Test 3

25.05.2016

Choose the only one correct answer. In calculations assume that: the rest mass of the electron $m_e = 9.11 \cdot 10^{-31} kg$, the rest mass of the proton $m_p = 1.67 \cdot 10^{-27} kg$, Planck constant $h = 6.63 \cdot 10^{-34} J \cdot s$, electron charge $e = 1.6 \cdot 10^{-19} C$, Compton wavelength of the electron $\lambda_C = 2.4 \cdot 10^{-12} m$

1. A free electron in motion along the x axis has a localized wave function. The uncertainty in its momentum is decreased if:

A. the wave function is made more narrow
B. the wave function is made less narrow
C. the wave function remains the same but the energy of the electron is increased
D. the wave function remains the same but the energy of the electron is decreased
E. none of the above

2. If a wave function ψ for a particle moving along the x axis is normalized, then:

A. $\int |\varphi|^2 dt = 1$

B. $\int |\varphi|^2 dx = 1$

C. $\frac{\partial \varphi}{\partial x} = 1$

D. $\frac{\partial \varphi}{\partial t} = 1$

E. $|\varphi|^2 = 1$

3. An electron is in a one-dimensional trap with zero potential energy in the interior and infinite potential energy at the walls. The ratio E_3/E_1 of the energy for n = 3 to that for n = 1 is:

A. 1/3
B. 1/9
C. 3/1
D. 9/1
E. 1/1

4. Four different particles are trapped in one-dimensional wells with infinite potential energy at their walls. The masses of the particles and the width of the wells are

1. mass = $4m_0$, width = $2L_0$
2. mass = $2m_0$, width = $2L_0$
3. mass = $4m_0$, width = L_0
4. mass = m_0, width = $2L_0$

Rank them according to the kinetic energies of the particles when they are in their ground states.

A. 1, 2, 3, 4

B. 1, 2, 3 and 4 tied

C. 1 and 2 tied, then 3, 4

D. 4, 3, 2, 1

E. 3, 1, 2, 4

5. Among the following functions:

I. $\sin(kx)$

II. $\exp(kx)$

III. $\exp(ikx)$

eigenfunctions of the momentum operator are:

A. only I

B. only II

C. only III

D. II and III, only

E. I, II and III