Speed Test-30

1. **(c)** The species CO, NO^+, CN^- and C_2^{2-} contain 14 electrons each.

2. **(d)** Rutherford used doubly charged helium particle. (α - particle)

3. **(d)** $E_n^{H} = -2.18\times10^{-18}\left(\frac{Z^2}{n_H^2}\right)J = \frac{-2.18\times10^{-18}}{n_H^2}J$

$$E_n^{He^+} = -2.18\times10^{-18}\left(\frac{Z^2}{n_{He^+}^2}\right)J = \frac{-2.18\times10^{-18}\times4}{n_{He^+}^2}J$$

$$E_n^{H} = E_n^{He^+} \Rightarrow \frac{1}{n_H^2} = \frac{4}{n_{He^+}^2} \Rightarrow n_{He^+} = 2\times n_H$$

If $n_H = 1$ Then $n_{He^+} = 2$

If $n_H = 2$ Then $n_{He^+} = 4$

If $n_H = 3$ Then $n_{He^+} = 6$

4. **(c)** Energy of a photon, $E = \frac{hc}{\lambda}$

$$= \frac{6.626\times10^{-34}(Js)\times3\times10^{8}(ms^{-1})}{331.3\times10^{-9}(m)} = 6\times10^{-19}J$$

No. of photons emitted per second

$$= \frac{600\ (J)}{6\times10^{-19}(J)} = 10^{21}$$

5. **(a)** $\Delta E = 2.178\times10^{-18}\left(\frac{1}{1^2}-\frac{1}{2^2}\right) = \frac{hc}{\lambda}$

$$2.17\times10^{-18}\times\frac{3}{4} = \frac{hc}{\lambda} = \frac{6.62\times10^{-34}\times3\times10^{8}}{\lambda}$$

$$\lambda = \frac{6.62\times10^{-34}\times3\times10^{8}\times4}{2.17\times10^{-18}\times3} = 1.214\times10^{-7}m$$

6. **(d)** Energy required to break one mole of Cl – Cl bonds in Cl_2

$$= \frac{242\times10^{3}}{6.023\times10^{23}} = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{\lambda}$$

$$\therefore \lambda = \frac{6.626\times10^{-34}\times3\times10^{8}\times6.023\times10^{23}}{242\times10^{3}}$$

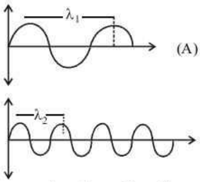
$$= 0.4947\times10^{-6}\ m = 494.7\ nm$$

7. **(d)** For Balmer $n_1 = 2$ and $n_2 = 3$;

$$\bar{\nu} = R_H\left(\frac{1}{2^2}-\frac{1}{3^2}\right) = \frac{5R_H}{36}\ cm^{-1}$$

8. **(c)** For 4p electron $n = 4, l = 1, m = -1, 0 + 1$ and $s = +\frac{1}{2}$ or $-\frac{1}{2}$.

9. **(c)** Em waves shown in figure A has higher wavelength in comparison to em waves shown in figure B. Thus these waves also differ in frequency and energy. $\nu = \frac{c}{\lambda}$



(A) $\Rightarrow E_1 = \frac{hc}{\lambda_1}$

(B) $\Rightarrow E_2 = \frac{hc}{\lambda_2}$

$$\lambda_1 > \lambda_2 \Rightarrow E_1 < E_2$$

10. **(a)** For d-subshell $\Rightarrow$ Number of orbitals = 5, $l = 2$
f-subshell $\Rightarrow$ Number of orbitals = 7, $l = 3$
s-subshell $\Rightarrow$ Number of orbitals = 1, $l = 0$
p-subshell $\Rightarrow$ Number of orbitals = 3, $l = 1$

11. **(a)** For s-electron, $l = 0$

$$\therefore \text{Orbital angular momentum} = \sqrt{0(0+1)}\frac{h}{2\pi} = 0$$

12. **(b)** $\Delta E = h\nu = \frac{hc}{\lambda}$;

$$\therefore \lambda = \frac{hc}{\Delta E} = \frac{6.63\times10^{-34}(3\times10^{8})}{3.03\times10^{-19}} = 656\ nm$$

13. **(a)** $(n + l)$ rule the higher the value of $(n + l)$, the higher is the energy. When $(n+l)$ value is the same see value of n.

	I	II	III	IV
$(n + l)$	(4 + 1)	(4 + 0)	(3 + 2)	(3 + 1)
	5	4	5	4

$\therefore$ IV < II < III < I

14. **(c)** (i) Beyond a certain wavelength the line spectrum becomes band spectrum.
(ii) For Balmer series $n_1 = 2$
(iv) For calculation of longest wavelength use nearest value of n_2. Hence for longest wavelength in Balmer series of hydrogen spectrum, $n_1 = 2$ & $n_2 = 3$.

15. (a) $\bar{\nu} = \frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

For second line in lyman series

$n_2 = 3$

$\therefore \frac{1}{\lambda} = R_H\left[\frac{1}{1^2} - \frac{1}{3^2}\right] = R_H\left[\frac{1}{1} - \frac{1}{9}\right] = \frac{8R_H}{9}$

16. (c) The kinetic energy of the ejected electron is given by the equation

$$h\nu = h\nu_o + \frac{1}{2}mv^2 \quad \because \nu = \frac{c}{\lambda}$$

or $$\frac{hc}{\lambda} = \frac{hc}{\lambda_o} + \frac{1}{2}mv^2$$

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

$$= hc\left(\frac{\lambda_o - \lambda}{\lambda\lambda_o}\right)$$

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

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

17. (a) $p = \frac{h}{\lambda} = \frac{6.63\times10^{-34}}{2.2\times10^{-11}} = 3\times10^{-23}\ \text{kg / s}$

18. (d) Atomic orbitals are 4s, 3s, 3p and 3d. $(n + l)$ values being 4, 3, 4 and 5. Hence 3d has highest energy.

19. (a)

20. (b) Since electrons are negatively charged particles they got deflected toward positively charged electrode whereas proton being positively charged will get deflected toward negative electrode. Since neutrons are neutral, so they went straight.

21. (a) The expression for orbital angular momentum is

Angular momentum $= \sqrt{l(l+1)}\left(\frac{h}{2\pi}\right)$

For d orbital, $l = 2$.

Hence, $L = \sqrt{2(2+1)}\left(\frac{h}{2\pi}\right) = \sqrt{6}\left(\frac{h}{2\pi}\right)$

22. (c) $\Delta x \,.\, \Delta p = \frac{h}{4\pi}$ or $\Delta x \,.\, m\Delta v = \frac{h}{4\pi}$;

$$\Delta v = \frac{0.011}{100}\times3\times10^4 = 3.3\ \text{cms}^{-1}$$

$$\Delta x = \frac{6.6\times10^{-27}}{4\times3.14\times9.1\times10^{-28}\times3.3} = 0.175\ \text{cm}$$

23. (b) $E = h\nu = \frac{hc}{\lambda}$; and $\nu = \frac{c}{\lambda}$

$$8\times10^{15} = \frac{3.0\times10^8}{\lambda}$$

$$\therefore \lambda = \frac{3.0\times10^8}{8\times10^{15}} = 0.37\times10^{-7} = 37.5\times10^{-9}\ \text{m} = 4\times10^1\ \text{nm}$$

24. (a) According to de-Broglie's equation

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

Given, $h = 6.6\times10^{-34}$ Js, $m = 200\times10^{-3}$ kg

$$v = \frac{5}{60\times60}\text{m/s}$$

$$\lambda = \frac{6.6\times10^{-34}}{200\times10^{-3}\times5/(60\times60)} = 2.38\times10^{-10}\ \text{m}$$

25. (b) Average atomic mass of Fe

$$= \frac{(54\times5)+(56\times90)+(57\times5)}{100} = 55.95$$

26. (a) $\Delta E = -2.0\times10^{-18}\times\left(\frac{1}{2^2} - \frac{1}{1^2}\right)$

$$= -2.0\times10^{-18}\times\frac{-3}{4}$$

$$= 1.5\times10^{-18}$$

$$\Delta E = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{\Delta E} = \frac{6.6\times10^{-34}\times3\times10^8}{1.5\times10^{-18}} = 1.325\times10^{-7}\ \text{m}$$

27. (a) We know $\Delta p.\Delta x \geq \frac{h}{4\pi}$

since $\Delta p = \Delta x$ (given)

$\therefore \Delta p.\Delta p = \frac{h}{4\pi}$

or $m\Delta v.\, m\Delta v. = \frac{h}{4\pi}$ $[\therefore \Delta p = m\Delta v]$

or $(\Delta v)^2 = \frac{h}{4\pi m^2}$

or $\Delta v = \sqrt{\frac{h}{4\pi m^2}} = \frac{1}{2m}\sqrt{\frac{h}{\pi}}$

Thus option (a) is the correct option.

28. (b) The radius of nucleus is of the order of 1.5×10^{-13} to 6.5×10^{-13} cm or 1.5 to 6.5 Fermi (1 Fermi $= 10^{-13}$ cm)

29. (b)

30. **(b)**

	5p	4f	6s	5d
$(n+l)$	5+1	4+3	6+0	5+2
	6	7	6	7

Hence the order is 5p < 6s < 4f < 5d

31. **(a)**

32. **(c)**

33. **(c)** Not more than two electrons can be present in same atomic orbital. This is Pauli's exclusion principle.

34. **(a)**

35. **(b)**

36. **(c)**

37. **(d)** Total energy of a revolving electron is the sum of its kinetic and potential energy.

Total energy = K.E. + P. E.

$$= \frac{e^2}{2r} + \left(-\frac{e^2}{r}\right)$$

$$= -\frac{e^2}{2r}$$

38. **(d)** From the expression of Bohr's theory, we know that

$$m_e v_1 r_1 = n_1 \frac{h}{2\pi}$$

$$\& \; m_e v_2 r_2 = n_2 \frac{h}{2\pi}$$

$$\frac{m_e v_1 r_1}{m_e v_2 r_2} = \frac{n_1}{n_2} \frac{h}{2\pi} \times \frac{2\pi}{h}$$

Given, $r_1 = 5r_2, n_1 = 5, n_2 = 4$

$$\frac{m_e \times v_1 \times 5r_2}{m_e \times v_2 \times r_2} = \frac{5}{4}$$

$$\Rightarrow \frac{v_1}{v_2} = \frac{5}{4 \times 5} = \frac{1}{4} = 1:4$$

39. **(a)** The electronic configuration of Rubidium (Rb = 37) is

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^1$

Since last electron enters in 5*s* orbital

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

40. **(d)** Except Al^{3+} all contain one electron and Bohr's model could explain the spectra for one electron system, Bohr's model was not able to explain the spectra of multielectron system.

41. **(a)**

42. **(d)** $r_n = 0.529 \frac{n^2}{Z}$ Å

For hydrogen, $n = 1$ and $Z = 1$; $\therefore r_H = 0.529$

For Be^{3+}, $n = 2$ and $Z = 4$;

$$\therefore r_{Be^{3+}} = \frac{0.529 \times 2^2}{4} = 0.529$$

43. **(a)** Velocity of electron

$$v_n = 2.19 \times 10^6 \frac{Z}{n} \text{ m s}^{-1}$$

The distance travelled by electron in 10^{-8} s in Second Bohr's Orbit

$$= \frac{2.19 \times 10^6 \times 1 \times 10^{-8}}{2} \text{ m}$$

$$= 1.095 \times 10^{-2} \text{ m}$$

The circumference of second orbit = $2\pi r_2$

$$= 2\pi \times 0.529 \times 10^{-10} \times 2^2$$

$$= 13.3 \times 10^{-10} \text{ m}$$

$$\therefore \text{ Number of revolutions} = \frac{1.095 \times 10^{-2}}{13.3 \times 10^{-10}} = 8.23 \times 10^6$$

44. **(b)** de – Broglie wavelength is given by :

$$\lambda = \frac{h}{mv} \quad \text{... (i)}$$

$$\text{K.E.} = \frac{1}{2} mv^2$$

$$v^2 = \frac{2KE}{m}$$

$$v = \sqrt{\frac{2KE}{m}}$$

Substituting this in equation (i)

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

$$\lambda = h\sqrt{\frac{1}{2m(K.E.)}} \quad \text{...(i)}$$

i.e. $\lambda \propto \frac{1}{\sqrt{KE}}$

$\therefore$ when *KE* become 4 times wavelength become 1/2.

45. **(a)** $r_n = a_0 \times n^2$

$$r_4 = a_0 \times (4)^2 = 16a_0$$

$$mvr = \frac{nh}{2\pi}; \; mv = \frac{4h}{2\pi \times 16a_0};$$

$$\lambda = \frac{h}{mv} = \frac{h}{h/8\pi a_0} = 8\pi a_0$$