

PHYS 178 – Assignment 4

Sketchy Answers

This assignment contributes 2% to your final grade. Please write brief answers directly on the sheet in the spaces provided (and on the back if necessary). The assignment should be turned into the PHYS 178 assignment box on level 2 of E7B, just outside the doorway to E7A.

1. How is the composition of the giant planets inferred?

Theoretical models of the planets are constructed for different compositions and compared to measurements of mass and radius. In addition, the response of the planet's structure to rotation and to the tides raised by moons creates changes in the gravitational field around the planet. This can be modelled and compared with the variations in the gravitational field inferred from perturbations to the orbits of satellites, rings and the trajectories of spacecraft.

2. Why is the composition of the gas giants different from the terrestrial planets?

The gas giants formed in the outer solar nebula, where temperatures were cold enough that volatile species such as water were frozen onto the surface of the small dust grains that agglomerate together to form the beginnings of planets. Because of this, the forming planetary bodies became sufficiently massive (10-15 Earth masses) that their gravity was able to capture the surrounding hydrogen and helium, which comprised the dominant component of the gas in the solar nebula.

3. Why is the vertical separation between the different cloud layers on Jupiter smaller than for the other giant planets?

The cloud layers form at particular temperatures, so the reason they are more closely spaced is that the temperature of Jupiter's atmosphere increases more rapidly with depth compared to the other giant planets. The rapid increase with depth reflects heating associated with the compression of gas as it sinks. Jupiter's strong gravity means that the pressure in its atmospheres rises rapidly with depth, and therefore so does the temperature.

4. What is the Great Red Spot?

A long-lived hurricane-like storm on Jupiter (etc).

5. Why does the atmosphere of Uranus appear to be almost featureless?

The lack of a significant internal heat source means that the atmosphere is more stable without much of the convective upwelling that is responsible for formation of cloud decks.