PHYS 301 Relativistic Energy Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

$E=mc^{2}$ $E=m\_{0}c^{2}+K$ $E^{2}=p^{2}c^{2}+m\_{0}^{2}c^{4}$ $∆t=\frac{∆t\_{0}}{\sqrt{1-β^{2}}}$; $ β=\frac{v}{c} $ $ γ=\frac{1}{\sqrt{1-β^{2}}}$

1. The mass of an electron is 9.109 381 88 × 10-31 kg. Calculate the rest energy of the electron in MeV. [c = 2.99792458 x108 m/s, 1eV = 1.60217662 x 10-19 J]

2. The sun radiates electromagnetic energy at the rate of .

(a)  What is the change in the sun's mass during each second that it is radiating energy?

(b)  The mass of the sun is . What fraction of the sun's mass is lost during a human lifetime of 75 years?

3. How much work must be done to increase the speed of an electron from rest to (a) 0.500*c*, (b) 0.990*c*, and (c) 0.9990*c*?

4. To six significant figures, find (a) *γ* and (b) *β* for an electron with kinetic energy *K* = 100.000 MeV.

5. If *m0* is a particle's rest mass, *p* is its momentum magnitude, and *K* is its kinetic energy, (a) show that

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(b) For low particle speeds, show that the right side of the equation reduces to *m*. (c) If a particle has *K* = 55.0 MeV when *p* = 121 MeV/*c*, what is the ratio *m/me* of its mass to the electron mass?

6. The mass of a muon is 207 times the electron mass; the average lifetime of muons at rest is 2.20 *μ*s. In a certain experiment, muons moving through a laboratory are measured to have an average lifetime of 6.90 *μ*s. For the moving muons, what are (a) *β*, (b) *K*, (c) *p* (in MeV/*c*), and (d) *p* in kg.m/s?