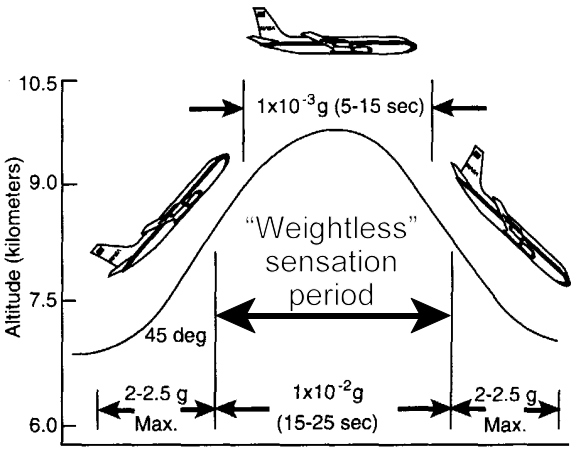
THE "VOMIT COMET" ZERO-GRAVITY TRAINER Name_____

You are about to watch a brief video clip of two radio disk jockeys, Mark and Brian, riding a NASA "Vomit Comet" Zero-Gravity Trainer. This type of plane is used for astronaut training and low-gravity experiments, and was used to film the movie "Apollo 13." Recently a private corporation has begun offering rides on this type of plan for about $3700.

The trainers are modified jet airplanes. Most of the passenger seats have been removed, and the walls padded to protect the occupants. The planes typically fly for 2 to 3 hours and make 40 parabolic arcs through the air as shown in the figure at right.

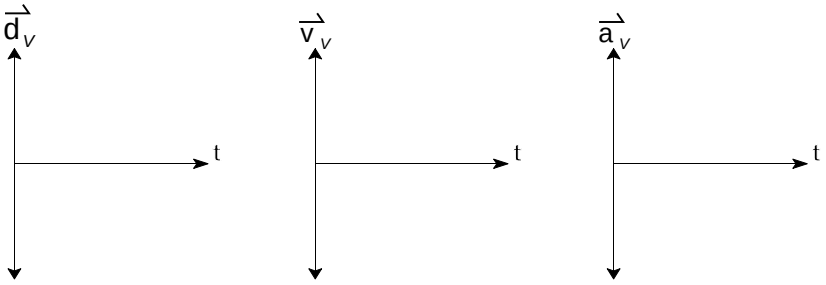


During each arc, a plane first ascends upward at 45° and presses the occupants down with 2 to 2.5 g's (19.6 to 24.5 m/s^2). Then it traces out a parabola and the occupants feel nearly weightless for 15 to 25 seconds. Then it pulls out with another period of 2 to 2.5 g's before doing another arc.

The occupants are not really weightless - they are simply in freefall. That is, they are actually accelerating toward Earth at 9.8 m/s^2 while they both rise and then fall in a plane that is executing a perfect parabola. The gut-wrenching sensations produced on the flights have earned the planes the nickname of the "vomit comets." When the video starts, you'll see Mark and Brian ready for the first parabola, barf bags ready in the pockets on their chests!

- NOW WATCH THE VIDEO; IT LASTS ABOUT FOUR MINUTES -

1. The plane traces a parabola, so for half of the "weightless" or "zero-gravity" period the plane is actually rising through the air, and falling during the other half. Draw the vertical displacement, velocity, and acceleration graphs for the occupants during the "weightless" sensation period, recalling that they are not *really* weightless, and are both rising and falling.



2. Suppose during one arc the occupants are "weightless" for a **total** of 20.0 seconds. So they spend 10.0 s ascending and 10.0 s descending. Using the true acceleration of gravity of 9.80 m/s^2, calculate how far the plane would fall in meters and then in feet (1 m = 3.281 ft) from vertical rest during the **descending half** of its arc:
   Fall in meters (m): Fall in feet (ft):
   SHOW YOUR WORK

3. Let's suppose that Brian's pre-flight weight was 175 pounds. Compute his mass in slugs, using $F_g = mg$ where g is 32.2 ft/s^2. Stay in US Customary units throughout your calculation – do NOT convert to SI/metric units.

4. Now convert Brian's mass into kilograms, using the US-to-metric mass conversion factor in your notes: