$$

$$\upsilon = 1.24\times10^{15}\text{ s}^{-1}$$

23. **(D)**

$$\text{Rb} = [\text{Kr}]5s^{1}$$

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

24. **(C)**

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

If n = 2 then

$$E = -3.4\text{ eV}$$

25. **(B)**

$$ns \rightarrow (n-2)f \rightarrow (n-1)d \rightarrow np$$

Sequence of filling of electrons.

26. **(C)**

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

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

27. **(D)**

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

28. (B)

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

$$r_3 = 0.529\times\frac{3^{2}}{1} \Rightarrow r_4 = 0.529\times\frac{4^{2}}{1}$$

$$\frac{r_4}{r_3} = \frac{4^{2}}{3^{2}} = \frac{16}{9} \Rightarrow r_4 = \frac{16r_3}{9}$$

29. (C)

$$W = h\nu = 6.6\times10^{-34}\times1.3\times10^{15} = 8.58\times10^{-19}\text{ J}$$

30. (C)

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

For $Li^{2+}, r = \frac{a_0 (2)^2}{3} = \frac{4a_0}{3}$

31. (A)

For determined shortest wavelength, $n_2 = \infty$

For Lyman series, $\bar{\nu}_L = \frac{1}{\lambda_L} = R\left[\frac{1}{(1)^2} - \frac{1}{\infty^2}\right]$

For Paschen series, $\bar{\nu}_P = \frac{1}{\lambda_P} = R\left[\frac{1}{(3)^2} - \frac{1}{\infty^2}\right]$

$\frac{\bar{\nu}_L}{\bar{\nu}_P} = \frac{\lambda_P}{\lambda_L} = 9$

32. (C)

According to Bohr's model energy in n^{th} state

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

For second excited state, of $He^+, n = 3$

$\therefore\ E_3(He^+) = -13.6 \times \frac{2^2}{3^2} eV = -6.04 eV$

33. (C)

$\lambda = 250 nm$

$E = \frac{hc}{\lambda} = \frac{1240 eV.nm}{250 nm} = 4.96 eV$

KE= stopping potential $= 0.5 eV$

$E = W_0 + K.E.$

$4.96 = W_0 + 0.5$

$W_0 = 4.46 \approx 4.5 eV$

34. (B)

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

$r = 211.6 pm = 2.11 \mathring{A} \Rightarrow 0.529 \times \frac{n^2}{1} = 2.11 \mathring{A} [Z = 1]$

$n = 2$ (Balmer series)

35. (C)

According to Bohr's model $v \propto \frac{Z}{n}$

$Z =$ Atomic no. (corresponding to $+ve$ charge)

$n =$ Principal quantum no.

This relation suggest that when the Z increases, the velocity will also increase, so statement I is wrong and as 'n' decreases, velocity will also increase. So statement II is correct.

36. (C)

Energy of one mole of photons $=\frac{hc}{\lambda}\times N_A$

$=\frac{6.63\times10^{-34}\times3\times10^{8}}{300\times10^{-9}}\times6.02\times10^{23}$

$=399.13\times10^{3}$ Joule/mole=399 kJ/mole

37. (D)

$2\pi r=n\lambda$

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

$2\pi\times\frac{4^2}{1}a_0=4\lambda\Rightarrow\lambda=2\pi\times\frac{4}{1}a_0\Rightarrow\lambda=8\pi a_0$

38. (D)

Given $\lambda=1.5\pi a_0$ …….(i)

Radii of stationary states (r) is expressed as:

$r=a_0\frac{n^2}{Z}$ ………(ii)

From equation (i) and (ii)

$n\lambda=\frac{2\pi a_0n^2}{Z};\lambda=\frac{2\pi a_0n}{Z}$

$1.5\pi a_0=2\pi a_0\frac{n}{Z}\Rightarrow\frac{n}{Z}=\frac{1.5}{2}=0.75$

39. (D)

According to de-Broglie wavelength equation,

$\lambda=\frac{h}{mv}\Rightarrow\lambda\propto\frac{1}{v}$

According to photoelectric effect.

$h\nu-h\nu_0=\frac{1}{2}mv^2;\nu-\nu_0=\frac{1}{2}\times\frac{mv^2}{h}$

$\nu-\nu_0\propto v^2\Rightarrow v\propto\nu-\nu_0{}^{1/2}$

$\therefore\lambda\propto\frac{1}{(\nu-\nu_0)^{1/2}}$

40. (B)

First Bohr orbit of H atom has radius $r=0.529\,\mathring{A}$. Also, the angular momentum is quantised.

$mvr=\frac{h}{2\pi}\Rightarrow2\pi r=\frac{h}{mv}=\lambda$

$\therefore\lambda=2\pi\times0.529\,\mathring{A}$

41. (B)

Lower the value of $(n+l)$ for an orbital, lower is its energy. If two orbitals have same value of $(n+l)$ then lower value of n will have the lower energy

$A\Rightarrow3d\Rightarrow n+l=3+2=5$

$B\Rightarrow4p\Rightarrow n+l=4+1=5$

$C \Rightarrow 4d \Rightarrow n + l = 4 + 2 = 6$
$D \Rightarrow 3s \Rightarrow n + l = 3 + 0 = 3$
Order is $D < A < B < C$

42. (A)
(A) $n + l = 3 + 0 = 3$
(B) $n + l = 4 + 0 = 4$
(C) $n + l = 3 + 1 = 4$
(D) $n + l = 3 + 2 = 5$
Higher $(n + l)$ value, higher the energy ; if same $(n + l)$ value, then higher n value, higher the energy.
Thus: $D > B > C > A$

43. (C)

Orbit	Angular nodes (ℓ)	Radial nodes $(n - \ell - 1)$
2p	$\ell = 1$	$2 - 1 - 1 = 0$
3p	$\ell = 1$	$3 - 1 - 1 = 1$
3s	$\ell = 0$	$3 - 0 - 1 = 2$
2s	$\ell = 0$	$2 - 0 - 1 = 1$

3s orbital has no angular nodes and two radial nodes.

44. (C)
Number of radical nodes $= n - l - 1$
Number of angular nodes $= l$
For $5d; n = 5, l = 2$
5d orbital has two radial nodes and two angular nodes.

45. (D)
Atomic orbital is characterised by *n*, *l*, *m*.

46. (D)
Isotopes have same atomic number but different mass number. They have different number of neutrons which results in different mass number.

47. (D)
As in Thomson model, protons are diffused (charged is not centered) α-particles deviate by small angles and due to repulsion from protons, their speed decreases.

48. (B)
In the Balmer series of H–atom, the transition takes place from the higher orbital to $n = 2$. Therefore, the longest wavelength corresponds to $n_1 = 2$ and $n_2 = 3$. As wavelength decreases, energy increase or we can say that n_2 increases. The energy difference between two consecutive lines decreases or the line slowly converge. Hence, statement I, II, III are the correct statements among the given options.

49. (C)

For emission spectrum,

$$\bar{v} = R_H\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) \Rightarrow \bar{v} = R_H\left(\frac{1}{n^2} - \frac{1}{8^2}\right)$$

$$\Rightarrow \bar{v} = \frac{R_H}{n^2} - \frac{R_H}{64}$$

Comparing to $y = mx + c$, we get

$x = \frac{1}{n^2}$ and $m = +R_H$ (slope)

50. (B)

When temperature is increased, black body emits high energy radiation from higher wavelength to lower wavelength.

51. (D)

(a), (b) and (c) are according to quantum theory but (d) is statement of kinetic theory of gases.

52. (A)

Under the given situation,

$n = 1, l = 0, 1, 2$

$n = 2, l = 0, 1, 2, 3$

$n = 3, l = 0, 1, 2, 3, 4$

According to (n + l) rule, order of filling of subshells will be:

1s, 1p, 2s, 1d, 2p, …..

Atomic number 6	$1s^2\ 1p^4$
Atomic number 9	$1s^2\ 1p^6\ 2s^1$
Atomic number 8	$1s^2\ 1p^6$
Atomic number 13	$1s^2\ 1p^6\ 2s^2\ 1d^3$

Therefore option (a) is correct.

53. (A)

As the value of Z (atomic number) increase, energy orbitals decreases (becomes more –ve value).

$\therefore$ order of energy of 2s orbital is H > Li > Na > K.

54. (C)

	$n+\ell$
(I) $n = 4$ $\ell = 2$ $4d$	6
(II) $n = 3$ $\ell = 2$ $3d$	5
(III) $n = 4$ $\ell = 1$ $4p$	5
(IV) $n = 3$ $\ell = 1$ $3p$	4

The energy of an atomic orbital increases with increasing $n+\ell$. For identical values of $n+\ell$, energy increases with increasing value of *n*. Therefore the correct order of energy is:

$$\begin{matrix} 3p & < & 3d & < & 4p & < & 4d \\ \text{IV} & & \text{II} & & \text{III} & & \text{I} \end{matrix}$$

55. (492)

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

$$\frac{1}{\lambda} = R\left(\frac{1}{5^2} - \frac{1}{3^2}\right)$$

$$\frac{\lambda_2}{720} = \frac{\frac{7}{16\times 9}}{\frac{16}{25\times 9}} = \frac{7}{16}\times\frac{25}{16}$$

$$\lambda = 492$$

56. (50)

Power of infrared range = 1 mW = 10^{-3} W or 10^{-3} Js^{-1}

$\therefore$ In 0.1 second the energy emitted = 10^{-4} J

$$\because\ E = nh\nu = nh\frac{c}{\lambda} \Rightarrow \text{ then; } 10^{-4} = n\times\frac{hc}{\lambda}$$

$$\Rightarrow 10^{-4} = \frac{n\times 6.63\times 10^{-34}\times 3\times 10^{8}}{1000\times 10^{-9}}$$

$$\Rightarrow n = 5.02\times 10^{14} = 50.2\times 10^{13}$$

57. (548)

$$\Delta x\times\Delta p_x \geq \frac{h}{4\pi}$$

$$\Rightarrow 2a_0\times m\Delta \mathrm{v}_x = \frac{h}{4\pi} \text{ (for minimum uncertainty)}$$

$$\Rightarrow \Delta \mathrm{v}_x = \frac{h}{4\pi}\times\frac{1}{2a_0}\times\frac{1}{m}$$

$$= \frac{6.63\times 10^{-34}}{4\times 3.14\times 2\times 52.9\times 10^{-12}\times 9.1\times 10^{-31}}$$

$$= 548273\ \mathrm{ms}^{-1} = 548.273\ \mathrm{km\ s}^{-1}$$

58. (58)

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

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

$$\Delta \mathrm{v} = 5\times 10^{6}\times\frac{0.02}{100}$$

$$\Delta \mathrm{v} = 10^{3}\ \mathrm{m/s}$$

$$\Delta x = \frac{h}{4\pi \times m \cdot \Delta v} = \frac{6.63\times10^{-34}}{4\times3.14\times9.1\times10^{-31}\times10^{3}}$$

$= 5.8\times10^{-8}$ m

$= 58\times10^{-9}$ m

59. (2)

$$\lambda = \frac{h}{\sqrt{2m(K.E.)}}; K.E. = \frac{h^2}{2m\lambda^2}$$

$$K.E. = \frac{h^2}{2m\lambda^2} = \frac{43.9\times10^{-68}}{2\times9.1\times10^{-31}\times10.89\times10^{-20}}$$

$K.E. = 2.215\times10^{-18}$

$E_{abs} = E_{req} + K.E.$

$$\frac{E_{abs}}{E_{req}} = 1 + \frac{K.E.}{E_{req}} = 1 + \frac{2.215\times10^{-18}}{13.6\times1.602\times10^{-19}} = 2.0166$$

60. (4)

No. of neutrons $= 26$; No. of electrons $= 25$

% of extra neutrons than electrons $= \frac{26-25}{25}\times100 = 4$

61. (10)

Maximum number of spectral lines

$$= \frac{n(n-1)}{2} = \frac{5\times4}{2} = 10$$

62. (2)

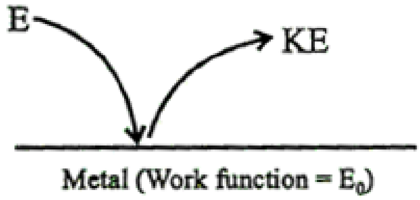
Total energy per sec. $= 50J$

$\because E = nh\nu = \frac{nhc}{\lambda}$

$$50 = \frac{n\times6.63\times10^{-34}\times3\times10^{8}}{795\times10^{-9}}$$

$n = 2\times10^{20}$

63. (222)



$E = E_0 + (KE)_{max}$

$$\frac{hc}{\lambda} = 4.41\times10^{-19} + KE$$

$$\frac{6.63\times10^{-34}\times3\times10^{8}}{300\times10^{-9}} = 4.41\times10^{-19} + KE$$

So, $(KE)_{max} = 6.63\times10^{-19} - 4.41\times10^{-19}$

$= 2.22\times10^{-19}\,J = 222\times10^{-21}\,J$

64. (1758)

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

$$\frac{h}{9.1\times10^{-31}\times x\, v_{neutron}} = \frac{h}{1.6\times10^{-27}\times v_{neutron}}$$

$$x = 1758$$

65. (22)

$$m\times2.4\times10^{-26}\times10^{-7} = \frac{6.626\times10^{-34}}{4\pi}$$

$$m = 22gm$$

66. (6)

d-broglie wave-length of electron:

$$\lambda_e = \frac{h}{\sqrt{2m(KE)}} \left\{\begin{array}{l}\because e^{-}\text{is acceleated} \\ \text{from rest} \\ \Rightarrow KE = q\times v\end{array}\right\}$$

$$\lambda = \frac{h}{\sqrt{2mqV}} = \frac{6.63\times10^{-34}}{\sqrt{2\times1.6\times10^{-19}\times9.1\times10^{-31}\times40\times10^{3}}}$$

$$= 0.614\times10^{-11}m = 6.14\times10^{-12}m$$

67. (9)

Incident energy of photon = Work function of metal +K.E. of photoelectron

$$h\nu = h\nu_0 + KE \qquad \ldots\ldots(i)$$

Incident energy of photon

$$= \frac{hc}{\lambda} = \frac{6.63\times10^{-34}\times3\times10^{8}}{248\times10^{-9}\times1.6\times10^{-19}}eV = 5eV$$

Now using equation (i),

$$5 = 3 + KE$$

$$KE = 2.0eV$$

Now, $\lambda = \frac{h}{\sqrt{2m\,KE}} = \frac{6.63\times10^{-34}}{\sqrt{2\times9.1\times10^{-31}\times2\times1.6\times10^{-19}}}$

$$= 8.68\times10^{-10}m \approx 9\mathring{A}$$

68. (2)

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

$$\frac{\lambda_{Li}}{\lambda_P} = \sqrt{\frac{m_P(e)V}{m_{Li}(3e)(V)}} \qquad m_{Li} = 8.3m_P$$

$$\frac{\lambda_{Li}}{\lambda_P} = \sqrt{\frac{1}{8.3\times3}} = \frac{1}{5} = 0.2 = 2\times10^{-1}$$

69. (2)

For a given value of n, l ranges from 0 to $n-1$

For given l, m_l ranges from $-l$ to $+l$

Quantum number of set (B) and (C) can be correct (A) and (D) are wrong as $n = l$ is not possible.

70. (0)

$Zn^{+} \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$

Outermost electron is in 4 s subshell, so $m = 0$

71. (0)

$Ga^{+} : 1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$

The azimuthal quantum number for the valence electron (4s-subshell) of Ga^{+} ion is zero(0).

72. (0)

Given: $n = 4$ and $m_l = 3$

Hence, l value must be 3.

$\therefore$ Number of radial nodes $= n - l - 1$

$= 4 - 3 - 1 = 0$