A modern home computer has a hard drive whose capacity is typically about 500 gigabytes. A song that you download typically has a size of about 10 megabytes, and if you have a fast internet connection you can usually download at a rate of about 1 megabytes/sec. At that rate it takes about 10 seconds to download a song, and if your entire hard drive were available to store songs on your playlist, you could accommodate about 50000 songs!

The RBSP spacecraft instruments will be generating data that has to first be stored onboard the spacecraft, then at a specific time in the orbit, transmitted to Earth before the next round of data has to be stored on top of the old data.

The spacecraft engineers have worked with the scientists to determine how often the scientists want to store their measurements on each satellite. The average rate is 9,000 bytes/second. Each satellite will download the data once every orbit when the satellite is closest to Earth (perigee). The ground station has a busy schedule working with other satellites so each of the two RBSP satellites will only have 10 minutes every orbit to download all of its stored data. The orbit period is 9 hours.

Problem 1 – How many megabytes of data do both of the spacecraft collect after one orbit?

Problem 2 – At what rate in bytes/second will the data have to be downloaded to the ground station?

Problem 3 – The mission is being supported by NASA to last two years during its first operations cycle. How much data will both of the RBSP satellites accumulate during its first 2-year period in :

A) DVD disks (1 DVD = 4 gigabytes)

B) Songs (1 song = 10 megabytes).

Problem 1 – How many megabytes of data do both of the spacecraft collect after one orbit?

Answer: Time = 9 hours x (3600 seconds / 1 hr) = 32,400 seconds.
Total data = 9,000 bytes/sec x 32400 seconds = 291,600,000 bytes or 291.6 megabytes per spacecraft and **583.2 megabytes**/orbit for two spacecraft combined.

Problem 2 – At what rate in bytes/second will the data have to be downloaded to the ground station?

Answer: 583.2 megabytes have to be downloaded within 10 minutes or 600 seconds so the rate will be R = 583,200,000 bytes / 600 seconds = **972,000 bytes/second**.

Problem 3 – The mission is being supported by NASA to last two years during its first operations cycle. How much data will both of the RBSP satellites accumulate during its first 2-year period A) In DVD disks (1 DVD = 4 gigabytes) B) Songs (1 song = 10 megabytes).

Answer: A) 1 year = 365 days x 24 hours/day x 3600 seconds/hr = 31,536,000 seconds.
The data rate for two satellites is 18000 bytes/second, so in 2 years the satellites will accumulate 18000 x 31536000 = 567.6 billion bytes or 567.6 gigabytes.

A single DVD stores 4 gigabytes so you will need 567.6/4 = 141.9 or **141 DVDs**.

B) Number of songs = 567,600 megabytes / 10 megabytes = 56,760 or **56,760 song**s.