1. $E=h\nu=h\cdot\frac{c}{\lambda}$，$\Delta E=hc\cdot\frac{\Delta\lambda}{\lambda^2}$，由 $\Delta E\cdot\Delta t\geq\frac{\hbar}{2}$

$\Rightarrow\Delta t=\frac{\pi}{2}\cdot\frac{\lambda^2}{hc}\cdot\frac{1}{\Delta\lambda}=\frac{\lambda^2}{4\pi c\Delta\lambda}=\frac{\lambda}{4\pi c\left(\frac{\Delta\lambda}{\lambda}\right)}\approx 1.59\times10^{-9}\,s$

2. $\Delta x\cdot\Delta p_x\geq\frac{\pi}{2}\Rightarrow\Delta p_x\geq\frac{\hbar}{2\Delta x}$

$\Delta p_x=\sqrt{\overline{(p_x-\overline{p_x})^2}}$，而 $\overline{p_x}=0\Rightarrow p_x=\Delta p_x$

考虑三维，统计下 $p_x=p_y=p_z\Rightarrow p^2=3p_x^2=3(\Delta p_x)^2$

$\therefore E_k=\frac{3\hbar^2}{2m\cdot4\Delta x^2}\approx 2.87\times10^{8}\,eV$

3. $\Delta x\cdot\Delta p_x\geq\frac{\hbar}{2}$，$E=\frac{p_x^2}{2m}\approx\frac{\Delta p_x^2}{2m}=\frac{\hbar^2}{8m\Delta x^2}$

1-19. $qvB=m\frac{v^2}{R}$，$v=\frac{qBR}{m}$，$\lambda=\frac{h}{mv}=\frac{h}{qBR}\approx1\times10^{-13}\,m$

1-20. $\frac{\partial\psi}{\partial t}=A\omega\sin(kx-\omega t)$，$\frac{\partial\psi}{\partial x}=Ak\cos(kx-\omega t)$

$\frac{\partial^2\psi}{\partial x^2}=-Ak^2\sin(kx-\omega t)$

左式 $=i\hbar\cdot A\omega\sin(kx-\omega t)$，右式 $=\frac{\hbar^2}{2m}\cdot Ak^2\sin(kx-\omega t)$

$\Rightarrow$ 验证 $i\omega\neq\frac{\hbar}{2m}\cdot k^2\Rightarrow i\cdot\frac{E}{\hbar}\neq\frac{p^2}{2m}\cdot\frac{1}{\hbar}$，有 i 故不等