

3. [3 Points] The fragments of Shoemaker-Levy 9 impacted Jupiter in July of 1994 with a velocity of roughly 60 km/s. How much energy was released in each impact, on average? How much total energy was released? How does this compare to the amount of energy that would be released if the world's entire arsenal of nuclear weapons (~10,000 Mt) were detonated? Express your answers in Megatons of TNT (1 Mt = 4.2×10^{15} J)

4. [2 Points] Briefly describe the possible effects if a comet with the same energy as Shoemaker-Levy 9 (the whole thing, not just one fragment) impacted the Earth.

5. [2 Points] The rate of impacts with Jupiter is thought to be several thousand times the rate of impacts with the Earth. With this information and your answer to question #4 in mind, is Jupiter's presence in the outer solar system beneficial or detrimental to life on Earth? Explain why.

6. a) [5 Points] Jupiter emits 1.8 times as much energy as it receives from the sun. If the planet has an albedo of about 0.5, and is about 5.2 AU from the sun, how much energy must be generated inside the planet for the following energy balance equation to hold true? The sun gives off 3.83×10^{26} Joules of energy every second.

$$\text{Solar Energy} + \text{Internal Energy} = \text{Emitted Energy}$$

- b) [2 Points] What is the source of this internal energy?