

# Rocheworld space physics assignment



**ASSIGN  
BUSTER**

Forward put a lot of thought into getting the physics of the story right. A large amount of the story takes place in outer space, where the gravity is much different than it is on Earth. There are a couple of specific points in the book where Forward explains in detail the physics of a situation. Not all the points he is trying to make really has a huge affect on the story, but it provides a certain attachment to what the characters are experiencing, and also has the opportunity to educate the readers on what being in space would be like.

When the crew is on Mercury, they are educated quite extensively on the gravitational forces that are happening there. First, is the placement of the station “ orbiting” Mercury. On the Mercury Laser Propulsion Construction Command Center the Chief Administrator tells them, informer NOT in free-fall”. The crew was under the assumption that they were in free-fall, because they we able to float around the station as free-fall would allow. The Chief Administrator shows them what he means by pushing himself up to the ceiling and holding on to a light fixture.

In free-fall, he old let go of the fixture, and he would remain next to the light fixture on the ceiling, because there is no gravity to pull him back down to the ground. When he first let go of the fixture it seemed like that’s exactly what happened, but then after a couple seconds it became clear that he was very slowly floating back down to the ground. The Chief explained that, “ Mercury Center is not in orbit around Mercury, but it is floating at some point eighty thousand kilometers above the surface of the planet. The pull of Mercury is counteracted by the large ring-sail that you saw as you arrived... What he is trying to explain is that at that distance from the surface of

Mercury, the gravitational force is 1/30th of Earth. The entire station is actually being pulled down towards Mercury. They are able to counteract the gravitational force of Mercury, by the humongous circular light-sail that the station has. The light sail at the station works the same way that the Prometheus is propelled through space. While the Prometheus uses laser light from the station to be propelled through the stars, the Laser Station has a large light-sail ring that captures the light rower from the sun, which pushes the station forward away from Mercury.

They are able to calibrate the light-sails to a perfect medium to match the pull from Mercury, so as the planet pulls, the Sun's light rays pushes the station an equal amount, keeping the station pinned between the two forces inside the shadow cone of Mercury. Although this is not a very important detail to the story, it does a great job to explain the realistic physics that are used in the book, and helps make things more sense on a believable level. The Chief was explaining this to the crew because it ally is an important detail for the characters to recognize on the station.

He explains that the crew is so used to free-fall, that they won't even recognize the difference until it is too late to do anything about it. They could be outside of the station, let go of a handhold for a couple seconds, and before they know it, they will rescue. Forward also made some points on what it's like to live on the Prometheus in predominately free-fall gravity. As the Prometheus makes its way to Bernard, propelled by the laser light beam, the ship has no ability to create artificial gravity, so he crew is in free-fall for the duration.

Living in free-fall is obviously very different from living in the gravity we have on Earth, and the ship has been fitted with some tricks to make life a bit easier on the ship. One of the most interesting steps taken was to cover a lot of the ship in Velour. The ground, couches, and beds have been covered in Velour, along with the bottoms of the crews shoes and clothes, so they can stick to the ground and other surfaces, instead of constantly floating around. As the Prometheus is propelled forward, there is a bit of gravity at times, not always, from the linear acceleration from the laser beam.

As the ship accelerates, there is a minimal, although apparent, affect of G forces on the crew temporarily. These forces will not remain though, as the crew “catches up” with the momentum of the ship, and returns to total free-fall. There is a part in the book while the crew is under the effect of No-Die, that they play a childish game using centrifugal force. In the circular room outside crew quarters, they played “Around the World, Don’t Fall In”. They could start running along the walls in the room, and eventually pick up enough speed to create up to  $1/3$  G forces to “stick” to the wall so they could run easier.

When they got tripped up, they would safely float away from the wall into the room, no longer experiencing the G forces to keep them pushed down against the wall. This is a good example of how a centrifugal artificial gravity machine would work, and I’m curious as to why the Prometheus doesn’t have something of that nature on board so the crew can escape the free-fall environment from time to time to get important work done easier, but I’m guessing Velour is much cheaper than a centrifugal force machine for the ship.

Overall, Forward does a really good job explaining general space physics and how these scenarios are accurate to real life without interfering too much with the story. The Mercury station's "orbit" using the Sun to counteract the pull of Mercury is quite an interesting and brilliant idea that seems like a pretty sound theory that could work in reality if the calculations were correct, and using the light-sails for the station and space ships to create forward momentum is already a possible mechanism for travel, very much like a hot air balloon, except with light rays instead of hot air.