Quiz #2 **PS303** **Modern Physics**
March 24, 2015

Answer Key
Name

Show your work !!
Grading: You will earn 1 points by circling the correct answer.
You will earn 1 more point by providing work that supports your answer.

2 points

1. A glowing object emits radiation with a spectrum in which there is one particular wavelength at which the maximum intensity occurs. If the temperature of the object is doubled, what happens to the wavelength of the intensity maximum?

(Circle One)

$\lambda_{max} T = \text{constant}$

(a) Remains the same

(b) Becomes twice as large

(c) Becomes half as large

(d) Becomes 4 times as large

(e) Becomes 16 times as large

2 points

2. A particle has a lifetime of 3.2×10^{-23} s. The rest energy of the particle is about 600 MeV. What range of values will most likely result from a measurement of its rest energy?

(Circle One)

$$\Delta E = \frac{\hbar}{\Delta t} = \frac{\hbar c}{c\,\Delta t}$$

(a) 599 to 601 MeV

(b) 590 to 610 MeV

$$\Delta E = \frac{197\ \text{MeV}\cdot\text{fm}}{3\times10^{8}\ \frac{\text{m}}{\text{s}}\ 10^{15}\ \frac{\text{fm}}{\text{m}}\ 3.2\times10^{-23}\ \text{s}}$$

(c) 500 to 700 MeV

$$\Delta E = \frac{197\ \text{MeV}\cdot\text{fm}}{3(3.2)\ \text{fm}} = 20.52$$

(d) 0 to 1200 MeV

$E = 600\ \text{MeV} \pm 10\ \text{MeV}$
$590 \leftrightarrow 610\ \text{MeV}$

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2 points

3. What is the de Broglie wavelength of an electron with a kinetic energy of 12.8 eV?

(Circle one)

(a) 96.9 nm

(b) 0.34 nm

(c) 16.8 nm

(d) 0.66 nm

Non-relativistic

$K = \frac{p^2}{2m}$ $\quad p^2 = 2mK$

$p = \sqrt{2mK}$

$\gamma = 1 + \frac{KE}{m_e c^2}$

$= 1 + \frac{12.8\ eV}{511{,}000\ eV}$

$\cong 1.000$

$\lambda = \frac{h}{p} = \frac{hc}{pc} = \frac{1240\ eV \cdot nm}{\sqrt{2(511{,}000\ eV)\,12.8 eV}} = 0.34\ nm$

2 points

4. An electron in the ground state of an infinite potential energy well has an energy of 8.0 eV. How much additional energy must be supplied for the electron to jump from the ground state to the first excited state?

(a) 8.0 eV

(b) 16.0 eV

(c) 24.0 eV

(d) 32.0 eV

$E_n = n^2 E_1$ $\quad E_1 = 8.0 eV$

$E_2 = 4E_1 \Rightarrow$ $\quad E_2 = 32.0 eV$

Additional Energy = 24.0 eV