Space Shuttle Columbia – Kinetic Energy Matters!

The Space Shuttle Columbia disintegrated during reentry on the morning of 1 February 2003. The cause of the accident was determined months later. A review of video footage taken during the launch 16 days earlier showed a large piece of foam insulation falling off the external fuel tank shortly after liftoff then striking the leading edge of the orbiter's left wing. This compromised the thermal protection system at the point of impact and allowed the superheated gases generated on reentry to melt the aluminum frame there. The left wing snapped off first, the orbiter tumbled and broke apart, scattering pieces across eastern Texas. All seven crew onboard were killed

Eighty-two seconds into STS 107 [the mission number], a sizeable piece of debris struck the left wing of the Columbia. Visual evidence and other sensor data established that the debris came from the bipod ramp area and impacted the wing on the wing leading edge. At this time Columbia was traveling at a speed of about 2300 feet/second (fps) through an altitude of about 65,900 feet.

Based on a combination of image analysis and advanced computational methods, the Board determined that a foam projectile with a total weight of 1.67 lb and impact velocity of 775 fps would best represent the debris strike….

\*NB\* it should read mass of.

1.67 lb = 0.759 kg

775 ft/s = 236 m/s

[Columbia Accident Investigation Board](http://caib.nasa.gov/" \t "_blank)

Show that a piece of rigid foam insulation like the one that struck the Space Shuttle Columbia possesses a considerable amount of kinetic energy despite being "just a piece of foam".

1. Determine the kinetic energy of the foam debris that struck Columbia in 2003.
2. How fast would a 10 kg sledge hammer have to travel in order to have the same kinetic energy as the foam? State your answer in km/h
3. How massive would a defensive tackle of American or Canadian football have to be if he ran as fast as a world class sprinter (11.5 m/s) and had the same kinetic energy as the foam debris? State your answer in kilograms.