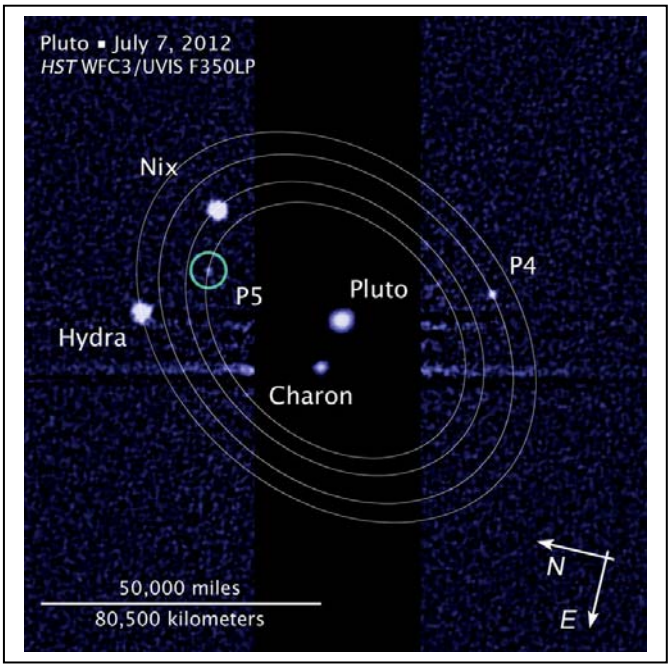

The most distant, well-known object in our solar system, Pluto is an irresistible object for Hubble investigations.

In July, 2012, Hubble scientists released an image of Pluto showing a fifth satellite, called simply P5. It is irregularly shaped and about 15 km in diameter, probably made from solid water-ice.

Its average orbit radius is 47,000 km (29,000 miles) and appears to lie in the same orbit plane as the other satellites. It takes about 20 days to orbit Pluto.

The table below gives the list of the four minor satellites to Pluto as of 2012.

Name	Discovery	Diameter	Distance	Period
		(km)	(km)	(days)
Pluto V	2012	10-25	42,000	20.2
Nix	2005	46-137	48,708	24.9
Pluto IV	2011	13-34	59,000	32.1
Hydra	2005	61-167	64,749	38.2

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

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

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 $M\ (kg) = 6.9 \times 10^{10}\ R$, where R is in units of $km^3/days^2$, what is the mass of Pluto in kilograms using the new moon P5 data?

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

Name	Discovery	Diameter	Distance	Period	R
		(km)	(km)	(days)	
Pluto V	2012	10-25	42,000	20.2	**1.82×10^{11}**
Nix	2005	46-137	48,708	24.9	**1.86×10^{11}**
Pluto IV	2011	13-34	59,000	32.1	**1.99×10^{11}**
Hydra	2005	61-167	64,749	38.2	**1.86×10^{11}**

The values for R are very similar to each other even though there is a large change in the orbit distances and periods.

Average = **1.88×10^{11} $km^3/days^2$**

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

Answer: For the satellites of Pluto we know that $D^3/P^2 = 1.88 \times 10^{11}$ $km^3/days^2$, so if D = 35,000 km, then solving for P we get

$P^2 = (35000)^3 / 1.88 \times 10^{11}$

P = 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 (kg) = 6.9×10^{10} R, where R is in units of $km^3/days^2$, what is the mass of Pluto in kilograms using the new moon P5 data?

Answer: $R = 1.82 \times 10^{11}$, so
$M = 6.9 \times 10^{10} (1.82 \times 10^{11})$ and
$M = 1.25 \times 10^{22}$ kg.