Asteroid Split Analysis, Intuitor.com Movie-Mini-Lab

Name ____________________ Date _________

Movie: *Armaggedon* (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 Armaggedon

Background: The two tables below contain both the assumptions and parameters needed to evaluate if Earth could be saved by the plucky heroes in *Armaggedon*. 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 them by the diameter of Earth plus 800 miles (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	773 miles	Longest east to west dimension of Texas
Density of asteroid	5500 kg/m^3	Density of Earth
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	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)	22,000 mph	From the movie
Time for asteroid halves to reach Earth from bomb detonation	2 hr	Not stated in movie. H owever, it would take 10.84 hrs to go from the moon to Earth. Allowing 8 hrs to drill and .84 hrs to land and take off gives 2 hrs.
Earth's Radius	6.38 x 10^6 meters	
Factor for converting miles to kilometers	1 mile = 1.609 kilometers	
Factor for converting megatons of TNT to joules	1 megaton of TNT = 4.184 x 10^{15} joules	

Data and Analysis: Fill in the following table. Attach sample calculations for each item.

Variable	Calculated Value With Units
Separation Velocity of the 2 asteroid halves assuming that 100% of the nuclear bomb's explosive energy is converted to kinetic energy split equally between the halves of the asteroid.	
Distance between the asteroid halves when they reach Earth (assume no gravitational attraction force between the asteroids)	

List additional reasons based on movie observations which cast doubt on whether Earth could be saved even if the asteroid were split.

Conclusions: