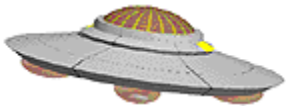
The Flight of the Navigator



1. David Freeman, a 12 year old boy living a normal suburban life (complete with dog, loving parents, and annoying younger brother). What year does this scene take place?
2. David is trekking through the woods when he falls into a ravine and blacks out. Waking later, after 4 hours, David heads home only to find an older couple in his house and no visible trace of his parents or brother. Police arrive, and David's statements are met with puzzlement. His parents are located in a nearby city in Florida, but upon meeting them, David is shocked to see they have visibly aged. He faints and is taken to a hospital. There, his younger (now older) brother Jeff explains the several years have passed since that night in the woods and David was declared dead. How many years had passed?
3. Everyone in the family is overjoyed with this miraculous reunion, though no one can explain David's disappearance or lack of aging. NASA official Dr. Faraday arrives at David's home and asks for testing. David agrees. At the NASA base, David receives garbled messages in his head, apparently coming from someone in a nearby hangar. During tests, Faraday discovers that David's brain now holds incredible amounts of information related to a strange craft, galaxy maps, and more. Although David can't remember any of it, Faraday theorizes that David spent those 4 hours on an alien space ship on a journey out to the planet "Phaelon" and back-----a distance of 560 light years each way. It turns out that these government scientists had discovered a space vehicle near the same location where David woke up from his siesta and the fact that he hadn't aged in 8 years made them suspicious. How does David react with this information?

4. David hears more from the voice, and follows it's directions to a hanger. What is creating this voice? What does David find? What name does David call it?

5. This movie appear to derive to derive it's inspiration from the theory of special relativity. However, it degenerates into the usual incomprehensible pseudoscientific hodge-podge. What do the scientists in the Navigator label the theory that explains time dilation?

6. Although it is theoretically possible for David to have only been gone 4.4 hours in his frame of reference. If he goes fast enough, because Phaelon is 560 light years away, there is no way that only 8 years can have elapse on Earth. The minimum elapsed time in the Earth frame of reference would be somewhere a little more than 1,120 years. In other words, how long would it take light to travel 560 light years away and back? How would this detail change the plot?

7. Let's overlook the obvious error of the 560 light year distance to Phaelon, and simply calculate how fast David would have been traveling relative to Earth to account for the time difference experienced by each frame of reference. Because

$$T = \frac{T_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

   a. Convert 4.4 hours into years? (Note: the would be T_o)

   b. Using T = 8 years; solve for v in terms of c.

      (Note that c is the speed of light c = 3 x 10^8 m/s)

8. From the eight years elapsed on Earth for David's round trip journey, we can deduce that Phaelon must be no more than just slightly over four light years away (which happens to be the distance to Alpha Centauri, our nearest star system) in the Earth/Phaelon frame of reference.
   a. How far apart, though, are Earth and Phaelon in David's reference frame during his flight?

      Use $L = L_0\sqrt{1 - \frac{v^2}{c^2}}$

      [Note that L_o = 8 Light-years and v is from your answer in #7 (b).]

9. While we're at it, let's calculate the magnitude of the acceleration David would experience on his interstellar sojourn.
   a. Because David needs to achieve an average speed of that calculated from #7 (b), and because he has to accelerate from rest to a maximum speed and then come to a stop for the first half of his trip, his top speed must be greater than the average--------even closer to c. Therefore, for our purposes let's just assume a maximum velocity of about c. He has to accelerate from rest in a maximum time of 1.1 hours. Therefore what is the minimum acceleration he needs to be in m/s^2:

      Use $a = \frac{\Delta v}{\Delta t}$

      (Note: Convert 1.1 hours to seconds)

b. Compare your answer with g = 9.8 m/s².
c. Do you think David would survive the g forces? Why?

10. One of the many major problems that we encounter when contemplating the idea of interstellar space flight is the limitation that no mass can ever attain the speed of light. In formulating his theory of special relativity, Einstein showed that although positions, lengths, and times are relative to reference frame, fundamental conservation laws still hold. Particularly relevant is the fact that conservation of momentum is maintained as long as the mass term is replaced by:

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Where m_o is called the rest mass and is the mass measured when the object is stationary relative to the observer/measurer. This is mass as we normally think of it. However, according to the equation, the "relative mass" m depends on the relative velocity of that mass. As you can see an object gets more massive as it gets faster, and m approaches infinity as v yields to c. This means that it would take infinite energy to get any mass all the way up to c. We don't have that much energy, so we're stuck with c as the ultimate speed limit.

a. Let's say David whizzes past at a speed of #7 (b), and you want to determine his mass in your frame of reference. Because you know he has a mass of about 40 kg when he is lounging around in his living room, you can determine his relativistic mass:
(Note: Use the above equation)

b. How many tonnes is this? Use 1000 kg = 1 tonne

11. Back to the Movie: The robot escapes the base with David onboard the space ship. It turns out that David, along with creatures from other planets, was taken for study on the robot's peaceful home planet. The robot did not return David to his original timeline (eight years prior), fearing that humans are too delicate to survive time travel. While the robot explains how he was captured by NASA while leaving Earth, David takes a liking to a small creature on the ship whose home planet was destroyed.
a. When the alien craft speeds away from the NASA base, it's slipstream tears off the roof of a small booth. Why didn't the wake also sweep the people in it's path down to the ground?
b. How would the robot travel backward in time with David?

c. After David's ship breaks free and exits the hangar, he orders the robot to take him 20 miles away. Back at the tracking room a technician informs Dr. Faraday that the ship has gone 20 miles straight up, but the target altitude indicated on the screen reads 184,800 ft. Does this actually convert to 20 miles? [Note 5,280 ft = 1 mile] How far is this?

d. When the ship goes straight up 20 miles, the ship appears to be in space with the curvature of the earth and atmosphere visible. Even from your calculated answer from above, is this reasonable? [Note: Outer Space is about 50 miles straight up] How many feet is Space?

12. David and the robot both need each other to get home. David needs the robot to pilot to Florida, and the robot needs star chart information in David's head to navigate back to his galaxy. The robot performs a scan of David to extract the information but accidentally gets some of David's memories and personality. The robot's voice immediately changes, becoming les robotic and more humorous and erratic. David and the robot bicker as to their next course of action, to which the robot's response is to shut down in a freefall, forcing David to take control and drive the ship. The two bond, and David heads for his family. What does the robot warn David about?

13. They locate David's house. David discovers NASA is waiting for him for more "guinea pig tests." What does David urge the robot to do?

14. How does the robot get David back to where he wants to be? Is this possible? Why? Explain…..

15. What was the souvenir found in David's back pack?