Film  
Different Worlds and Moon

Objective
• Solar System formation: current model and supporting evidence for the model  
• Formation of the Moon: current model and supporting evidence for the model

Questions
1. What did the discovery of craters on Mercury by Mariner 10 tell us about the history of the Solar System?

2. What is a plausible explanation for Uranus’ spinning on its back?

3. What is the significance of the direct observation of Shoemaker-Levy 9 comet colliding with Jupiter?

4. Pluto is rather different from the other planets in that  
A. it has a highly elliptical orbit  
B. its orbital plane has large inclination angle  
C. it is located within the Kuiper Belt  
D. All of the above

5. Why didn’t Kuiper Belt Object continue to grow and become icy planets?

6. As scientists tried to simulate planetary formation process using supercomputers, they had difficulties reproducing Uranus and Neptune. Which of the following is a possible reason for such difficulties?
A. The computers are not fast enough  
B. According to the current theory, at the locations of Uranus and Neptune, there is enough dust and gas in a given volume of space to form planetary embryos  
C. At the location of Uranus and Neptune, temperature is low enough for water to condense  
D. The presence of Jupiter prevents the formation of planetary embryos at the locations of Uranus and Neptune.

7. Why do we consider Pluto the “grandfather” of the planets in the Solar System?

8. According to the model of Lunar origin by a giant impact, the Moon formed from  
A. material broken off the Earth  
B. material broken off the Mars-sized impactor  
C. material from both the Earth and the impactor  
D. material in the proto-satellite disc

9. Which of the following is a critical piece of evidence for Lunar origin by a giant impact?
A. The light-colored Lunar highland rocks are best explained by low-density material rising to the top in a magma ocean, and a giant impact is the mostly likely mechanism to deliver the energy to produce large-scale melting on the proto-Moon.  
B. By and large, the compositions of lunar and terrestrial basalts are similar
C. The Moon is a satellite of the Earth
D. The Moon has a prograde orbit around the Earth, which makes an origin by capture unlikely.

10. The Moon is bone dry. How does the lack of water fit into the model of Lunar origin by a giant impact?

Keys
1. A crater-covered Mercury provide a strong support for the accretion theory: giant impacts in the inner Solar System would have produced a large amount of debris. These debris would have been swept by the inner planets during an intense bombardment stage.
2. Uranus may have been hit by an impactor the size of the Earth, which knocked its spinning axis from nearly perpendicular to the ecliptic plane to nearly parallel to the ecliptic plane.
3. The direct observation of the collision between Shoemaker-Levy 9 and Jupiter provide a live demonstration of accretion by collision, which is still happening nowadays.
4. D
5. The Kuiper Belt is far away from the Sun. There are probably not enough dust and gas in a given volume of space to initiate runaway growth of planetesimals into planetary embryos.
6. B
7. Pluto probably formed earlier than the other planets. Pluto-like planetary bodies may have been the “seeds” from which other planets (esp. the giant planets) have grown.
8. C
9. A
10. A giant impact would lead to substantial heating (kinetic energy converted into heat). A small body like the Moon cannot retain water vapor at high temperature. This may be an important reason for the lack of water on the Moon.