

Scientific notation is an important way to represent very big, and a very small, numbers. Here is a sample of astronomical problems that will test your skill in using the number representation.

Problem 1: The sun produces 3.8×10^{26} ergs per second of radiant energy. How much energy does it produce in one year (3.1×10^7 seconds)?

Problem 2: One gram of matter converted into energy yields 1.0×10^{10} ergs of energy. How many tons of matter in the sun is annihilated every second to produce its luminosity of 3.8×10^{26} ergs per second? (One metric ton = 10^3 grams)

Problem 3: The mass of the sun is 1.99×10^{33} grams. If a single proton has a mass of 1.6×10^{-24} grams, how many protons are in the sun?

Problem 4: The approximate volume of the visible universe (A sphere with a radius of about 14 billion light years or 1.3×10^{22} sublight-years. One light-year equals 9.2×10^{17} centimeters), how many cubic centimeters does the visible universe occupy?

Problem 5: A coronal mass ejection from the sun travels 1.0×10^{13} centimeters in 17 hours. What is its speed in kilometers per second?

Problem 6: The NASA data archive at the Goddard Space Flight Center contains 35 terabytes of data from over 1000 science missions and investigations. (1 terabyte = 10^{12} bytes). How many CD-ROMs does this equal if the capacity of a CD-ROM is about 6×10^8 bytes? How long would it take, in years, to transfer the data to a dial-up modem operating at 56,000 kilobits? (Note: one byte = 8 bits)

Problem 7: Pluto is located at a distance of 5.9×10^{12} centimeters from Earth. At the speed of light (3.0×10^{10} cm/sec) how long does it take a light signal (or radio message) to travel to Pluto and return?

Problem 8: The planet HD209458b, now known as OGLE, was discovered by astronomers in 1996 and is at a distance of 150 light-years (1 light-year = 9.2×10^{17} kilometers). If an interstellar probe were sent to investigate this world up close, traveling at a maximum speed of 700 km/sec (about 10 times faster than our fastest spacecraft, *Mellan-1*), how long would it take to reach OGLE?