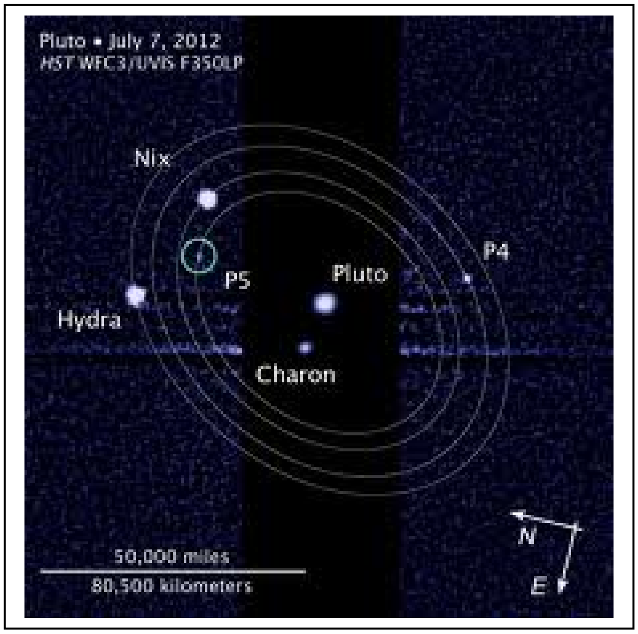
Pluto's Fifth Moon!



The most distant well-known object in our solar system, Pluto, is an irresistible object for Hubble Space Telescope investigations.

In July, 2012, Hubble scientists released an image of Pluto showing a new moon called P5. It is irregularly shaped and about 15 km in diameter, and probably made from ice.

Its average orbit radius is 47,000 km and appears to lie in the same orbit plane as the other four moons, and takes about 20 days to make one orbit.

The table below gives the details for the four new moons of Pluto as of 2012.

Name	Discovery	Diameter (km)	Distance (km)	Period (hours)
Pluto V	2012	10 to 25	42,000	485
Nix	2005	46 to 137	48,700	598
Pluto IV	2011	13 to 34	59,000	770
Hydra	2005	61 to 167	65,000	917

Problem 1 – Compute for each moon the cube of the distance,D^3, and the square of the period, P^2. Calculate the value $R = D^3/P^2$ for each moon. What do you notice about the values for R? What is the average value for R using the data from the five moons?

Problem 2 – Suppose future observations discover a new moon, P6, orbiting at a distance of 35,000 km from Pluto. What would you predict as the orbit period for this satellite?

Problem 3 - The mass of a body can be determined from Kepler's Third Law, which you verified in Problem 1. By using the formula $M = 6.9 \times 10^{10}$ R, where R is in units of $km^3/days^2$, what is the mass of Pluto in kilograms?

Name	Discovery	Diameter	Distance	Period	R
		(km)	(km)	(hours)	
Pluto V	2012	10 to 25	42,000	485	3.15×10^8
Nix	2005	46 to 137	48,700	598	3.23×10^8
Pluto IV	2011	13 to 34	59,000	770	3.46×10^8
Hydra	2005	61 to 167	65,000	917	3.27×10^8

Problem 1 – Compute for each moon the cube of the distance,D^3, and the square of the period, P^2. Calculate the value $R = D^3/P^2$ for each moon. What do you notice about the values for R? What is the average value for R using the data from the five moons?

Answer: The values for R are very similar to each other even though there is a large range in orbit distances and periods**. The average value is 3.28×10^8 km^3/hours^2**

Problem 2 – Suppose future observations discover a new moon, P6, orbiting at a distance of 35,000 km from Pluto. What would you predict as the orbit period for this satellite in days?

Answer: $P^2 = (35000)^3/3.28 \times 10^8 = 130{,}716$ so
P = 361 hours or **15.1 days**.

Problem 3 - The mass of a body can be determined from Kepler's Third Law, which you verified in Problem 1. By using the formula $M = 6.9 \times 10^{10}$ R, where R is in units of km^3/days^2, what is the mass of Pluto in kilograms?

Answer: First convert R into the correct units:

$R = 3.28 \times 10^8$ km^3/hours^2 x (24 hours/1 day)^2 = 1.88×10^{11} km^3/day^2

Then $M = 6.9 \times 10^{10} \times 1.88 \times 10^{11}$ so M = **1.3×10^{22} kg**.

Note, the mass of Earth is 6.0×10^{24} kg, so Pluto has a mass equal to about
1.3×10^{22} kg/6.0×10^{24} = 0.002 Earths!