2. A suitable Hemiltonian 'H' which takes into account the mutual interactions of the electrons as well as spin orbit interaction is ,

(a) $H = \sum_{i=1}^{z}\left[\frac{-\hbar^2}{2m}\nabla_i^2 - \frac{ze^2}{r_i} - \sum_i (r_i)\vec{l}_i \cdot \vec{s}_i\right] + \sum_{i,j}\frac{l^2}{r_{ij}}$

(b) $H = \sum_{i=1}^{z}\left[\frac{-\hbar^2}{2m}\nabla_i^2 - \frac{ze^2}{r_i}\right] + \sum_{i,j}\frac{e^2}{r_{ij}}$

(c) $H = \sum_{i=1}^{z}\left[\frac{-\hbar^2}{2m} - \frac{ze^2}{r_i}\right] - \sum_i (r_i)\vec{l}_i \cdot \vec{s}_i$

(d) $H = \sum_{i=1}^{z}\left[\frac{-\hbar^2}{2m} + \frac{e^2}{r_i}\right] - \sum_i \frac{ze^2}{r_i}$.

3. The spectroscopic value for the internuclear distance for H–molecule is

(a) 2.5 A° (b) 0.02 A°

(c) 0.74 A° (d) 0.002 A°.

4. If 'ρ' is density matrix and $\hat{F}$ is any operator then $\langle\hat{F}\rangle$ is

(a) Trace $\left(\frac{\rho}{\hat{F}}\right)$ (b) Trace (ρ)

(c) Trace $\left(\frac{\hat{F}}{\rho}\right)$ (d) Trace $(\hat{F}\rho)$.

5. Lagrangian equation for the generalised co–ordinate $\vec{a}_i$ is,

(a) $\frac{\partial L}{\partial \vec{a}_i} - \frac{\partial L}{\partial a_i} = 0$

(b) $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{\vec{a}}_i}\right) - \frac{\partial L}{\partial \vec{a}_i} = 0$

(c) $\frac{\partial L}{\partial a_i} - \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{\vec{a}}_i}\right) = 0$

(d) $\frac{d}{dt}\left(\frac{\partial L}{\partial a_i}\right) - \left(\frac{\partial L}{\partial \dot{\vec{a}}_i}\right) = 0$.

Answer ALL questions in 1 or 2 sentences :

6. Give the connecting relation between scattering amplitude and scattering cross section.

7. What is the type of atoms for which Thomas Fermi method is suited to?

8. Give the meaning of 'self–consistent'.

9. How will you represent spin $\frac{1}{2}$–density matrix?

10. Define Hermiatian operator N_k through creation operator a_k and annihilation operator a_k^+.