Arts & Science 2D06

Quiz #4 2013 Nov 21 **Name:**

NB: Mark values are given in brackets [ ] beside each problem. Write all your answers on the quiz paper. No books or notes allowed. Time to write quiz: 50 minutes.

Rotational K.E. $= (1/2)I\omega^2$

Elastic collisions, target m_2 stationary: $v_1 = \frac{(m_1-m_2)}{(m_1+m_2)}u_1$, $v_2 = \frac{2m_1}{(m_1+m_2)}u_1$

Gamma factor: $\gamma = (1 - v^2/c^2)^{-1/2}$ Momentum: $p = \gamma mv$

Lorentz transformation: $x' = \gamma(x - vt)$, $t' = \gamma(t - \frac{v}{c^2}x)$.

Velocity addition: $u' = \frac{(u-v)}{(1-uv/c^2)}$ Mass of proton $= 1.67 \times 10^{-27}$ kg

Rest-mass Energy: $E = mc^2$ Kinetic energy: $K = (\gamma - 1)mc^2$

Speed of light: 3×10^8 m/s 1 light-year = distance traveled by light in one year

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1. [3] Identical forces act for the same length of time on two different masses. The change in momentum of the smaller mass is:

a) smaller than the change in momentum of the larger mass, but not zero.

b) larger than the change in momentum of the larger mass.

c) equal to the change in momentum of the larger mass.

d) zero.

2. [2] What is the quantity used to measure an object's resistance to changes in rotational motion?

a) mass

b) moment of inertia

c) angular velocity

d) angular acceleration

3. [5] Suppose that the kinetic energy of a proton in a particle accelerator is 80% of its total energy. What is the momentum of this proton?

4. [5] A 4.0-kg mass and a 9.0-kg mass are being held at rest against a compressed spring, with one mass on each end, on a frictionless surface. When the masses are released, the 4.0-kg mass moves to the right with a speed of 2.0 m/s. What is the velocity of the 9.0-kg mass after the masses are released?

5. [5] One 20-year-old twin sister takes a space trip with a speed of $0.80c$ for 30 years according to a clock on the spaceship. Upon returning to the Earth, what is her own age and the age of the Earth-based twin sister? (Ignore all accelerations and decelerations.)

[20] total marks