Past Semester's Exam Questions

ASTR 220 Discussion # 11

Apr. 17, 2019

Name: _____

Section: _____

1. What's the basic idea behind the kinetic impactor deflection strategy?

   A. To run a spaceship into a near-Earth asteroid with enough force to break it into pieces.

   B. To run a spaceship into a near-Earth asteroid, causing the asteroid to accelerate and gain or lose orbital energy.

   C. To shoot missiles, like bullets, at a near-Earth asteroid from a nearby spacecraft, pushing the asteroid off-course.

   D. To use the impact of a spaceship with a near-Earth asteroid to change the asteroid's rotation rate so that the asteroid's own centrifugal force will change its orbit.

2. What is the primary importance of jets of material expelled from the impact site? Why should we bother understanding these?

   A. They are highly visible from Earth and can indicate a successful mission. We only need to understand their brightness.

   B. They contribute momemtum to the impact via Newton's 3rd Law. We need to understand this momentum in order to understand the change in orbital energy.

   C. They can harm the spacecraft and interfere with the impact. We need to understand their density and composition so as not to jeopardize the mission.

   D. They aren't very important; they're interesting, but understanding them isn't vital to the mission.

3. Which two items below are the most important for astronomers to consider when deciding which deflection strategy to use to stop an asteroid impact?

   A. How long until the impact occurs and the size of the asteroid

   B. The porosity of the asteroid and its average distance from the Sun

   C. The mass of the asteroid and how fast it is rotating

   D. The asteroid's albedo and its orbital period

4. Suppose that NASA is planning to deflect a near-Earth asteroid using the nuclear deflection strategy. A new observation of the asteroid reveals that its diameter is actually 3 times smaller than previously calculated. How should the energy released by the nuclear weapons on the spacecraft be altered to keep the same amount of deflection distance?

   A. The energy released should be about 1.44 times smaller.

   B. The energy released should be about 9 times smaller.

   C. The energy released should be about 3 times bigger.

   D. The energy released should be about 3 times smaller.

   E. The energy released should be 27 times smaller.

5. We have discussed in class the announcement by the Russian military that they intend to modify some of their nuclear ICBMs in order to stop the impact of 20 - 50 m asteroids. We also discussed if the energy of one of the nuclear weapons on a Russian ICBM would be sufficient to deflect an asteroid that size.

   However, there is another way that the Russian military could potentially use one of their ICBMs to stop a 50-m asteroid from impacting the Earth: the ICBM could ram the asteroid and deflect it using the kinetic impactor deflection strategy. In this problem, you will determine if this is feasible.

   A 50-m near-Earth asteroid would have a mass of approximately $1.6 \times 10^8 kg$. A Russian ICBM has a mass of $2.8 \times 10^5 kg$. The top speed this sort of ICBM can achieve is about $6 \times 10^3 m/s$. If this is the impact speed with the asteroid, how far will it be deflected in 6 days ($5.2 \times 10^5 s$)? **Show your work, including your original equation. Is this distance bigger or smaller than the radius of the Earth, which is** $6.4 \times 10^6 m$**?** (You may assume a force multiplication factor of 2.)