Physics 135-1, Quiz 5, Spring 2018 **Solution Key**

1) Here are some fun facts about two of Jupiter's moons:

	Orbit Radius	Orbit Period
Io	421,600 km	1.769138 days
Ganymede	???	7.154553 days

1a) (5 points) What is the orbit radius of Ganymede?
1b) (7 points) What is the mass of Jupiter? ($G = 6.674 \times 10^{-11}$ N m^2 / kg^2)

Solutions
From Kepler's Third Law, $P^2 = (4\pi^2/GM)a^3$. Taking the ratio means that $a_2^3 = a_1^3(P_2^2/P_1^2)$, or $a_2 = (421{,}600)(7.154553/1.769138)^{2/3} =$ 1,070,158 km.

Using the data for Io, $M_J = 4\pi^2a^3/GP^2 = 4\pi^2(4.216 \times 10^8)^3/(6.674 \times 10^{-11})[(1.769)(24)(60)(60)]^2 =$ 1.898×10^{27} kg.

2) (8 points) Deimos, which is the smaller of Mars' two moons, has a radius of 6.1 km and a mass of 2.4×10^{15} kg. If you were standing on the surface of Deimos, how fast would you need to throw a baseball in order to throw it completely off the moon?

Solution
We need the kinetic energy of the baseball to equal its gravitational potential, or $\frac{1}{2}$ mv^2 = GMm/r, for the baseball to just escape. Solving for v, we have $v = (2GM/r)^{1/2} =$ $[2(6.674 \times 10^{-11})(2.4 \times 10^{15})/6100]^{1/2} =$ 7.25 m/s = 16.2 mph. This is so slow, it wouldn't even be a decent pitch in a high-toss softball tournament. Actually, this is so slow, many people could run up a ramp and jump off Deimos.