

Exam 1 --- 2003 ---SOLUTIONS

I. Multiple choice

1.b., 2.a., 3.d., 4.e., 5.b.

II. a. $E = 1136 \text{ MeV}$ since $\gamma = 2.294$ and $E = \gamma m c^2$
(Note: on some browsers Gamma is g and superscripts do not appear.)

b. lifetime = $\tau = \gamma \tau_0 = 2.85 \times 10^{-8} \text{ sec}$ (longer)

c. $v\tau = 7.68 \text{ m}$

d. $v_2' = (v_1 + |v_2|) / (1 + v_1 v_2/c^2) = 1.8c/1.81 = 0.994 c$

(= v_2 measured from beam 1 = $0.994 c$)

e. Total E in lab = $E_1 + E_2 = 2 \times 1136 \text{ MeV} = 2272 \text{ MeV}$

III. a. $E_1 = -122.4 \text{ eV}$, $E_2 = -30.6 \text{ eV}$, $E_3 = -13.6 \text{ eV}$

b. $3 \rightarrow 1 : 108.8 \text{ eV}$, $3 \rightarrow 2 : 17.0 \text{ eV}$, $2 \rightarrow 1 : 91.8 \text{ eV}$

c. $3 \rightarrow 2$ longest $\lambda = 7.29 \times 10^{-8} \text{ m}$

d. $eV_{\text{stop}} = (17.0 - 1.9) \text{ eVolts} = 15.1 \text{ eV}$ or $V_{\text{stop}} = 15.1 \text{ Volts}$

IV. a. $\Delta x_{\text{min}} = 2.6 \times 10^{-12} \text{ m}$

(Note: on some browsers Delta appears as D and lambda as l.)

b. $\lambda = 3.3 \times 10^{-12} \text{ m}$

c. $\text{KE} = 1.0 \times 10^{-20} \text{ J}$

d. $f = 1.5 \times 10^{13} \text{ s}^{-1}$

e. $\lambda f = 50 \text{ m/s} = 1/2 \times 100 \text{ m/s}$

f. $|\psi(x=\lambda/4, 0)|^2 = A^2$

(Note: On some browsers Psi appears as y.)