Name:

Atmospheric Escape & Planet Composition

Atmospheric Escape

(a) $v \approx \sqrt{\frac{T}{m}}$ (b) $v_{esc} \approx \sqrt{\frac{M_{planet}}{r_{planet}}}$

We can use the above equations to determine whether or not a planet is likely to hold on to an atmosphere of a particular composition. Use these equations to answer the following questions.

1) Consider two planets at the same temperature that have atmospheres that contain the same molecules. If planet A is 300 times the mass, and 11 times the size (radius) of planet B, will it have a larger of smaller escape velocity than planet B? Does this make it easier or harder for planet A to hold on to the same atmosphere as planet B?

2) Consider a planet that forms with an atmosphere that is composed of two different molecules. Molecule A in the atmosphere is heavier than molecule B. Which molecule is more likely to be retained in the atmosphere, A or B? Explain.

Planet Composition

3) Calculate the density of the following planets given their masses and volumes and fill in the table below.

Planet	Mass (g)	Volume (cm^3)	Density (g/cm^3)
A	3.26 x 10^26	6.08 x 10^25	
B	1.9 x 10^30	1.43 x 10^30	
C	5.68 x 10^29	8.27 x 10^29	
D	1.0 x 10^28	1.76 x 10^27	

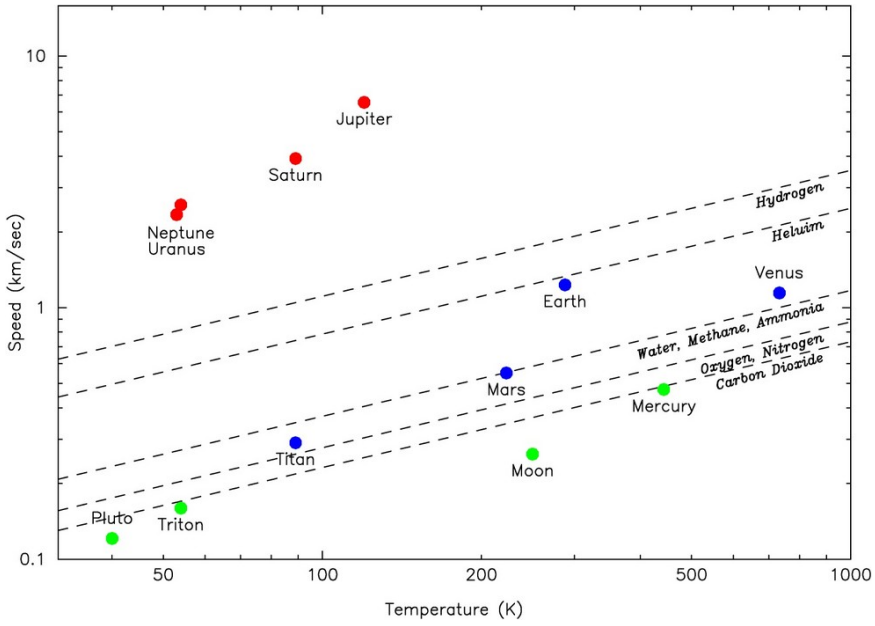
4) Which of the above planets are terrestrial (rocky) and which of the above are gas giants given their densities? Which planet has the most Earth-like density?

Challenge Questions:

5) If there was no life on Earth what other planet in the solar system would its atmospheric composition most closely responsible? Give a reason for your answer.

6) If Jupiter were at the distance of Mercury, it would be about 3.5 times hotter (neglecting any potential greenhouse gas effects). At this distance

and temperature, would Jupiter be in danger of losing its atmosphere to thermal escape? Use the plot below from lecture to justify why or why not.



7) The density of Saturn is 0.687 g/cm^3. If you could find a body of water large enough, would Saturn float? Why or why not?

8) Planet D in question 3 is an exoplanet called Kepler-78b. It orbits its star at a distance that is 40 times closer than Mercury is to the Sun, making its temperature as hot as 3000 K (5,000 degrees Fahrenheit). Is this planet likely to have an atmosphere like Earth? Why or why not?