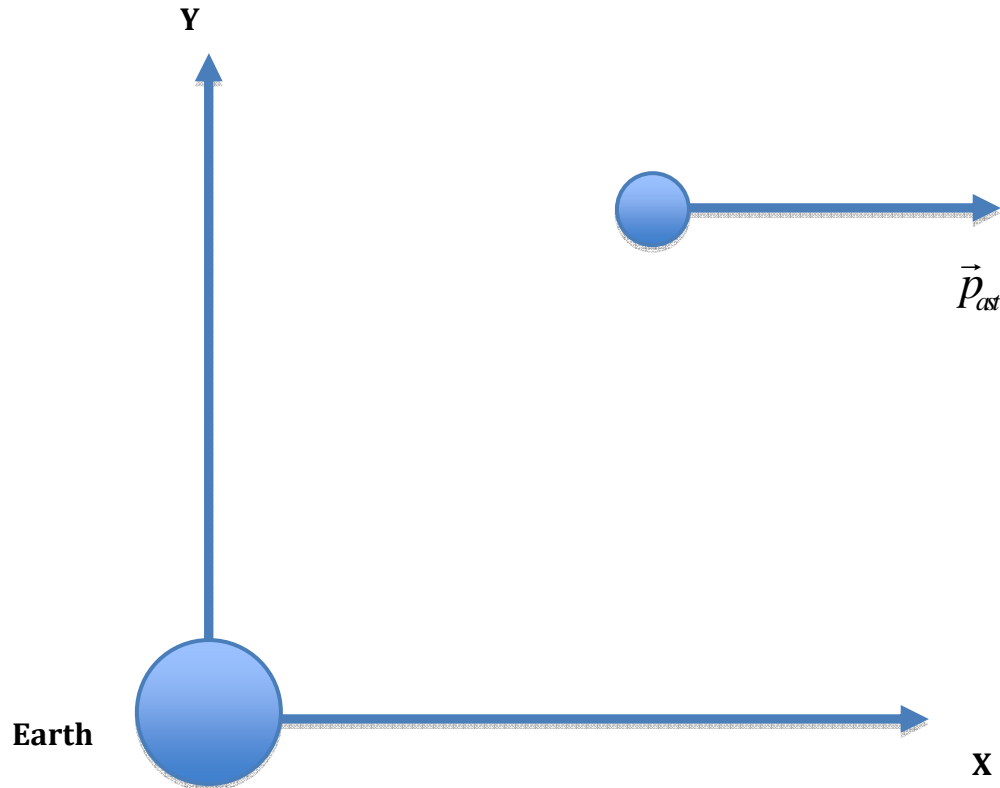


PHYS 172 Problem of the Week #3 – Spring 2012



The diagram above (not to scale) shows an asteroid passing near Earth. At the instant shown, the Earth is at position $\langle 0, 0, 0 \rangle$, the asteroid is at $\langle 1.7 \times 10^8, 1.1 \times 10^8, 0 \rangle m$, and the asteroid has a momentum of $\vec{p}_{ast} = \langle 2.4 \times 10^{16}, 0, 0 \rangle kg \cdot m / s$.

The Earth's mass is $6 \times 10^{24} kg$, and the asteroid's mass is $2 \times 10^{13} kg$.

- On the diagram, draw an arrow representing the gravitational force vector on the asteroid due to the Earth. Label this arrow \vec{F}_{Earth} .
- On the diagram, draw an arrow representing the component of the gravitational force on the asteroid that is **parallel** to its momentum. **This arrow must be drawn to the same scale as the arrow you drew for part a.** Label this arrow \vec{F}_{\parallel} .

- c. On the diagram, draw an arrow representing the component of the gravitational force on the asteroid that is **perpendicular** to its momentum. This arrow must be drawn to the same scale as the arrow you drew in part a. **Label this arrow \vec{F}_\perp .**
- d. Which of the components of the force \vec{F}_\parallel or \vec{F}_\perp , is responsible for changing the **direction** of the asteroid's momentum?
- e. At the instant shown, is the **magnitude** of the asteroid's momentum increasing, decreasing, or not changing? If you answered that the magnitude of the asteroid's momentum is changing, which component(s) of the force is (are) responsible for the change?
- f. Calculate the gravitational force on the asteroid due to the Earth. Show all steps in your work, and express your answer as a three-component vector.
- g. What is the momentum of the asteroid 10 hours, or 3.6×10^4 seconds later? Show all steps in your work and express your answer as a three-component vector. You may assume that this is a relatively short period of time.
- h. What is the new position of the asteroid 10 hours later? Show all steps in your work and express your answer as a three-component vector.