

Astronomy 12, Section 109
Worksheet 9

The Outer Planets

Planet 5 – Jupiter

1. Like the rest of the outer planets, Jupiter has no surface. How is that possible?

Jupiter's composition simply gets denser and denser as one goes down, slowly transitioning from the gaseous outer layers to its more liquid-like interior with no abrupt surface-like transition.

2. What two elements is Jupiter primarily composed of?

Hydrogen and helium; in a similar proportion to that found in the Sun.

3. What is the cause of Jupiter's banded cloud patterns?

The bands are similar to the tradewinds-band on Earth: each band corresponds to a convection cell, on which Coriolis forces have acted to cause strong East-West winds blowing in alternate directions.

4. What is the form (phase) of the matter in Jupiter's interior? Is the term "gas giant" a misnomer?

Jupiter's interior is made of metallic hydrogen. It is technically in the form of a super-critical fluid at extremely high density, temperature and pressure, but can be compared to a liquid. So deep in its interior, Jupiter is more of a "liquid giant" than a "gas giant".

Planet 6 – Saturn

5. Name a few ways Saturn differs from Jupiter.

Saturn has stronger winds, less visible banding, a lower concentration, and a very large ring system, among other things.

6. Recent Cassini pictures show colorful auroras at Saturn's poles. These and many other lines of evidence suggest that Saturn, like Jupiter, has a strong magnetic field. Where does it come from?

The magnetic field is believed to come from the circulating motions of metallic hydrogen in Saturn's interior in the same way the motions of Earth's iron-nickel outer core generate our magnetic field.

Planet 7 – Uranus

7. How does the composition of Uranus and Neptune differ from that of Jupiter and Saturn?

Uranus and Neptune have much larger concentrations of molecules (water, methane, ammonia) and have much less H/He. Their interiors are in the form of a supercritical molecular "slush" rather than metallic hydrogen, and their rocky cores are (relatively) larger.

8. Describe the motion of the Sun in the "sky" over the course of a day in the Uranian summer.

In summertime, the Sun is only a few degrees from Uranus' rotation axis (North pole). So the Sun would simply wobble in small circles about the planet's celestial north pole once per day, never rising or setting.

Planet 8 – Neptune

9. What is notable about Neptune's magnetic field? Where does this field probably originate?

Neptune's magnetic field (like that of Uranus) is not aligned with the planet's rotation axis. It is believed to originate from the circulating motions of a water-ammonia solution in the planet's interior... but this idea is still speculative.