DPP - Daily Practice Problems

Chapter-wise Sheets

Date : ______ **Start Time :** ______ **End Time :** ______

CHEMISTRY (CC02)

SYLLABUS : Structure of Atom

Max. Marks : 180 **Marking Scheme :** + 4 for correct & (–1) for incorrect **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. Among the following groupings which represents the collection of isoelectronic species?

(a) $NO^+, C_2^{2-}, O_2^-, CO$ (b) N_2, C_2^{2-}, CO, NO

(c) CO, NO^+, CN^-, C_2^{2-} (d) NO, CN^-, N_2, O_2^-

2. Rutherford's experiment which established the nuclear model of the atom used a beam of

(a) β-particles which impinged on a metal foil and got absorbed

(b) γ-rays which impinged on a metal foil and ejected electrons

(c) helium atoms which impinged on a metal foil and got scattered

(d) helium nuclei which impinged on a metal foil and got scattered

3. Which of the following levels of H and He^+ have same energy respectively ?

(A) 1, 2 (B) 3, 4 (C) 2, 4 (D) 3, 6

(a) A and D (b) A and B

(c) C and D (d) A, C and D

4. A 600 W mercury lamp emits monochromatic rediation of wavelength 331.3 nm. How many photons are emitted from the lamp per second? ($h = 6.626 \times 10^{-34}$ Js; velocity of light $= 3 \times 10^8\ ms^{-1}$)

(a) 1×10^{19} (b) 1×10^{20}

(c) 1×10^{21} (d) 1×10^{23}

5. Energy of an electron is given by $E = -2.178 \times 10^{-18}\ J\left(\frac{Z^2}{n^2}\right)$.

Wavelength of light required to excite an electron in an hydrogen atom from level n = 1 to n = 2 will be:

($h = 6.62 \times 10^{-34}$ Js and $c = 3.0 \times 10^8\ ms^{-1}$)

(a) 1.214×10^{-7} m (b) 2.816×10^{-7} m

(c) 6.500×10^{-7} m (d) 8.500×10^{-7} m

6. The energy required to break one mole of Cl – Cl bonds in Cl_2 is 242 kJ mol^{-1}. The longest wavelength of light capable of breaking a single Cl – Cl bond is

($c = 3 \times 10^8\ ms^{-1}$ and $N_A = 6.02 \times 10^{23}\ mol^{-1}$).

(a) 594nm (b) 640nm

(c) 700nm (d) 494nm

RESPONSE GRID	
	1. ⓐⓑⓒⓓ 2. ⓐⓑⓒⓓ 3. ⓐⓑⓒⓓ 4. ⓐⓑⓒⓓ 5. ⓐⓑⓒⓓ 6. ⓐⓑⓒⓓ

Space for Rough Work

7. The first emission line in the atomic spectrum of hydrogen in the Balmer series appears at

(a) $\frac{9R_H}{400}cm^{-1}$ (b) $\frac{7R_H}{144}cm^{-1}$

(c) $\frac{3R_H}{4}cm^{-1}$ (d) $\frac{5R_H}{36}cm^{-1}$

8. Which one of the following set of quantum numbers is not possible for 4p electron?

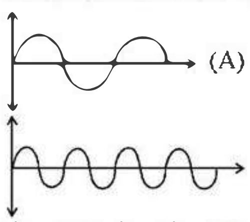
(a) $n=4, l=1, m=-1, m_s=+\frac{1}{2}$

(b) $n=4, l=1, m=0, m_s=+\frac{1}{2}$

(c) $n=4, l=1, m=2, m_s=+\frac{1}{2}$

(d) $n=4, l=1, m=-1, m_s=-\frac{1}{2}$

9. What will be the difference between electromagnetic radiation shown in A and B respectively ?



(i) Velocity (ii) Wavelength
(iii) Frequency (iv) Energy
(a) (ii) only (b) (ii) and (iv)
(c) (ii), (iii) and (iv) (d) (iv) only

10. Match the columns.

Column-I (Sub shell)	Column-II (Number of Orbitals)	Column-III (Angular/Azimuthal Quantum Number)
(A) d	(p) 1	(i) 1
(B) f	(q) 3	(ii) 2
(C) s	(r) 5	(iii) 0
(D) p	(s) 7	(iv) 3

(a) A – (r) – (ii), B – (s) – (iv), C – (p) – (iii), D – (q) – (i)
(b) A – (q) – (i), B – (s) – (iv), C – (p) – (iii), D – (r) – (ii)
(c) A – (p) – (iii), B – (s) – (iv), C – (r) – (ii), D – (q) – (i)
(d) A – (r) – (ii), B – (p) – (iii), C – (s) – (iv), D – (q) – (i)

11. The orbital angular momentum for an electron revolving in an orbit is given by $\sqrt{l(l+1)}.\frac{h}{2\pi}$. This momentum for an s-electron will be given by

(a) zero (b) $\frac{h}{2\pi}$ (c) $\sqrt{2}.\frac{h}{2\pi}$ (d) $+\frac{1}{2}.\frac{h}{2\pi}$

12. The energy of a photon is given as ΔE/atom 3.03×10^{-19} J atom^{-1}. Then the wavelength (λ) of the photon is
(a) 65.6nm (b) 656nm (c) 0.656nm (d) 6.56nm

13. The electrons, identified by quantum numbers n and l (I) n = 4, l = 1 (II) n = 4, l = 0 (III) n = 3, l = 2 (IV) n = 3, l = 1 can be placed in order of increasing energy, from the lowest to highest, as
(a) (IV) < (II) < (III) < (I) (b) (II) < (IV) < (I) < (III)
(c) (I) < (III) < (II) < (IV) (d) (III) < (I) < (IV) < (II)

14. For Balmer series in the spectrum of atomic hydrogen, the wave number of each line is given by $\bar{v} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ where R_H is a constant and n_1 and n_2 are integers. Which of the following statement(s) is (are) correct?
(i) As wavelength decreases, the lines in the series converge.
(ii) The integer n_1 is equal to 2.
(iii) The ionization energy of hydrogen can be calculated from the wave number of these lines.
(iv) The line of longest wavelength corresponds to $n_2 = 3$.
(a) (i), (ii) and (iii) (b) (ii), (iii) and (iv)
(c) (i), (ii) and (iv) (d) (ii) and (iv)

15. The wavelength (in cm) of second line in the Lyman series of hydrogen atomic spectrum is (Rydberg constant = R cm^{-1})

(a) $\left(\frac{8R_H}{9}\right)$ (b) $\left(\frac{9}{8R_H}\right)$

(c) $\left(\frac{4}{3R_H}\right)$ (d) $\left(\frac{3R_H}{4}\right)$

16. If λ_o and λ be threshold wavelength and wavelength of incident light, the velocity of photoelectron ejected from the metal surface is:

(a) $\sqrt{\frac{2h}{m}(\lambda_o - \lambda)}$ (b) $\sqrt{\frac{2hc}{m}(\lambda_o - \lambda)}$

(c) $\sqrt{\frac{2hc}{m}\left(\frac{\lambda_o - \lambda}{\lambda\lambda_o}\right)}$ (d) $\sqrt{\frac{2h}{m}\left(\frac{1}{\lambda_o} - \frac{1}{\lambda}\right)}$

RESPONSE GRID					
	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ
	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ

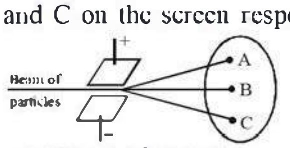
Space for Rough Work

17. If wavelength of photon is 2.2×10^{-11} m, h = 6.6×10^{-34} Js, then momentum of photon is
(a) 3×10^{-23} kg/s (b) 3.33×10^{22} kg/s
(c) 1.452×10^{-44} kg/s (d) 6.89×10^{43} kg/s

18. Which of the following set of quantum numbers belong to highest energy?
(a) $n=4, l=0, m=0, s=+\frac{1}{2}$
(b) $n=3, l=0, m=0, s=+\frac{1}{2}$
(c) $n=3, l=1, m=1, s=+\frac{1}{2}$
(d) $n=3, l=2, m=1, s=+\frac{1}{2}$

19. From the data given below A, B, C and D respectively are,
(A) 10 e^-, atomic no. 11 (B) 10 e^-, atomic no. 6
(C) 10 e^-, atomic no. 10 (D) 10 e^-, atomic no. 9
(a) Na^+, C^{4-}, Ne, F^- (b) C^{4-}, Ne, Na^-, F^-
(c) F^-, Na^+, Ne, C^{4-} (d) F^-, Na^+, C^{4-}, Ne

20. Suppose beam containing all three fundamental subatomic particles are allowed to pass through an electric field as shown in figure. The subatomic particles detected at three points A, B and C on the screen respectively are ?



(a) Protons, neutrons, electrons
(b) Electrons, neutrons, protons
(c) Electrons, protons, neutrons
(d) Neutrons, protons, electrons

21. For a *d*-electron, the orbital angular momentum is
(a) $\sqrt{6}(h/2\pi)$ (b) $\sqrt{2}(h/2\pi)$
(c) $(h/2\pi)$ (d) $2(h/2\pi)$

22. The uncertainty in the position of an electron (mass = 9.1×10^{-28} g) moving with a velocity of 3.0×10^{4} cm s^{-1} accurate upto 0.011% will be
(a) 1.92cm (b) 7.68cm (c) 0.175cm (d) 3.84cm.

23. The values of Planck's constant is 6.63×10^{-34} Js. The velocity of light is 3.0×10^{8} m s^{-1}. Which value is closest to the wavelength in nanometres of a quantum of light with frequency of 8×10^{15} s^{-1}?
(a) 5×10^{-18} (b) 4×10^{1}
(c) 3×10^{7} (d) 2×10^{-25}

24. The wavelength associated with a golf ball weighing 200 g and moving at a speed of 5 m/h is of the order
(a) 10^{-10}m (b) 10^{-20}m (c) 10^{-30}m (d) 10^{-40}m

25. Given that the abundances of isotopes ^{54}Fe, ^{56}Fe and ^{57}Fe are 5%, 90% and 5%, respectively, the atomic mass of Fe is
(a) 55.85 (b) 55.95 (c) 55.75 (d) 56.05

26. Based on the equation:

$$\Delta E = -2.0\times10^{-18}\,J\left(\frac{1}{n_2^2}-\frac{1}{n_1^2}\right)$$

the wavelength of the light that must be absorbed to excite hydrogen electron from level n = 1 to level n = 2 will be:
(h = 6.625×10^{-34} Js, C = 3×10^{8} ms^{-1})
(a) 1.325×10^{-7} m (b) 1.325×10^{-10} m
(c) 2.650×10^{-7} m (d) 5.300×10^{-10} m

27. If uncertainty in position and momentum are equal, then uncertainty in velocity is :
(a) $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$ (b) $\sqrt{\frac{h}{2\pi}}$
(c) $\frac{1}{m}\sqrt{\frac{h}{\pi}}$ (d) $\sqrt{\frac{h}{\pi}}$

28. The radius of an atomic nucleus is of the order of:
(a) 10^{-10} cm (b) 10^{-13} cm
(c) 10^{-15} cm (d) 10^{-8} cm

29. In Cu. (At. No. 29)
(a) 13 electrons have spin in one direction and 16 electrons in other direction
(b) 14 electrons have spin in one direction and 15 electrons in other direction
(c) one electron can have spin only in the clockwise direction
(d) None of the above is correct.

30. The correct order of increasing energy of atomic orbitals is
(a) 5p < 4f < 6s < 5d (b) 5p < 6s < 4f < 5d
(c) 5p < 5d < 4f < 6s (d) none of these

31. Match the columns.

	Column-I		Column-II
A.	X-rays	I.	$\nu = 10^{0} - 10^{4}$ Hz
B.	UV	II.	$\nu = 10^{10}$ Hz
C.	Long radio waves	III.	$\nu = 10^{16}$ Hz
D.	Microwave	IV.	$\nu = 10^{18}$ Hz

(a) A – IV ; B – III ; C – I ; D – II
(b) A – III ; B – IV ; C – I ; D – II
(c) A – IV ; B – I ; C – III ; D – II
(d) A – IV ; B – III ; C – II ; D – I

RESPONSE GRID					
	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ
	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ
	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ

Space for Rough Work

32. What does negative sign in the electronic energy for hydrogen atom convey.
(a) Energy of electron when n = ∞
(b) The energy of electron in the atom is lower than the energy of a free electron in motion
(c) The energy of electron in the atom is lower than the energy of a free electron of rest
(d) The energy of electron decreases as it moves away from nucleus

33. If the nitrogen atom had electronic configuration $1s^7$ it would have energy lower than that of the normal ground state configuration $1s^2\ 2s^2\ 2p^3$ because the electrons would be closer to the nucleus. Yet $1s^7$ is not observed. It violates
(a) Heisenberg's uncertainty principle
(b) Hund's rule
(c) Pauli exclusion principle
(d) Bohr postulate of stationary orbits

34. If $n = 6$, the correct sequence for filling of electrons will be:
(a) $ns \rightarrow (n-2)f \rightarrow (n-1)d \rightarrow np$
(b) $ns \rightarrow (n-1)d \rightarrow (n-2)f \rightarrow np$
(c) $ns \rightarrow (n-2)f \rightarrow np \rightarrow (n-1)d$
(d) $ns \rightarrow np \rightarrow (n-1)d \rightarrow (n-2)f$

35. What is the expression of frequency (ν) associated with absorption spectra of the photon.
(a) $\nu = \frac{R_H}{h}\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right) n_i > n_f$
(b) $\nu = \frac{R_H}{h}\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right) n_f > n_i$
(c) $\nu = -\frac{R_H}{h}\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right) n_f > n_i$
(d) All the above are correct

36. Chlorine exists in two isotopic forms, Cl-37 and Cl-35 but its atomic mass is 35.5. This indicates the ratio of Cl-37 and Cl-35 is approximately
(a) 1 : 2 (b) 1 : 1 (c) 1 : 3 (d) 3 : 1

37. If m and e are the mass and charge of the revolving electron in the orbit of radius r for hydrogen atom, the total energy of the revolving electron will be:
(a) $\frac{1}{2}\frac{e^2}{r}$ (b) $-\frac{e^2}{r}$ (c) $\frac{me^2}{r}$ (d) $-\frac{1}{2}\frac{e^2}{r}$

38. An electron, e_1 is moving in the fifth stationary state, and another electron e_2 is moving in the fourth stationary state. The radius of orbit of electron e_1 is five times the radius of orbit of electron e_2 calculate the ratio of velocity of electron e_1 (v_1) to the velocity of electron e_2 (v_2).
(a) 5 : 1 (b) 4 : 1 (c) 1 : 5 (d) 1 : 4

39. The correct set of four quantum numbers for the valence electrons of rubidium atom ($Z = 37$) is:
(a) $5, 0, 0, \pm\frac{1}{2}$ (b) $5, 1, 0, +\frac{1}{2}$
(c) $5, 1, 1, +\frac{1}{2}$ (d) $5, 0, 1, +\frac{1}{2}$

40. Among species H, Li^{2+}, He^{+}, Be^{3+} and Al^{3+} Bohr's model was able to explain the spectra of
(a) all of these
(b) none of these
(c) all other species except Be^{3+}
(d) all other species except Al^{3+}

41. Match the columns.

	Column-I (Quantum number)		Column-II (Information provided)
A.	Principal quantum number	I.	orientation of the orbital
B.	Azimuthal quantum number	II.	energy and size of orbital
C.	Magnetic quantum number	III.	spin of electron
D.	Spin quantum number	IV.	shape of the orbital

(a) A – II; B – IV; C – I; D – III
(b) A – IV; B – II; C – I; D – III
(c) A – II; B – I; C – IV; D – III
(d) A – II; B – IV; C – III; D – I

42. The radius of which of the following orbit is same as that of the first Bohr's orbit of hydrogen atom?
(a) He^{+} ($n=2$) (b) Li^{2+} ($n=2$)
(c) Li^{2+} ($n=3$) (d) Be^{3+} ($n=2$)

43. The average life of an excited state of hydrogen atom is of the order 10^{-8} s. The number of revolutions made by an electron when it is in state n = 2 and before it suffers a transition to state n = 9 are
(a) 8.23×10^6 (b) 2.82×10^6
(c) 22.8×10^6 (d) 2.28×10^6

44. If the kinetic energy of an electron is increased four times, the wavelength of the de-Broglie wave associated with it would become
(a) one fourth (b) half
(c) four times (d) two times

45. If the radius of first orbit of H-atom is a_0, then de-Broglie wavelength of electron in 4^{th} orbit is
(a) $8\pi a_0$ (b) $\frac{a_0}{4}$ (c) $16 a_0$ (d) $2\pi a_0$

RESPONSE GRID					
	33. (a)(b)(c)(d)	34. (a)(b)(c)(d)	35. (a)(b)(c)(d)	36. (a)(b)(c)(d)	37. (a)(b)(c)(d)
	38. (a)(b)(c)(d)	39. (a)(b)(c)(d)	40. (a)(b)(c)(d)	41. (a)(b)(c)(d)	42. (a)(b)(c)(d)
	43. (a)(b)(c)(d)	44. (a)(b)(c)(d)	45. (a)(b)(c)(d)		

Space for Rough Work

DAILY PRACTICE PROBLEMS — CHEMISTRY SOLUTIONS — DPP/CC02

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

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

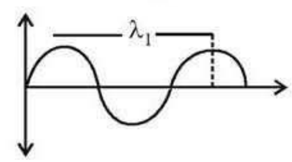
$$\therefore \lambda = \frac{6.626\times10^{-34}\times3\times10^8\times6.023\times10^{23}}{242\times10^3}$$

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

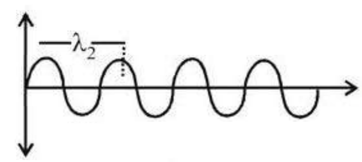
7. **(d)** For Balmer $n_1 = 2$ and $n_2 = 3$;

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

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 ⇒ Number of orbitals = 5, $l = 2$
f-subshell ⇒ Number of orbitals = 7, $l = 3$
s-subshell ⇒ Number of orbitals = 1, $l = 0$
p-subshell ⇒ Number of orbitals = 3, $l = 1$
11. **(a)** For s-electron, $l = 0$

$\therefore$ 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) $\bar{v} = \frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

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) $p = \frac{h}{\lambda} = \frac{6.63\times10^{-34}}{2.2\times10^{-11}} = 3\times10^{-23}\,kg/s$

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

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

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

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

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

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

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

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

Given, $h = 6.6 \times 10^{-34}$ Js, $m = 200 \times 10^{-3}$ kg

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

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

25. (b) Average atomic mass of Fe

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

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

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

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

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

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

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

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

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

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

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

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

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 :

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

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

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

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

Substituting this in equation (i)

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

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

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

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

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

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

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

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