Hwk 2
—31 Jan 2011

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<< PhysicalConstants`
```

Problem 1

(a) In terms of velocity, Newton's form of Kepler's 3rd Law is

$v^2 = G M / R$.

I read the velocity from the graph.

```
In[821]:= mSaturn =
  Convert[(139*^6 Meter) (35*^3 Meter / Second)^2 / GravitationalConstant, Kilogram]
```

```
Out[821]= 2.55121 × 10^27 Kilogram
```

The actual mass is

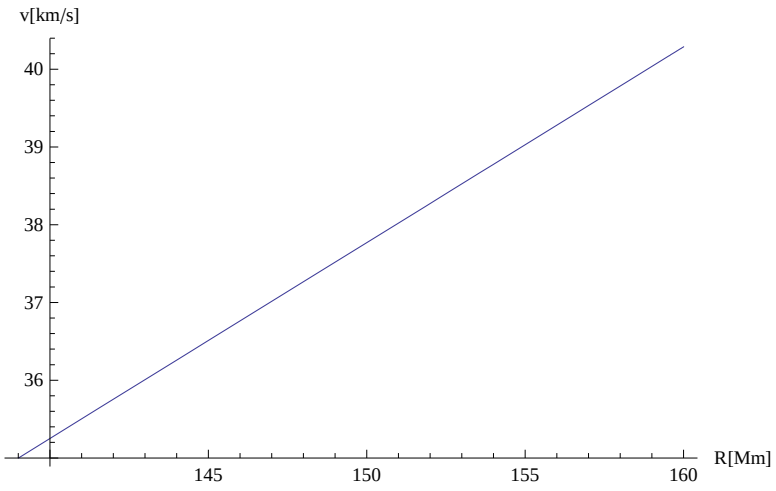
```
In[822]:= AstronomicalData["Saturn", "Mass"]
```

```
Out[822]= 5.6850 × 10^26
```

Keeler's measurement of velocity is off by a factor of 2.

(b) If the rings were solid, the rotation period would be the same. The rotation speed is then proportional to the radius.

```
Plot[35 (x / 139), {x, 139, 160}, AxesLabel → {"R[Mm]", "v[km/s]"}]
```



Problem 2

In gaseous or liquid hydrogen, an electron is held by its nucleus. The electron does not go to some other nucleus. In metallic hydrogen, an electron moves so fast that the electric force of a nucleus cannot it. Instaed, the electrons can wander through the sea of nuclei.

Problem 3

(a) The observational data are the mass and radius of the planet. Models show how that mass and radius are related for different

assumptions of the composition. In class we showed models with (1) a mixture of hydrogen and helium, (2) water, methane, and ammonia, and (3) rock. The assumption that fit the observations best was the mixture of hydrogen and helium.

(b) If Jupiter and Saturn were made of water, methane, and ammonia and they had the same mass, their radii would be smaller. (According to the models, the radii would be about 4 earth radii, rather than about 10 earth radii.)