Every 4 days, this planet orbits a sun-like star located 153 light years from Earth. Astronomers using NASA's Hubble Space Telescope have confirmed that this gas giant plane is orbiting so close to its star its heated atmosphere is escaping into space.

Observations taken with Hubble's Cosmic Origins Spectrograph (COS) suggest powerful stellar winds are sweeping the cast-off atmospheric material behind the scorched planet and shaping it into a comet-like tail. COS detected the heavy elements carbon and silicon in the planet's super-hot, 2,000-degree-

Problem 1 - Based upon a study of the spectral lines of hydrogen, carbon and silicon, the estimated rate of atmosphere loss may be as high as $4 \times 10^{11}$ grams/sec. How fast is it losing mass in: A) metric tons per day? B) metric tons per year?

Problem 2 - The mass of the planet is about 60% of Jupiter, and its radius is about 1.3-times that of Jupiter. If the mass of Jupiter is $1.9 \times 10^{27}$ kg, and its radius is $7.13 \times 10^7$ meters, what is the density of A) Jupiter? B) HD209458b?

Problem 3 - Suppose that, like Jupiter, the planet has a rocky core with a mass of 18 times Earth. If Earth’s mass is $5.9 \times 10^{24}$ kg, what is the mass of the atmosphere of HD209458b?

Problem 4 - About how long would it take for HD209458b to completely lose its atmosphere at the measured mass-loss rate?

Space Math http://spacemath.gsfc.nasa.gov
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Answer: A) $4 \times 10^{11}$ grams/sec x $(10^{-6}$ kg/gm x 86,400 sec/day = $3.5 \times 10^{10}$ tons/day
B) $3.5 \times 10^{10}$ tons/day x 365 days/year = $1.3 \times 10^{13}$ tons/year

Problem 2 - The mass of the planet is about 60% of Jupiter, and its radius is about 1.3-times that of Jupiter. If the mass of Jupiter is $1.9 \times 10^{27}$ kg, and its radius is $7.13 \times 10^{7}$ meters, what is the density of A) Jupiter? B) HD209458b?

Answer: A) $V = \frac{4}{3} \pi R^3$ so $V(\text{Jupiter}) = 1.5 \times 10^{24}$ meters$^3$. Density = mass/volume so Density (Jupiter) = $1.9 \times 10^{27}$ kg/$1.5 \times 10^{24}$ meters$^3$ = $1266$ kg/meter$^3$.
B) Mass = 0.6 M(\text{Jupiter}) and volume = $(1.3)^3 V(\text{Jupiter})$ so density = $0.6/(1.3)^3 \times 1266$ kg/meter$^3$ = $342$ kg/meter$^3$.

Problem 3 - Suppose that, like Jupiter, the planet has a rocky core with a mass of 18 times Earth. If Earth's mass is $5.9 \times 10^{24}$ kg, what is the mass of the atmosphere of HD209458b? Answer: $M(\text{HD209458b}) = 0.6x \text{Jupiter} = 1.1 \times 10^{27}$ kg so $M(\text{atmosphere}) = 1.1 \times 10^{27}$ kg $- 18x(5.9 \times 10^{24}$ kg) = $9.9 \times 10^{26}$ kg.

Problem 4 - About how long would it take for HD209458b to completely lose its atmosphere at the measured mass-loss rate?

Answer: Time = Mass/rate
= $9.9 \times 10^{26}$ kg / $(1.3 \times 10^{16}$ kg/year)
= $7.6 \times 10^{10}$ seconds
= 2,456 years!