1. $\psi(x) = \sqrt{\frac{2}{L}} \sin \frac{n\pi x}{L}$ (or $\psi(x) = \frac{\sqrt{2}}{L} \cos \frac{n\pi x}{L}$)

$$\Delta x = \sqrt{\overline{x^2} - \overline{x}^2}$$

$\overline{x} = \frac{L}{2}$ (or 0 if they used cosine)

$$\overline{x^2} = \frac{2}{L}\int_0^L x^2 \sin^2 \frac{n\pi x}{L}\, dx = \frac{x^3}{6} - \frac{L x^2}{4n\pi} \sin\left(\frac{2n\pi x}{L}\right)\Bigg|_0^L$$

$$= \frac{2}{L}\left[\frac{L^3}{6} - \frac{L^3}{4n^2\pi^2}\right]$$

$$\Delta x = \sqrt{\frac{L^2}{3} - \frac{L^2}{2\pi^2 n^2} - \frac{L^2}{4}} = \sqrt{L^2\left(\frac{1}{12} - \frac{1}{2\pi^2 n^2}\right)}$$

$\overline{p} = 0$

$$\overline{p^2} = +\int \sqrt{\frac{2}{L}} \cdot \sqrt{\frac{2}{L}} \cdot \frac{n^2\pi^2}{L^2} \cdot \hbar^2 \sin^2 \frac{n\pi x}{L}\, dx$$

$$= \frac{n^2\pi^2\hbar^2}{L^2}$$

$$\Delta p = \sqrt{\frac{n^2\pi^2\hbar^2}{L^2}} = \frac{n\pi\hbar}{L}$$

$\Delta x \Delta p$ should be $\geq \frac{\hbar}{2}$, thus they can conclude the minimum/max in dependence of the one they didn't calculate.

2. $\bar{r} = \int R^*(r)\, r\, R(r) \cdot \int \Theta^* \Theta$

= any of the functions on Page 257 of the book put together.

~~B~~ Just be sure $n=3$, and l matches on each, it's

$R_{n,l}\, \Theta_{l,m}$.

for example if I use ~~nlm~~ $(n,l,m) = (3,0,0)$ then it's

$$\bar{r} = \int_0^{\infty} \frac{1}{(3a_0)^3}\left(2 - \frac{4r}{3a_0} + \frac{4r^2}{27a_0^2}\right)^2 e^{-2r/3a_0}\, dr \cdot \int_0^{\pi/2} d\theta \int_0^{2\pi} d\phi \left(\sqrt{\frac{1}{4\pi}}\right)^2$$

Electron Structure Chemical Valence.

3. He: $1s^2$ 0

C: $1s^2 2s^2 2p^2$ 4

Ne: $1s^2 2s^2 2p^6$ 0

4. a) Ground State of Hydrogen Wave function

$$\varphi_{1,0} = \frac{1}{\sqrt{\pi}\, a_0^{3/2}} e^{-r/a_0}$$

$$P = \varphi^*_{100}\varphi_{100} = \frac{1}{\pi a_0^3} e^{-2r/a_0}$$

b) ii

5. $L_z = -\hbar \Rightarrow m_\ell = -1$

First excited $\Rightarrow n = 2$

Again choose from functions on 257

$$\psi(r,\theta,\phi) = R_{2,1}(r)\,\Theta_{1,-1}$$

$$= \frac{1}{(2a_0)^{3/2}} \frac{r}{\sqrt{3}\,a_0} e^{-r/2a_0} \cdot \sqrt{\frac{3}{8\pi}} \sin\theta e^{\pm\phi}$$