5.6 PROJECT

THE WEIGHTLESSNESS OF PARABOLIC ARCS

A reduced-gravity aircraft is an aircraft that can simulate weightlessness of its passengers and contents by following a parabolic flight path. While zero gravity (zero-g) is not perfectly attained, the simulation is close enough to zero-g to train astronauts and film movie scenes. This type of aircraft has lovingly been given the nickname "vomit comet" due to two-thirds of all passengers experiencing airsickness during the 40 to 60 parabolic maneuvers of the flight.

According to NASA, the function $f(t) = -4.9t^2 + 87.21t + 9144$ can be used to describe the altitude in meters of a certain reduced-gravity aircraft t seconds after the start of the parabolic maneuver. Reduced gravity occurs during the entire parabolic arc of the maneuver.

1. Determine the altitude when reduced gravity starts and ends.
2. How long does the reduced-gravity period last? Round your answer to the nearest tenth of a second.
3. What is the maximum height attained by the aircraft during the parabolic maneuver? At what time into the parabolic maneuver is this height attained? Round your answer to the nearest tenth.

Suppose an 80-second movie scene takes place in zero-g. The production crew needs to plan the film sequence to minimize the cost of renting a reduced-gravity aircraft.

4. The 80-second scene would need to be split up across multiple periods of weightlessness and then stitched together in editing. What is the minimum number of parabolic arcs the movie crew would need to film the entire scene once?
5. If it takes the aircraft approximately 5 minutes from the end of one parabolic arc to set up to start another parabolic arc, how long would it take to film the 80-second scene one time?

The production crew learns that another company with a reduced-gravity aircraft can follow a parabolic arc of $f(t) = -4.9t^2 + 98.2t + 8930$ to increase the time spent in weightlessness. The cost is 15% more than the initial company.

6. Determine the length of each reduced-gravity period in seconds with the second company. Round your answer to the nearest tenth.
7. Assuming the aircraft needs the same 5 minutes from the end of a parabolic arc before starting another, determine the total time it would take to film the 80-second scene. (**Hint:** Determine the number of arcs needed to film the entire scene.)
8. Discuss the pros and cons of choosing each reduced-gravity aircraft to film the 80-second scene.