

Name _____

5.73

Quiz 9

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1.

Grid Points

$x_p, x_{i+1} = x_i + h$ (h is step size, not Planck's constant)

$\psi_i \equiv \psi(x_i)$

$U(x)$ is potential

$\left[\frac{d^2}{dx^2} - \frac{2m}{\hbar^2} (U(x) - E) \right] \psi = 0$ is Schrödinger Equation

$V(x) = C[U(x) - E]$

$C = \frac{2m}{\hbar^2}$

$V_i = V(x_i)$

A. What is the grid definition of $\left. \frac{d\psi}{dx} \right|_{x=x_i}$?

B. What quantity has the grid definition $h^{-2}[\psi_{i+i} - 2\psi_i + \psi_{i-1}]$?

C. Use $\{\psi_i\}, h, V_i$ to write the grid form of the Schrödinger Equation.

- D. Suppose you are searching for values of E which satisfy a nonlinear equation

$$F(E) = 0.$$

You know that $F(E_1) = a$
and
 $F(E_1 + \delta) = a + \gamma.$

If you expand $F(E)$ about E_1

$$F(E) = F(E_1) + \left. \frac{dF}{dE} \right|_{E_1} (E - E_1)$$

then what value of E is your first iterative solution of $F(E_i) = 0$? To solve for E_i , you need $\left. \frac{dF}{dE} \right|_{E_1}$, which you obtain from the definition of the

derivative, and $F(E_i) = 0 = F(E_1) + \left. \frac{dF}{dE} \right|_{E_1} (E_i - E_1).$