PROBLEM SHEET- 1

Q1. (A)

Bh (1.42)	Ik (4.82)	Uc (6.14)	Dt (8.28)	Bc (11.13)
Ai (13.90)	Ye (15.23)	Sk (16.89)		Om (20.33)
	Zw (28.11)	Dr (30.27)	Fq (32.45)	Fn (35.74)

(B) State : Gas

Reactivity : Very Low

Electrical Conductivity : Very Low

(C) Yes, between Sk and Om (16.89 < At. Wt < 20.33).

State : Hard, High Melting Solid

Reactivity : High

Electrical Conductivity : Very High

Q2. (a) $\lambda = \dfrac{6.626 \times 10^{-34}}{0.8 \times 10^{-3} \times 340} = \underline{\underline{2.43 \times 10^{-33}\ m}}$

(b) $\lambda = \dfrac{6.626 \times 10^{-34}}{10^{-8} \times 10^{-5}} = \underline{\underline{6.63 \times 10^{-21}\ m}}$

(c) $\lambda = \dfrac{6.626 \times 10^{-34}}{10^{-11} \times 10^{-8}} = \underline{\underline{6.63 \times 10^{-15}\ m}}$

(d) $\lambda = \dfrac{6.626 \times 10^{-34}}{9.1 \times 10^{-31} \times 4.8 \times 10^{6}} = \underline{\underline{1.52 \times 10^{-10}\ m}}$

Q3. $m = 510 kg$; $v = 22 kmph$

(a) $p = 510 \times \frac{22 \times 1000}{3600} = \underline{\underline{3116.67 \ kg\,ms^{-1}}}$

$$\lambda = \frac{h}{p} = \frac{6.626 \times 10^{-34}}{3116.67} = \underline{\underline{2.126 \times 10^{-37} m}}$$

(b) $\Delta x \, \Delta p = \Delta m \, (m \Delta v) \Rightarrow m(\Delta x \, \Delta v) = \frac{\hbar}{2} = 5.27 \times 10^{-35} \ Js$

$\Rightarrow \Delta x \Delta v = \frac{5.27 \times 10^{-35}}{510} \Rightarrow \Delta x (0.01) = \frac{5.27 \times 10^{-35}}{510}$

$\Rightarrow \Delta x = \frac{5.27 \times 10^{-35}}{510 \times 0.01} = \underline{\underline{1.03 \times 10^{-35} m}}$

(c) Consider $h = 0.01 \ Js$, then,

$\lambda = \frac{0.01}{3116.67} = \underline{\underline{3.2 \times 10^{-6} m}}$

$\Delta x = \frac{1.03 \times 10^{-35}}{6.626 \times 10^{-34}} \times 0.01 = \underline{\underline{1.55 \times 10^{-4} m}}$

Q4. Possible 'l' values in N-shell, $(n = 4)$

$l = 0 \Rightarrow m_l = 0 \ (2)$

$l = 1 \Rightarrow m_l = -1, 0, 1 \ (6)$

$l = 2 \Rightarrow m_l = -2, -1, 0, 1, 2 \ (10)$

$l = 3 \Rightarrow m_l = -3, -2, -1, 0, 1, 2, 3 \ (14)$

This shell has the 4f orbitals which the previous i.e., M-shell doesn't have.

Energy of 4f > 4d > 4p > 4s. Each orbital of a particular subshell will have equal energy.

32 electrons can be accomodated in N-shell.

'g' will first appear in 'O'- shell i.e., $n=5$.

Q5. (a)(i) $E_1 = -13.6 \times \frac{25}{1} = \underline{\underline{-340 eV}}$

(ii) $E_3 = -13.6 \times \frac{25}{9} = \underline{\underline{-37.78 eV}}$

(iii) $E_3 - E_1 = \underline{\underline{302.22 eV}}$

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

$= 10973731.57 \times 25 \left(\frac{1}{1^2} - \frac{1}{3^2}\right)$

$\boxed{\lambda = 4.11 \times 10^{-9} m}$ ans.

Q6. An Eigenfunction of a linear operator D defined on some function space is any non-zero function 'f' in that space that, when acted upon by D, is only multiplied by some scaling factor called an Eigenvalue.

$\sin\theta$ is an eigenfuncⁿ for the operator $\frac{d^2}{d\theta^2}$.

Eigenvalue = -1.

$e^{-3\theta}$ is an eigenfuncⁿ for both $\frac{d}{d\theta}$ and $\frac{d^2}{d\theta^2}$ operators.

Eigenvalues = -3 and 9 respectively.

Q7. (a) 7 ($l = 0,1,2,3,4,5,6$)

(b) 5 ($m_l = -2,-1,0,1,2$)

(c) 3 ($m_l = -1,0,1$)

Q8. $\psi_{5,1,(-1,0,1)}$