**Asteroid Split - Movie-Mini-Lab**

Movie: Armageddon (1998) Bruce Willis, Billy Bob Thornton, Ben Affleck, Liv Tyler

Purpose: Determine if a Texas sized asteroid could be split with a nuclear bomb so that the two halves would pass harmlessly by Earth, one on each side, as depicted in the movie Armageddon

Background: The two tables below contain both the assumptions and parameters needed to evaluate if the plucky heroes in Armageddon could save Earth. In order to miss Earth two conditions must exist.

1. The nuclear bomb must actually split the asteroid. We will assume that this happens and uses up none of the bomb blast’s energy.
2. The separation velocity of the asteroid halves has to be high enough to separate each of them by the radius of Earth plus 1290 kilometers (according to the movie) in the time it takes to reach Earth after the nuclear blast.

We will make the most generous possible assumptions (GPA) in calculating the separation velocity and separation distance. Obviously, if the GPA calculations indicate Earth is doomed, there is no reason to make a more realistic analysis.

Table 1) Assumptions To Be Used For The Analysis

|  |  |  |
| --- | --- | --- |
| **Assumption** | **Size** | **Comment** |
| **Diameter of asteroid** | 1000 km | From the movie the asteroid is quoted to be the size of Texas. |
| **Density of asteroid** | 7000 kg/m3 | From the film, the substance of which the asteroid is composed is ‘Iron Ferrite’, assumed to be a mixture of Iron based minerals. This gives an upper bound on the density of the asteroid as pure iron is much denser than the majority of minerals it can produce. |
| **Shape of asteroid** | Sphere | In the movie the asteroid is elongated but for simplicity of calculations we’ll assume its spherical |
| **Nuclear bomb's yield** | 100 megatons | This is the size of the largest nuclear weapon ever created. ***Typical nuclear bomb = 15 megaton yield*** |
| **Amount of Thermonuclear**  **Energy Converted to kinetic energy of the asteroid pieces** | 100% | This energy would be equally divided between the 2 asteroid halves and ***would move the halves apart in the most favorable manner***. *Obviously, this is a very liberal assumption since most of the energy would be dissipated as heat.* |

Table 2) Parameters To Be Used For The Analysis

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Size** | **Comment** |
| **Velocity of Asteroid** (toward Earth) | 10,000 m/s | Calculated from movie (22,000 mph) |
| **Distance from Earth that the bomb is detonation** | 101,000 km | Derived using certain timed events in the movie |
| **Earth’s Radius** | 6.38 x 106 m | This is my home… |
| **Factor for converting megatons of TNT to joules** | 1 megaton of TNT = 4.184 x 1015 Joules | A megaton is a unit of explosive power chiefly used for nuclear weapons, equivalent to one million tons of TNT. |

Analysis: Assuming that 100% of the nuclear bomb’s explosive energy is converted to kinetic energy and that when the bomb explodes the asteroid is split into equal halves, ***determine if it will strike earth.***

***First, please draw an annotated diagram of the sequence of events.***

**Conclusions**: Should we hire miners to save the planet if a larger asteroid is detected to be coming towards Earth?

**Bonus**: Which of the following super hero’s could have saved Earth?

1. Batman
2. Wolverine
3. Spiderman
4. Superman