Pb#3.

A free electron has a wavefunction

$$\psi(x) = A \sin(5\times 10^{10} x) \qquad x \text{ in meters.}$$

a) In general, for a free particle, $\psi(x) = A \sin kx$

$$\Rightarrow \quad k = 5\times 10^{10}\ m^{-1}$$

$$\Rightarrow \quad \lambda = \frac{2\pi}{k} = \frac{2\pi}{5\times 10^{10}} = 1.26\times 10^{-10}\,m = \boxed{1.26\,\mathring{A}}$$

b) $$\lambda = \frac{h}{p} \Rightarrow p = \frac{h}{\lambda} = \frac{6.63\times 10^{-34}}{1.26\times 10^{-10}} = \boxed{5.26\times 10^{-24}\ Kg\cdot\frac{m}{s}}$$

c) $$K = \frac{p^2}{2m} = \frac{(5.26\times 10^{-24})^2}{2\times 9.1\times 10^{-31}} = 1.5\times 10^{-17}\,J = \boxed{95\,eV}$$

Pb#6.

The wave-function of a particle is given by

$$\psi(x) = A\cos(kx) + B\sin(kx) \quad \text{— (1)}$$

A, B and k are constants

Schrodinger equation in the case where $U=0$ is

$$-\frac{\hbar^2}{2m}\frac{\partial^2\psi(x)}{\partial x^2} = E\,\psi(x) \qquad [\text{ time-independent S.E.}]$$

$$\Rightarrow \quad \frac{\partial\psi}{\partial x} = -Ak\sin(kx) + Bk\cos(kx)$$

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

$$\frac{\partial^2\psi}{\partial x^2} = -k^2\psi(x) \quad \Rightarrow \quad \frac{2mE}{\hbar^2} = k^2 \quad \text{or} \quad E = \frac{2m}{\hbar^2}k^2$$

So equation (1) is a solution of Schrodinger equation.